

Knowledge and Practices of Biomedical Wastemanagement among Nurses in Tertiary Level Hospitals

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ABSTRACT

Introduction: Biomedical waste (BMW) management is not just a legal need, but also a social responsibility. Utilizing the skills and knowledge of nursing practice, nurse can enhance proper BMW management while minimizing complications related to infectious wastes.

Methods: A descriptive type of cross sectional study was conducted among 297 nurses working in Dhaka Medical College and Hospital and Shaheed Suhrawardy Medical College and Hospital, in Dhaka city. Data were collected with a pretested semi-structured questionnaire and practices were assessed by observational checklist.

Results: Majority (58.6%) of the participants were belongs to age group 25-35 years. Only 4% had right knowledge about six types color coding bin for BMW storage according to national guideline for BMW management. Regarding practice 56% did not store waste in designated color coded bin, 53% recapped used needle, 93% didn't practice needle cutter, 47% not wear PPE. About barriers of BMWM 64% of respondents opined for inadequate nursing and support staff, of them 41% were well-trained, 35% stated that dedicated place for temporary storage.

Conclusion: Most of the nurses had knowledge of BMW and its management but less practice due to the unavailability of sufficient trained staff, logistics, designated places etc.

KEYWORDS: Biomedical waste, waste management, knowledge on BMW management, practice on BMW management, Nurse.

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INTRODUCTION

Biomedical waste management is a critical component of healthcare operations, ensuring the safe disposal of materials that may pose risks to public health and the environment (World Health Organization, 2017). Tertiary level hospitals, as advanced healthcare institutions, handle complex medical procedures and generate substantial amounts of biomedical waste. Nurses, being integral members of the healthcare workforce, are at the forefront of patient care and consequently play a significant role in the generation, segregation, and disposal of biomedical waste. Biomedical waste management (BMW) is seen as a necessity in health care facilities. Hospitals and nurses are interdependent aspects of BMW management. Regarding the safe

management of BMW management, there is role conflict among the generators, operators, decision-makers, and the general community due to a lack of awareness. Based on these facts, an integrated biomedical waste management system for hospitals and health care facilities should be incorporated (Gautam et al., 2021). The aim of biomedical waste management is proper segregation, collection, transport, handling and disposal in such a way that it is safe for environment as well as community.

Common generators (producers) of BMW include hospitals, health clinics, nursing homes, emergency medical services, medical research laboratories, offices of physicians, dentists, veterinarians, home health care and morgues or funeral homes. In healthcare facilities (like- hospitals, clinics,

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doctor's offices, and clinical laboratory), waste with these characteristics may alternatively be called medical or clinical waste. BMW is distinct from normal trash or general waste, and differs from other types of hazardous waste, such as chemical, radioactive, universal or industrial waste. Medical facilities generate waste hazardous chemicals and radioactive materials. While such wastes are normally not infectious, they require proper disposal. Some wastes are considered multi hazardous, such as tissue samples preserved in formalin (Wikipedia). The proper management of biomedical waste is crucial to prevent adverse environmental and public health impacts (Patil et al., 2017). Nurses, being frontline healthcare professionals, play a pivotal role in generating and handling biomedical waste. Their knowledge and adherence to best practices in biomedical waste management are essential for ensuring a safe and sustainable healthcare environment (Kumar et al., 2018). Inadequate management of biomedical waste can lead to the spread of infections, environmental pollution, and occupational hazards for healthcare workers (Prüss-Üstün et al., 2019). Therefore, understanding the knowledge and practices of nurses in tertiary level hospitals regarding biomedical waste management is imperative for enhancing overall healthcare waste management systems (Khan et al., 2020).

Proper waste management practice is important in today's society. Due to an increase in population, the generation of waste is getting doubled day by day. Moreover, the increase in waste is affecting the lives of many people. Improper Biomedical waste management offers a severe threat to human health and may result in a variety of health risks, including disease transmission not only to health workers, but also to patients and their attendants visiting health centers. Inadequate Biomedical waste management not only puts people at danger of infection from viruses like human immunodeficiency virus (HIV)/ AIDS, Hepatitis B virus, and Hepatitis C virus, but it also puts water, air, and soil pollution at risk, harming the ecosystem and the community as a whole. As a result, the Ministry of Environment and Forests issued the Bio-Medical Waste (Management and Handling) Rules, 1998 to ensure efficient waste management. BMW management's goal is to ensure that it is properly collected, handled, and disposed of. Not only are health-care workers supposed to know how to properly segregate and dispose of biomedical waste, but they should also be able to advise others on how to do so. Health centers are currently becoming a hub for spreading infections due to improper biological waste management, a lack of awareness, and inadequate knowledge (Gupta *et al.*, 2016). There are strong shreds of evidence to show transmission of life-threatening diseases such as HIV/AIDS, Hepatitis B, and C through improper biomedical waste management (Chudasama RK *et al.*, 2013). Moreover, it is estimated that roughly 350 million people worldwide are infected with chronic hepatitis B. (WHO, 2011). Keeping in view the above scenario, the present study

was conducted to assess the existing knowledge and practices of biomedical waste among nurses in tertiary level hospitals.

Materials and Methods

Study design: This study was descriptive type of cross-sectional study.

Study place: The study was conducted at Dhaka Medical College Hospital and Shaheed Suhrawadry Medical College Hospital, Dhaka, Bangladesh.

Study population: The study population consisted of registered nurses who had earned a diploma, bachelor's degree, or higher in nursing, who had worked in the inpatient units of Dhaka Medical College and Hospital (DMCH) and ShaheedSuhrawardy Medical College and Hospital (Sh.SMCH), Dhaka, for at least 1 year, and who were present during the data collection period.

Study period and duration: The study period was estimated 12 months' period from 1st January 2022 to 31st December 2022.

Sampling technique: Each respondent was selected by using convenience sampling technique and sample size of this study was 297.

Data collection technique: Data was collected by face to face interview.

Data collection instruments: A semi-structured questionnaire and observational checklist was developed in English and then translated into Bengali. The questionnaire consisted of fifth sections. The first section included the socio-demographic information of respondents. The second section included existing knowledge related to BMW management. The third section included practices of nurses regarding BMW management. The fourth section included barriers of nurses regarding BMW management. The fifth was an observational questionnaire assessing the practice of nurses on BMW management.

Demographic Information: The parameters of demographic data of respondents included age, gender, religion, marital status, educational qualification, professional experience; and training status of BMW management.

Knowledge Questionnaire: This tool consisted of 46 multiple choice questions, each of which had four options in which there was three incorrect with one correct option and some has more than one was correct option; and some questions has only "yes" or "no" option. The knowledge was calculated and interpreted using the frequency distribution table in the results section.

Practice Questionnaire: The observation questionnaire was used to assess the physical facilities and practices of respondents in selected hospitals. This tool consisted of 11 question, each of which had "yes" or "no" options among them two multiple choice questions, each of which had four options in which there was three incorrect with one correct option. Beside this, investigator use a observational checklist which contained sixteen questions with the options "Yes" and "no". The investigators observed the practice of respondents and filled in the questionnaire directly. The overall facilities

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and practices was calculated and interpreted using the frequency distribution table in the results section.

Barrier related Questionnaire: This tool consisted of nine questions, each of which had “yes” or “no” options. The investigator used this tool to identify the barriers of nurses on practices of biomedical waste management.

Data collection procedure: The objectives of the study were explained clearly to the participants before data collection. We used all data for the purpose of the research, and they were encrypted and stored electronically in a secure location, with a password used by the principal investigator to ensure privacy and confidentiality. Written informed consent was obtained from each participant, and then a semi-structured questionnaire was filled by face to face interview to collect all the data, except the practice tool. After the completion of the tool, using an observational method, the practice questionnaire was filled by data collectors.

Data processing & analysis:

- After collection data were cleaned, coded, and categorized. Then master tabulation sheet was prepared after proper checking, verifying and editing as per specific objectives and key variables
- Then data were entered into the computer using Statistical Package for Social Sciences (SPSS).
- The analysis was carried out using the statistical software namely SPSS (Statistical Package for Social Sciences), version 22.
- Descriptive data were analyzed by simple frequency distribution (mean, standard deviation, percentage) and cross tabulation.

Ethical Consideration

The study was conducted maintaining all the possible ethical considerations.

- Prior to the study ethical clearance was taken from Institutional Review Board (IRB) through proper channel.
- Appropriate written permissions were taken for data collection from the designated authority of Dhaka Medical College Hospital and Shaheed Suhrawardy Medical College Hospital, Dhaka through proper channel.
- The participation was voluntary. Before collection of data informed written consent was taken from each of the participant. Detailed study related information was read out and explained in the local language from a printed handout. Informed consent form contained objectives and methods of the study, duration and frequency, risks and benefits of the study. Consents were taken in Bengali and interviews were conducted in Bengali.
- The study was conducted through collection of data using questionnaire. Any sort of intervention or any other invasive procedures were not used.
- Participants will have all rights to withdraw from the study.
- Privacy and confidentiality will be maintained strictly.

RESULTS

Table 1: Information of the respondents according to socio-demographic profile (n=297)

| Age category of the respondents (year) | Frequency (f) | Percent (%) |
|--|---------------|-------------|
| 25-35 | 174 | 58.6 |
| 35-45 | 85 | 28.6 |
| 45-55 | 38 | 12.8 |
| Mean ± SD - 35.55± 7.611 | | |
| Gender | | |
| Female | 208 | 70.0 |
| Male | 89 | 30.0 |
| Educational Qualification | | |
| Diploma in Nursing | 190 | 64.0 |
| B.Sc. in Nursing | 69 | 23.2 |
| MPH/ MSN. | 38 | 12.8 |
| Duration of service | | |
| < 5 years | 118 | 39.7 |
| 5-10 years | 111 | 37.4 |
| 10-15 years | 33 | 11.1 |
| >15 years | 35 | 11.8 |
| Had training on BMW management | | |
| Yes | 155 | 52.0 |
| No | 142 | 48.0 |
| Total | 297 | 100 |

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Table1 shows, among 297 respondents, maximum 58.6% (174) belonged to 25-35 years of age. Mean age of the respondents was 35.55 years with Std. Deviation ± 7.611 years. Majority of the respondents were female 70.0% (208),

mostly 64.0% (190) respondents were completed Diploma in Nursing, 39.7% (118) of the respondent's length of service was below 05 years and 52% (155) had BMW management training.

Table 2: Information of the respondents regarding knowledge of biomedical waste management (n=297)

| Know about BMW | Frequency (f) | Percent (%) |
|--|----------------------|--------------------|
| Yes | 297 | 100 |
| No | 0 | 0 |
| BMW produced from | | |
| Hospitals and Clinic | 283 | 95.3 |
| House-hold | 4 | 1.3 |
| Industries | 9 | 3.0 |
| Cattle farm | 1 | .3 |
| Biomedical waste produce by clinical care provider | | |
| Yes | 219 | 73.7 |
| No | 78 | 26.3 |
| Biomedical waste produce by supporting staff and cleaner | | |
| Yes | 182 | 61.3 |
| No | 115 | 38.7 |
| Biomedical waste produce by Patients | | |
| Yes | 138 | 46.5 |
| No | 159 | 53.5 |
| Biomedical waste produce by non-clinical care provider | | |
| Yes | 28 | 9.4 |
| No | 269 | 90.6 |
| Color bin used in Hospital | | |
| 6 color's bin | 14 | 5.4 |
| 3 color's bin | 19 | 7.3 |
| 4 color's bin | 200 | 76.9 |
| 5 color's bin | 27 | 10.4 |
| Knowledge about dispose of BMW according to color coding | | |
| Correct answer | 262 | 88.2 |
| Incorrect answer | 35 | 11.8 |
| Knowledge about dispose of sharps in puncture proof container | | |
| Correct answer | 221 | 84.4 |
| Incorrect answer | 41 | 15.6 |
| Knowledge about dispose of expired drug in black colored bin | | |
| Correct answer | 154 | 51.9 |
| Incorrect answer | 143 | 48.1 |
| Knowledge about dispose of used gauze piece in yellow color bin | | |
| Correct answer | 215 | 72.4 |
| Incorrect answer | 82 | 27.6 |
| Uses of biohazard bag for internal transport of BMW | | |
| Yes | 230 | 77.0 |
| No | 67 | 23.0 |
| Disease transmitted by BMW | | |
| Yes | 287 | 97.0 |
| No | 10 | 3.0 |
| Route of transmission of BMW pathogens by needle stick injury | | |
| Yes | 255 | 88.9 |
| No | 32 | 11.1 |

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| Route of transmission of BMW pathogens by contact of BMW with cut injury | | |
|--|------------|------------|
| Yes | 187 | 65.2 |
| No | 100 | 34.8 |
| Route of transmission of BMW pathogens by direct contact | | |
| Yes | 87 | 30.3 |
| No | 200 | 69.7 |
| Getting Hepatitis B and C infection from BMW | | |
| Yes | 248 | 86.4 |
| No | 39 | 13.6 |
| Getting HIV infection from BMW | | |
| Yes | 174 | 60.6 |
| No | 113 | 39.4 |
| Getting Hepatitis A and gastrointestinal infection from BMW | | |
| Yes | 67 | 23.3 |
| No | 220 | 76.7 |
| Total | 297 | 100 |

Table 2 shows the distribution of knowledge regarding BMW. Out of 297 respondents, 100% (297) opined that they know about BMW. 95.3 (283) respondents said BMW produce from hospitals and clinic, 73.7% (219) opined biomedical waste produce by clinical care provider, only 5.4% (14) stated 6 color bins were used in hospitals for BMW management, 88.2% (262) opined they dispose BMW according to color coding, 84.4% (221) gave correct answer for dispose of sharps in puncture proof container, respectively 51.9% (154) gave correct answer for disposal of expired drugs in black colored bin and 72.4% (215) had knowledge

on disposal of used gauze pieces in yellow color bin and 77% (230) had knowledge on use of biohazard bag during internal transport of BMW. Out of 297 respondents, 97% (287) opined diseases transmitted by BMW. Among them 88.9% (255) had knowledge that disease transmitted by needle stick injury, 65.2% (187) for cut injury, and 30.3% (87) by direct contact. Beside this knowledge regarding health risk of BMW management, 86.4% (248) opined for chance of getting hepatitis B and C infection, 60.6% (174) for HIV infection and 23.3% (67) for hepatitis A and gastrointestinal infection.

Table 3: Information of the respondent's regarding practices of nurses on BMW management (n=297)

| BMW management practices | | Response | |
|--|----------|------------|-------------|
| | | Yes (%) | No (%) |
| Took protective measure when handling of BMW | | 183 (62) | 114 (38) |
| Recapping used needle | | 156 (53) | 141 (47) |
| Injured by needle or any sharp object at your workplace in the last 06 months | | 112 (38) | 185 (62) |
| Follow proper disposal method for biomedical waste | | 206 (69) | 91 (31) |
| Supervised and monitored supporting staffs practiced regarding use of leak-proof and lidded bin for BMW transport. | | 233 (78) | 64 (22) |
| Maintain record for biomedical waste | | 112 (38) | 185 (62) |
| Use register to write the amount of BMW (n=112) | | 90 (80) | 22 (20) |
| Regularly report to responsible authority about BMW | | 54 (18.18) | 243 (81.82) |
| Follow proper storage method for biomedical waste | | 207 (70) | 90 (30) |
| Maximum numbers of hours the waste can be stored (n=207) | 48 hours | 05 (2.4) | 202 (97.6) |
| | 36 hours | 2 (1) | 205 (99) |
| | 30 hours | 12 (5.8) | 195 (94.2) |
| | 24 hours | 188 (90.8) | 19 (9.2) |
| Number of color coded bin used in workplace | 01 set | 198 (66.7) | 99 (33.3) |
| | 02 sets | 29 (9.8) | 268 (90.2) |
| | 03 sets | 14 (4.7) | 283 (95.3) |
| | 04 sets | 56 (18.9) | 241 (81.1) |

Table 3 shows among 297 respondents, 62% (183) practiced to take protective measures. 47% (141) practiced not

recapping used needle, among them 38% (112) injured by sharp objects. 69% (206) practiced proper disposal method.

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78% (233) supervised supporting staffs practiced regarding used leak-proof and lidded bins during transport of BMW, 38% (112) maintained record among them 80% (90) kept record in register and 18.18% (54) sent report to concern authority about BMW. For temporary storage 70% (207)

practiced proper storage method, among them only 2.4% (05) respond maximum 48 hours for temporary storage and 9.8% (29) practiced 2 sets color coded bin.

Table 4: Information related to barriers of nurses regarding biomedical waste management (n=297)

| Barriers about BMW management. | Response | |
|--|----------|----------|
| | Yes (%) | No (%) |
| Available nursing staff for BMW management | 107 (36) | 190 (64) |
| Available supporting staff for BMW management | 107 (36) | 190 (64) |
| Availability of equipments for BMW management | 121 (41) | 176 (59) |
| Availability of color bins for BMW management | 149 (50) | 148 (50) |
| Availability of dedicated trolley for transport of waste | 213 (72) | 84 (28) |
| Available needle cutter for BMW management | 87 (29) | 210 (71) |
| PPE available for BMW management | 193 (65) | 104 (35) |
| Supporting staff trained for BMW management | 122 (41) | 175 (59) |
| Dedicated place for temporally storage of BMW | 193 (65) | 104 (35) |

Table 4 shows among 297 respondents, 36% (107) stated that sufficient nursing staffs were available for BMW management whereas 64% (190) stated sufficient nursing staffs were not available. Respectively 36% (107) stated supporting staffs were available but 64% (190) stated it not available. 41% (121) stated that equipments for BMW management were available but 59% (176) stated not available. 50% (149) stated that color bins for temporally storage of BMW were available but 50% (148) stated not

available. 72% (213) opined that dedicated trollies for transport of BMW are available but 28% (84) opined not available. 29% (87) stated that needle cutter was available but 71% (210) stated not available. 65% (193) stated PPE available but 35% (104) stated not available it. 41% (122) stated that supporting staff had BMW management training whereas 59% (175) stated supporting staff had not training. 65% (193) stated that they had defined place for BMW storage whereas 35% (104) stated no defined places.

Facilities and practiced related information taken by observational checklist

| Facilities items | Yes (%) | No (%) |
|--|----------|----------|
| Uninterrupted supply of black, green, red, blue, yellow bins | 117 (39) | 180 (61) |
| Level on the bins according to the category | 202 (68) | 95 (32) |
| Available needle crasher | 37 (13) | 260 (87) |
| Availability of protective equipment's like- gloves, apron, boot, musk. | 155 (53) | 142 (47) |
| Adequate soap and hand washing equipment | 169 (57) | 128 (43) |
| Bins are properly cleaned after emptying the waste. | 62 (21) | 235 (79) |
| Reporting mechanism for accidents, especially injuries caused by sharp objects. | 62 (21) | 235 (79) |
| Practices items | Yes (%) | No (%) |
| Store waste separately according to color codes | 131 (44) | 166 (56) |
| All tubes/bags (Plastic/rubber) perforated/ cut/ shredded | 92 (31) | 205 (69) |
| Needle cutting practice | 19 (7) | 278 (93) |
| Syringe nozzle cutting/melting | 15 (5) | 282 (95) |
| Wearing protective equipment | 157 (53) | 140 (47) |
| Regular hand washing practice developed, especially for waste remover. | 194 (65) | 103 (35) |
| Information on the quantity and type of medical waste produced, stored and transmitted | 44 (15) | 253 (85) |
| Supervised and monitoring supporting staffs practiced of using leak-roof and lidded bins during transport. | 128 (43) | 169 (57) |
| Monitoring supporting staffs practiced of using proper trolley for BMW transport | 158 (53) | 139 (47) |

Available facilities of the respondents and their data was collected by observational checklist- Among 297 respondents, the availability of facilities like- 39% had uninterrupted supply of color bins, 68% level on the bins

according to category, 13% had available needle crasher facility, 53% had available protective equipments in the working area, 57% had sufficient soap for hand washing. 21% had facility for properly cleaned the bins after emptying the

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waste, 21% had reporting facility for accidental injury. Above table shows the practices of the respondents; 44% store waste separately according to color codes, 31% practiced partial damage of plastic tubes/bags before discard. Only 7% respondents practiced needle cutter, 5% for syringe nozzle cutting, 53% had practiced of wearing protective equipments, 65% regular hand washing practiced, 15% had practiced to kept information regarding quantity of waste produced and stored, 43% practiced monitoring of supporting staffs practiced using the lids during transport, 53% practiced of supporting staffs practiced using proper trolley for BMW transport.

DISCUSSION

Improper biomedical waste management poses a significant threat to human health and can lead to a number of health issues, including the possibility of disease transmission to both patients and their visitors to medical facilities as well as to healthcare professionals. Inadequate management of biological waste not only increases the danger of infection with viruses like HIV, Hepatitis B, and C in humans, but also increases the risk of soil, water, and air pollution, which harms the ecosystem and the community as a whole. A descriptive cross-sectional study was conducted with the aim to assess the level of knowledge and practices of biomedical waste management and to exclude barriers among nurses in tertiary level hospital from January to December, 2022. This study also finds out the socio-demographic characteristics of the respondents and determines the association with BMW. Respondents (Nurses working in the hospital) were selected from two government tertiary level hospitals DMCH and Sh.SMCH, Dhaka. Majority of the respondents 58.6% (174) were from 25-35 years age group, next were 28.6% (85) from 35-45 years age group and rest were 12.8% (38) from 45-55 years age group. Mean age of the respondents was 35.55 years with Std. Deviation ± 7.611 years. Another study related to the knowledge on hospital waste management among senior staff nurses working in a selected medical college hospital showed that among 125 respondents belonged to age group of 35-40 years old constituted the highest proportion 45.6% (57), next to 30-35 age group 30.4% (38) (Uddin, M.N., Islam, M.R. and Yesmin, K., 2014). Similar finding was reported in the study related to biomedical waste management: a study of knowledge, attitude and practice among health care personnel at tertiary care hospital in Rajkot done by (Chudasama RK et al., 2013) showed that the majority of the respondents were young 26-30 years age group.

Present study shows that knowledge regarding sources of BMW 95% (283) know correctly about sources of BMW; whereas 5% (14) not know about sources of BMW. Study shows, the distribution of knowledge regarding segregation of BMW. Out of 297 respondents; 68.4% (203) know about segregation of BMW. Among them 40.4% (82) opined that waste should be segregated at source and work point, 34.5%

(70) respond waste generator should be responsible for segregate of BMW. Another study related to knowledge on hospital waste management among senior staff nurses working in a selected medical college hospital of Bangladesh showed knowledge about segregation of BMW 64% (Uddin, M.N., Islam, M.R. and Yesmin, K., 2014) and other study showed that knowledge on segregation of BMW at source was 50% (Gupta *et al.*, 2016), these findings was similar with current study. Out of 297 respondents knowledge regarding color coding bin. 88% (260) know about but among them only 5.4% (14) stated 6 color bins were used in hospital. Another study showed that the knowledge about color coding bin/containers was 92% (Mir, M.R., *et.al.* 2013). Other study showed that knowledge about color coding containers was 100% (Jahan *et al.*, 2018)

Several studies have highlighted the significance of healthcare professionals' awareness and compliance with biomedical waste management guidelines (Patil *et al.*, 2017). According to Patil *et al.* (2017), improper disposal of biomedical waste in healthcare settings can result in the contamination of water, soil, and air, contributing to the transmission of infectious diseases. Additionally, Prüss-Üstün *et al.* (2019) emphasized the need for comprehensive training programs to improve healthcare workers' understanding of biomedical waste management practices. Despite the existing literature on the subject, there is a dearth of research specifically focusing on the knowledge and practices of nurses in tertiary level hospitals regarding biomedical waste management (Kumar *et al.*, 2018). Nurses, being at the forefront of patient care, are responsible for generating a substantial amount of biomedical waste daily. Therefore, their awareness, training, and adherence to established protocols are vital for the overall success of biomedical waste management programs (Khan *et al.*, 2020). Biomedical waste includes potentially infectious materials, hazardous chemicals, and other materials that pose a threat to human health and the environment. Inadequate management of biomedical waste can lead to the spread of infections, environmental pollution, and occupational hazards for healthcare workers. Therefore, understanding the knowledge and practices of nurses in tertiary level hospitals regarding biomedical waste management is imperative for enhancing overall healthcare waste management systems.

CONCLUSION

The study find out that most of nurses had knowledge about BMW and its management. However knowledge regarding type of BMW and in house segregation respondents had less idea according to national guideline on hospital waste management. Insufficient manpower, inadequate logistics, designated place for temporary in-house storage as well as work load hamper safe practice in BMW management. To find out gaps in BMW management, this study identify some situations, like continuous compulsory training and refresher

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training for healthcare personnel specially nursing staffs working in tertiary level hospitals.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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