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Knowledge, attitude and practice of health care workers on solid medical waste management in two urban hospitals of Bangladesh: a mixed-method study

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Abstract

Background Proper management of solid medical waste is a crucial component of an efficient healthcare system. The objective of the present study was to assess the knowledge, attitude, and practices of medical waste management among the healthcare workers of two selected hospitals of Dhaka city of Bangladesh.

Methods This cross-sectional, mixed-method study was conducted in two tertiary care hospitals of Dhaka, Bangladesh–icddr, b Dhaka hospital (Private) and Dhaka Shishu hospital (Public) during November, 2011. A number of 138 healthcare professionals (29 doctors, 80 nurses and 29 cleaners) participated in the study. The study had three parts of data collection: (i) survey with health care workers to determine their knowledge, attitudes, and practices about medical waste management; (ii) in-depth interviews with health officials of infection control committee; and (iii) observation using a facility checklist to determine the current practice of medical waste management.

Results Overall, participants from IDH had better knowledge, and practice regarding solid medical waste management compared to DSH. Doctors of IDH demonstrated better knowledge regarding the responsible person for waste management and a better attitude regarding the statement that it was a teamwork (p-value < 0.05). Similarly, nurses and cleaners of IDH showed superior level of knowledge of waste handling as well as safer practices, including consistent use of personal protective equipment. Workers of DSH reported higher incidence of errors and sharp injuries also. From the observation, it was found that IDH authority was more likely to follow the waste management guideline. Poor knowledge and attitude were the major barriers for proper waste management in IDH while lack of funds, human resource and logistics were the major barriers in DSH.

Conclusions Both hospitals, particularly DSH, demonstrated significant deficiencies in knowledge, attitude, and practice of proper solid medical waste management. Despite limitations, IDH, exhibited more efficient waste management procedures.

Keywords Medical waste, Knowledge, Attitude, Practice, Bangladesh

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Background

With the advancement of medical technology and increasing access to healthcare service, there has been a rapid growth of medical waste over recent years posing a threat to public health and the environment [1]. Medical waste includes a wide range of materials generated during healthcare delivery such as needles, syringes, sharps, pharmaceuticals, laboratory cultures, blood and bodily fluids, and even radioactive materials [2]. Medical waste may be categorized as either hazardous or non-hazardous. Hazardous waste consists of infectious materials, sharps, chemical waste, pharmaceuticals, and radioactive waste. Infectious waste includes waste contaminated with blood or other bodily fluids, cultures from laboratory work, and waste items from patients, including but not limited to: bandages, swabs, discarded tissue samples, blood microscopy slides, and disposable medical devices. Non-hazardous waste, such as plastic packaging, paper and office products, is waste that does not pose any biological, chemical, radioactive or physical harm. It is estimated that globally about 15% of the total waste generated in Health Care Facilities is hazardous [3]. These waste poses occupational health and safety risks, and environmental pollution to the surrounding community if not disposed of properly. It is estimated that almost half of the healthcare workers are exposed to risk of blood-borne pathogens through a percutaneous injury, for instance, contaminated needle stick injuries [4]. Poor handling and disposal of medical waste not only impacts the health of health care workers, but also that of patients, visitors, and non-hospital staff involved in the handling and treatment of infectious health care waste. Approximately half of the global population is exposed to environmental, occupational and public health risks from poor medical waste management [5]. Hence, proper management of these waste is a crucial component of healthcare systems worldwide.

Despite the fact, appropriate waste management facilities are lacking in majority of the low- and middle-income countries. A study estimated that less than half of the healthcare workers are trained for waste management and around 38% of medical waste is segregated for proper management [1]. In Bangladesh, a lower-middle-income country in South-East Asian region, almost 50,000 tons of medical waste is generated every year, majority portion of which is not disposed properly acording to the waste management guidelines [6].

Medical waste management is a multifaceted process which includes segregation, storage, transport, treatment and proper disposal of the waste [1, 7]. Multiple stakeholders are involved in every stage of the medical waste management. Healthcare workers play a pivotal role in this process. Adequate knowledge and training of these workers are important for proper handling and disposal of medical waste. However, in Bangladesh, the knowledge, attitudes, and practices about handling medical waste are not explicitly and empirically documented. A small-scale study among nurses reported their inadequate knowledge regarding this issue [8]. To fill this gap, the present study aimed to assess the knowledge, attitude, and practice of medical waste management among the healthcare workers of Dhaka city of Bangladesh.

Methods

Study design and setting

This cross-sectional, mixed-methods study was conducted in two tertiary care hospitals of Dhaka, Bangladesh– icddr, b Dhaka hospital (IDH) (Private) and Dhaka Shishu hospital (DSH) (Public) during November, 2011.

Participants

The doctors, nurses and cleaners employed at the selected hospitals were considered as the study population. For the quantitative part of the study, sample size was calculated from the following formula: $n = z^2\ p(1\text{-}p)/d^2$, where z = 1.96 for 95% confidence level, p = prevalence of knowledge about medical waste management, and d = margin of error (considered as 0.05). A previous study reported that 5% of the nurses working in a tertiary care hospital had adequate knowledge about medical waste disposal, from which the calculated sample size for the present study was 73. Assuming a 10% non-response rate we approached 80 healthcare professionals from each hospital. Stratified random sampling from the list of the health care professionals (doctors, nurses, and cleaners) was used for recruitment of the participants.

For the qualitative part of the study, purposive sampling technique was used. One person from infection control committee from each hospital was included for in-depth interview. In addition to this, one ward was selected purposively for observation of in-house medical waste management.

Data collection

This mixed-methods study had three parts of data collection: (i) survey with health care workers (doctors, nurses and cleaners) to determine their knowledge, attitudes and practices about medical waste management; (ii) in-depth interviews with health officials of infection control committee; and (iii) observation using a facility checklist to determine the current practice of medical waste management.

Quantitative data collection was done by face-to-face interviews conducted by trained research assistants using a semi-structured questionnaire. The questionnaire was prepared by the research team in English based on the previous literature review and then translated into Bangla using back-translation method by two independent

translators. After preparation, it was pre-tested among 20 healthcare professionals of Islami Bank Hospital, Dhaka, a private tertiary care facility, to evaluate its linguistic validity, clarity, and appropriateness. This hospital was chosen as it was located within the same geographic region as the study hospitals to ensure the contextual similarity. Feedback from the pre-test was used to refine and finalize the questionnaire, addressing any issues related to language, comprehension, or content validity to enhance its suitability for the target respondents. The questionnaire had four parts: (i) socio-demographic information of the participants, (ii) knowledge about medical waste management, (iii) attitude about medical waste management and (iv) their practice of medical waste management.

Qualitative data included key informant interviews (KIIs) and direct observation of the medical waste management practice. The KIIs were conducted by a trained research assistant using an interview guide. All interviews were recorded and transcribed, unless the interviewee declined to be recorded. Lastly, a checklist was used to observe the facility practices of the medical waste management. The checklist was a spot checklist on the basis of Bangladesh government medical waste management rule which is adopted from WHO standard guideline to record if various waste management items were available and/or functional. At each hospital, one checklist was completed for each ward visited.

Statistical analysis

Descriptive statistics (mean with standard deviation for continuous variables and frequency with percentage for categorical variables) was used for analysis of the quantitative data. Chi-square test was used to compare the knowledge, attitude and practice of solid medical waste management between the healthcare workers of the selected hospitals. All statistical analyses were performed using STATA version 17.0.

For the qualitative analysis of the KIIs, all interview recordings were transcribed by research assistants. Thematic analysis was conducted to identify the level of knowledge, attitude and practice of medical waste management and key factors that were associated with this in the health facilities.

Results

Sociodemographic characteristics

A total of 138 healthcare professionals (69 from each hospital) were included in the present study. Among them, 29 were doctors, 80 were nurses and 29 were cleaners. The age distribution was similar in all healthcare workers. Male representation was higher among doctors and cleaners while female representation was higher among nurses in both hospitals. Working experience of the doctors were 9 years and 7 years in IDH and DSH respectively, while it was seven years for nurses and cleaners. Almost 29% of the doctors, 76% of the nurses and 21% of the cleaners were trained for medical waste management in IDH while the rate was 20%, 31% and 13% in DSH (Table 1).

Knowledge about waste management

Majority of the healthcare workers (doctors, nurses and cleaners) had knowledge about responsible person for medical waste management, disease transmitted due to improper solid medical waste management, Criteria for the container of sharp waste, WHO color code to segregate the sharp and contaminated waste, types of waste handling require the use of PPE, types of solid medical waste should be incinerated/burned and disposed, symbol for the room that used for storing solid waste and existence of WHO manual on safe management of solid waste from hospital. Overall level of knowledge about these issues among the healthcare workers in DSH was poor compared to the workers of IDH. However, significant differences in knowledge regarding the responsible person for medical waste management was among the doctors of IDH compared to DSH (p-value 0.001). Nurses at IDH demonstrated better level of knowledge in multiple areas, including identifying the responsible person for waste management (p-value 0.001), recognizing the disease transmission risks of improper sharp waste management (p-value 0.044), understanding the criteria for sharp waste containers (p-value 0.044), knowledge of the color code for segregating sharp waste (p-value 0.028),

Table 1 Socio-demographic characteristics of the participants ($n=138$)

Characteristics	Doctor		Nurse		Cleaner	
	IDH, $n=14$	DSH, $n=15$	IDH, $n=41$	DSH, $n=39$	IDH, $n=14$	DSH, $n=15$
Age (years)	31 (27–41)	31 (26–49)	32 (23–57)	30 (24–55)	23 (18–49)	33 (20–65)
Gender						
Male	6 (42.86)	10 (66.67)	15 (36.59)	0 (0.00)	12 (85.71)	4 (26.67)
Female	8 (57.14)	5 (33.33)	26 (63.41)	39 (100.00)	2 (14.29)	11 (73.33)
Working experience in health sector (years)	9 (2–22)	7 (2–23)	10 (2–33)	7 (2–32)	7 (1–20)	7 (1–20)
Working experience in this hospital (years)	1 (0.5–11)	3 (0.6–20)	3 (0.5–28)	3 (0.5–28)	2 (0.6–24)	1.5 (0.6–11)
Training on SMWM (Yes)	4 (28.57)	3 (20.00)	31 (75.61)	12 (30.77)	3 (21.43)	2 (13.33)

and awareness of the existence of WHO manuals on safe waste management (*p*-value 0.029). Among cleaners, significant differences were observed in knowledge about the criteria for sharp waste containers (*p*-value 0.016) and the use of personal protective equipment (*p*-value 0.001), with better knowledge observed in cleaners of IDH (Table 2).

Attitude towards waste management

Majority of the healthcare workers (doctors, nurses and cleaners) from both IDH and DSH had a positive attitude towards medical waste management. Only significant difference in attitudes toward solid medical waste management was observed among doctors of IDH and DSH regarding the perception that solid medical waste management is a teamwork effort, with IDH doctors expressing stronger agreement (*p*-value 0.027). No other significant differences were observed in the attitudes of nurses or cleaners across the two hospitals for any of the assessed statements (Table 3).

Practice of waste management

All the doctors and cleaners and more than 97% of the nurses from IDH reported that they always used the different waste bin for different health care waste, while the rate was 73%, 90% and 93% among the doctors, nurses and cleaners of DSH. Besides, More than 78% of the doctors and 100% of the nurses and cleaners of IDH reported that they used gloves always during handling of solid medical waste while the rate was 27%, 26% and 7% among the doctors, nurses and cleaners of DSH. Doctors of IDH were significantly more likely to always use gloves during the handling of solid medical waste compared to doctors of DSH (*p*-value 0.007). Similarly, nurses of IDH reported significantly higher adherence to this practice than those of DSH (*p*-value 0.001), as well as cleaners (*p*-value 0.001). Besides, nurses and cleaners of DSH were significantly more likely to report making mistakes during waste segregation (*p*-value 0.033 and 0.018, respectively) and experiencing injuries related to handling solid medical waste in the past year (*p*-value 0.008 and 0.011, respectively) compared to their counterparts of IDH (Table 4).

The practice of solid medical waste management in IDH and DSH are compared in Table 5. From the observation, we found that IDH maintained better compliance to the waste management guidelines compared to DSH. For instance, the sharp containers did not have lid and were not marked with appropriate label or logo in DSH. Moreover, workers in this hospital did not use PPE during handling of solid medical waste. However, neither of the hospitals restricted the area of storage of medical waste and there was no biohazard symbol for storage area. IDH had facilities for recycling the PVC based materials and facility for offsite disposal in contract with Dhaka City Corporation. However, DSH did not have neither of the facilities.

We observed no mistake made by the workers in both hospitals on the day of observation. KII from IDH mentioned that

Table 2 Knowledge about solid medical waste management of the participants (*n* = 138)

Knowledge questions	Doctor			Nurse			Cleaner		
	IDH, *n* = 14	DSH, *n* = 15	*p*-value	IDH, *n* = 41	DSH, *n* = 39	*p*-value	IDH, *n* = 14	DSH, *n* = 15	*p*-value
Responsible person for medical waste management	14 (100.00)	7 (46.67)	0.001	40 (97.56)	26 (66.67)	0.001	9 (64.29)	5 (33.33)	0.095
Disease transmitted due to improper solid medical (mainly sharp) waste management	12 (85.71)	9 (60.00)	0.121	29 (70.73)	19 (48.72)	0.044	10 (71.43)	7 (46.67)	0.228
Criteria for the container of sharp waste	12 (85.71)	9 (60.00)	0.121	29 (70.73)	19 (48.72)	0.044	10 (71.43)	4 (26.67)	0.016
Managing solid medical waste is as same as managing household waste (false)	14 (100.00)	15 (100.00)	0.990	41 (100.00)	39 (100.00)	0.990	12 (85.71)	11 (73.33)	0.410
WHO color code to segregate the sharp waste	9 (64.29)	11 (73.33)	0.600	10 (24.39)	5 (12.82)	0.183	2 (14.29)	1 (6.67)	0.528
Color code of waste bin that segregates the sharp waste (blood contaminated) in hospital	12 (85.71)	8 (53.33)	0.060	40 (97.56)	32 (82.05)	0.028	14 (100.00)	13 (86.67)	0.125
Types of waste handling require the use of PPE	13 (92.86)	14 (93.33)	0.966	39 (95.12)	32 (82.05)	0.060	13 (92.86)	5 (33.33)	0.001
Types of solid medical waste should be incinerated or burned	10 (71.43)	8 (53.33)	0.315	27 (65.85)	18 (46.15)	0.075	8 (57.14)	5 (33.33)	0.197
How treated solid medical waste should dispose to the environment	8 (57.14)	6 (40.00)	0.444	26 (63.41)	17 (43.59)	0.416	7 (50.00)	4 (26.67)	0.586
Correct symbol for the room that used for storing solid waste	7 (50.00)	3 (20.00)	0.089	20 (48.78)	9 (23.08)	0.020	2 (14.29)	2 (13.33)	0.937
Existence of WHO manual on safe management of solid waste from hospital	7 (50.00)	2 (13.33)	0.032	19 (46.34)	9 (23.08)	0.029	0 (0.00)	0 (0.00)	0.990

Table 3 Attitude towards solid medical waste management of the participants ($n=138$)

Attitude	Doctor			Nurse			Cleaner		
	IDH,$n=14$	DSH,$n=15$	*p*-value	IDH,$n=41$	DSH,$n=39$	*p*-value	IDH,$n=14$	DSH,$n=15$	*p*-value
Infection can be transmitted by improper solid medical waste management	14 (100.00)	15 (100.00)	0.990	40 (97.56)	39 (100.00)	0.330	14 (100.00)	14 (93.33)	0.321
Blood borne disease can be acquired through solid medical waste	12 (85.71)	13 (86.67)	0.937	39 (95.12)	34 (87.18)	0.211	14 (100.00)	13 (86.67)	0.125
Safe management of solid medical waste is not an issue at all	13 (92.86)	15 (100.00)	0.293	41 (100.00)	36 (92.31)	0.070	14 (100.00)	13 (86.67)	0.141
Safe management of solid medical waste is the only responsibility of government	12 (85.71)	15 (100.00)	0.129	41 (100.00)	36 (92.31)	0.070	12 (85.71)	13 (86.67)	0.937
Solid medical waste management is teamwork / no single class of people is responsible for safe management	12 (85.71)	7 (46.67)	0.027	39 (95.12)	34 (87.18)	0.202	13 (92.86)	13 (86.67)	0.583
Safe management of solid medical waste efforts by hospital increases financial burden on hospital administration	13 (92.86)	13 (86.67)	0.532	39 (95.12)	37 (94.87)	0.919	12 (85.71)	15 (100.00)	0.129
Registering of solid medical waste is an extra burden for hospital administration	13 (92.86)	13 (86.67)	0.532	34 (82.93)	29 (74.36)	0.352	10 (71.43)	6 (40.00)	0.121
Safe management of solid medical waste e is an extra burden of work for health care worker	13 (92.86)	13 (86.67)	0.583	38 (92.68)	34 (87.18)	0.412	14 (100.00)	14 (93.33)	0.324
Improperly managed solid medical waste waste may cause infections among health workers	13 (92.86)	13 (86.67)	0.583	41 (100.00)	39 (100.00)	0.990	14 (100.00)	13 (86.67)	0.157
Improperly managed solid medical waste may cause infections among patients	13 (92.86)	14 (93.33)	0.966	41 (100.00)	38 (97.44)	0.298	14 (100.00)	15 (100.00)	0.990

Table 4 Practice solid medical waste management of the participants ($n=138$)

Practice	Doctor			Nurse			Cleaner		
	IDH,$n=14$	DSH,$n=15$	*p*-value	IDH,$n=41$	DSH,$n=39$	*p*-value	IDH,$n=14$	DSH,$n=15$	*p*-value
Do you always use the different waste bin for different health care waste?	14 (100.00)	11 (73.33)	0.302	40 (97.56)	35 (89.74)	0.155	14 (100.00)	14 (93.33)	0.283
Do you use gloves always during handling of solid medical waste?	11 (78.57)	4 (26.67)	0.007	41 (100.00)	10 (25.64)	0.001	14 (100.00)	1 (6.67)	0.001
Did you make any mistake during segregating the different health care waste?	2 (14.29)	5 (33.33)	0.173	2 (4.88)	14 (35.90)	0.033	1 (7.14)	7 (46.67)	0.018
Did you injure yourself during handling of solid medical waste or by the solid medical waste in last 1 year?	3 (21.43)	6 (40.00)	0.26	2 (4.88)	13 (33.33)	0.008	2 (14.29)	9 (60.00)	0.011

"We segregate different waste at the point of generation. We always have bins; never are we face shortage in logistic.... So, who comes new in this hospital they make mistake as because they have less knowledge and practice about the solid medical waste management." (Nurse, member of infection control committee, IDH).

"...sometimes when the cleaning company changed, there was no color-coded bucket for few days and there is no lid any of the buckets now.... They (cleaners) collect all the waste at the early morning at the time of 5am or 6am and wash it with the bleaching powder.... They always want to do it properly but sometimes they make mistake due to workload."

On the other hand, KII from DSH mentioned that

Table 5 Comparison of waste management practice of IDH and DSH with Bangladesh medical waste management rules which is adopted from World Health Organization guideline

	Bangladesh medical waste management rules which is adopted from World Health Organization guideline	**ICDDR, B Dhaka Hospital**	**Dhaka Shishu Hospital**
1. Segregation	1. Segregation at the point of generation.	1. Segregation at the point of generation	1. Segregation at the point of generation
		↓	
2. Segregation	2. Color code bin for different type of solid medical waste.	2. Color coded bin for different type of solid medical waste. *(Color code does not maintain according to policy)*	2. Color coded bin for different type of solid medical waste. *(Color code does not maintain according to policy)*
		↓	
3. Collection	3 (a) Sharp containers should be made of plastic or metal	3 (a) Sharp containers are made of plastic	3 (a) Sharp containers are made of plastic
	3 (b) Sharp containers should have lid.	3 (b) Sharp containers have lid.	3 (b*) Sharp containers do not have lid*
	3 (c) Sharp containers should be marked with appropriate label or logo.	3 (c) Sharp containers are marked with appropriate label or logo	3 (c) *Sharp containers are not marked with appropriate label or logo.*
	3 (d) Everybody should use PPE during any activity of SMWM.	3 (d) Health care workers use PPE during handling of solid of medical waste	3 (d) *No use of PPE among health care workers during handling of solid of medical waste.*
	3 (e) Registering of waste should be maintained during collection.	3 (e) Maintain registering of waste during collection.	3 (e) Maintain registering of waste during collection
		↓	
4. Transportation	4 (a) Dedicated transport should be used for transportation of solid medical waste.	4 (a) Dedicated transport is used for transportation of solid medical waste.	4 (a) Dedicated transport is used for transportation of solid medical waste.
	4 (b) Everybody should use PPE during any activity of SMWM.	4 (b) Health care workers use PPE during transportation of solid of medical waste.	4 (b) *No use of PPE among health care workers during transportation of solid of medical waste.*
		↓	
5. Storage	5 (a) Solid medical wastes should be stored in a specified area.	5 (a) Have a specific place for storing solid medical waste.	5 (a) Have a specific place for storing solid medical waste.
	5 (b) Area for storing solid medical wastes should be restricted.	5 (b) *Area for storing solid medical wastes do not have any restriction.*	5 (b) *Area for storing solid medical wastes do not have any restriction.*
	5 (c) Storage areas should be marked with a biohazard symbol.	5 (c) *There is no biohazard symbol for storage area.*	5 (c) *There is no biohazard symbol for storage area.*
		↓	
6. Treatment	6 (a) Every health care facility should identify method for the treatment of clinical or infectious waste.	6 (a) Have an incinerator machine.	6 (a) Burn out the solid medical waste outside the hospital
	6 (b) Anatomical waste, infectious waste and sharp waste should be encapsulate or incinerated but it is optional and PVC based material should not be incinerated unless incinerator has technology to filter the gas.	6 (b) Incineration of infectious waste like contaminated saline sate, blood bag, gauze, syringe and needle. Have technology to filter the gas.	6 (b) Hospital burn infectious wastes like contaminated saline sate, blood bag, gauze, syringe and needle and throw recycling material into the municipal dustbin.
	6 (c) PVC based material can be recycled.	6 (c) Have facilities for recycling the PVC based material.	*6 (c) No facilities for recycling PVC based material.*
	(d) Everybody should use PPE during any activity of solid medical waste management.	6 (d) Health care workers use PPE during treatment of solid of medical waste6	6 (d) *No use of PPE among health care workers during treatment of solid of medical waste.*
		↓	
7. Disposal	7. At the health service centre concerned city corporation, municipal council or union council, in their respective places, will continue the safe disposal of the produced and classified safe medical waste as well as properly treated unsafe medical waste in the selected places.	7. Offsite disposal, have contract with Dhaka City Corporation.	7. *No facility of solid medical waste disposal.*

(Nurse, member of infection control committee, DSH).

Barriers of proper medical waste management

Multiple barriers of proper solid medical waste management were mentioned in the survey of the healthcare workers of IDH and DSH including inadequate knowledge and poor attitude among healthcare workers, inadequate interest and poor supervision of the hospital authority, insufficient logistics, insufficient workforce, high workload, and insufficient fund.

These barriers were also mentioned in the KIIs from both hospitals. In the KII from IDH it was mentioned

"...again, when company changed it was very difficult for us to train the new employee as because they have poor knowledge regarding this issue...when they first come, in some of the health care workers they have poor attitude regarding this, we were hammering every time, and then the change come." (Nurse, member of infection control committee, IDH).

In the KII from DSH it was mentioned

"...the authority does not want to take the responsibility but give all the responsibility on my head, that's why our management becomes poor day by day...earlier the entire infection control committee members used to supervise the whole hospital but now I do it alone. For me alone is very difficult to maintain everything. Also, we have deficient in logistic that hamper our waste management...we are very short in cleaners and sometimes they are absent, at that time due to lack of workforce we cannot manage the system properly...as far as I know we do not have special budget for waste management and that's why our waste management is poor." (Nurse, member of infection control committee, DSH).

Discussion

The present study identified the knowledge, attitude, and practice of solid medical waste management in two urban hospitals of Bangladesh depicting a comparative picture of the health care facility in public and private setting. We found that there was distinct difference in the knowledge, attitude, and practice of medical waste management between the two health care settings in Dhaka city. The barriers which contribute to these differences were identified from both health care workers and hospital authority which was found to be not similar.

Though insufficiency of knowledge about medical waste management was observed among the healthcare workers of both hospitals, participants from IDH had better knowledge compared to DSH. The differences were observed in the specific knowledge questions like knowledge of the person responsible for solid waste management and the existence of WHO manual on waste management. In knowledge questions among the respondents of IDH gave more correct answer than nurses of DSH, especially on specific questions such as kind of disease transmitted due to improper solid (mainly sharp) medical waste management, criterion for the container of sharp waste hospital, color code of respondent's hospital and the knowledge about the existence WHO manual on waste management. These findings are inconsistent with the findings of a similar study conducted in neighboring India which showed public hospital doctors and nurses had better knowledge regarding solid medical waste management than private hospital [9].

Regarding the attitude towards medical waste management, participants from both of the hospitals showed positive attitude. However, there was a difference among the doctors of both hospitals regarding the management of medical waste being a teamwork which might be due to the perception of the doctors of DSH that it was not their job to take part in the waste management. This finding was confirmed from our observations in DSH where it was found that placement of the bins were inaccessible for doctors. It is possible that the work environment influences the attitude of the health care workers.

From both the interviews and observation, it was evident that IDH practices the management of solid medical waste more properly compared to DSH. IDH followed the Bangladesh medical waste management rules more properly than IDH which is in line with the findings of a previous study conducted in Dhaka city where the practices of some of the private hospitals were found to be more appropriate than the public hospitals [10]. Similar findings were also reported by studies conducted in context of other south-east Asian countries like India and Pakistan where the public hospitals were relatively less efficient than most of the private hospitals in medical waste management [11, 12].

We found that healthcare workers from DSH were more prone to sharp injury than IDH. Better practice of using PPE by healthcare workers in IDH might contribute to the less incidence of injuries in comparison to DSH. Moreover, it was found that collection of injurious sharp instruments was more organized in IDH where a specific waste bin with a lid was used which might act as a preventive and protective mechanism for the health care workers.

From our finding it was revealed that two hospitals faced different kinds of barriers regarding medical waste management. IDH faced poor attitude and poor practice among health care workers while DSH faced poor hospital authority interest, insufficient workforce, logistic and fund regarding medical waste management as found in

the KIIs. It reflects that public hospital are in shortage of logistics and fund as well as poor interest regarding management of solid medical waste. Similar barriers for proper medical waste management were also reported in other low- and middle-income countries [13–15].

The study had several limitations. Although the study has made an effort to find the gaps in the waste management system between private hospital and public hospital, it cannot be generalized as it was conducted in two purposively selected hospitals only. Instead of structured questionnaire, a strong design like in-depth interview qualitative study would be more accurate and informative for finding out the barriers and influencing factors for proper management of solid medical waste. Moreover, there might a social desirability bias from both of the hospitals as some of the participants might exaggerate their responses in order to improve their image.

Conclusions

In conclusion, there was a substantial lack of knowledge, attitude, and proper practice of solid medical waste management in both of the hospitals, especially in DSH. The private one (IDH) managed their waste more efficiently though limitations existed. Sufficient budget was not available in the public hospital, which caused shortages of logistic and supplies.

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Data availability
Data will be available on request from the corresponding author.

Declarations

Ethics approval and consent to participate
The study protocol was reviewed and approved by Institutional review board of BRAC University, Dhaka, Bangladesh. The all authors declare no human subjects were harmed and the procedures followed were in accordance with the ethical standards and regulations established by the Helsinki Declaration of the World Medical Association. Administrative permission was obtained from the authorities of icddr, b Dhaka hospital and Dhaka Shishu hospital for collecting data. Informed written consent was obtained from each participant.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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