ASSESSMENT OF KNOWLEDGE, ATTITUDE, AND PRACTICE ABOUT BIOMEDICAL WASTE MANAGEMENT AMONG HEALTHCARE PROFESSIONALS AT PRIMARY HEALTHCARE FACILITIES IN BURAIMI GOVERNORATE

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ABSTRACT

Background: According to the World Health Organization report, 10– 25% of the BMW was estimated to be hazardous. It has become a major cause of concern for Health Care Facilities (HCF) and the environment. Biomedical waste management is still at the infancy stage and lately got attention due to increased awareness about hepatitis B virus, hepatitis C virus, human immune deficiency virus, and other potentially infectious diseases.

Objectives: To assess the Knowledge, Attitude, and Practices of Healthcare Professionals about Biomedical Waste Management at Primary Healthcare Facilities in Buraimi Governorate.

Methodology: A Cross sectional descriptive self-administered questionnaire-based study was conducted among 201 subjects from 1st of August 2021 to 30th October 2021 in Al-Buraimi hospital, Oman. Stratified random sampling comprised of four strata (74 nurses, 46 doctors, 14 housekeeping staff, 40 medical orderly, 8 pharmacists and 18 laboratory technologists). All participants should be working in primary healthcare institutions in Buraimi Governorate for at least six months full time duty during the conduction of study were included in the study. The participants were selected randomly to make the sample size of 143 with equal representation in each category in all primary health care institutions in Buraimi Governorate (6 health centers, 1 extended health center and 1 wilayate hospital (local). Those who were not willing to participate in the study and those who were working in the administration, part time and less than six months in duty were excluded from this study.

Results: Overall response rate was 143 (71.1%) from total 201, age range from 36 to 45 years was the highest between participants. Female proportion of 104 (73%) was higher as compare to males 39 (27%). 67.8% had more than >10 years working experience, and 49.6% had participated in at least one training course regarding biomedical waste management. The overall scores for knowledge, attitude, and practice were at a high level (89%, 96%, 87%, respectively). The overall knowledge, attitude and practice scores were found to be statistically insignificant ($P=0.100$, $P=0.346$, $P=0.364$ respectively) using chi square analysis ($P \leq 0.05$).

Conclusion: There should be a continuous training programme for all health personnel. Biomedical waste management rules should be strictly implemented at all levels.

Keywords: Biomedical waste management, health care personnel, knowledge, attitude and practice.

INTRODUCTION

Generation and disposal of Biomedical Wastes (BMW) have become an emerging problem worldwide [1]. It has become a major cause of concern for Health Care Facilities (HCF) and the environment [2]. According to the World Health Organization report, 10– 25% of the BMW was estimated to be hazardous [3]. However, evidence from different kinds of literatures indicated that the proportion of hazardous waste is varied from country to country ranging from 20% to 75% [4–6]. Biomedical waste (BMW) is "waste generated during diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological" [7] Biomedical waste management is still at the infancy stage and lately got attention due to increased awareness about hepatitis B virus, hepatitis C virus, human immune deficiency virus, and other potentially infectious diseases. Biomedical wastes can transmit more than 30 dangerous blood borne pathogens [8]. Improper healthcare waste management (HCWM) poses a serious public health problem worldwide. Approximately, 5.2 million people, including children, die every year due to waste-related diseases. Healthcare waste (HCW) carries higher risk of infection and injuries than other types of waste [9]. Biomedical waste consists of both risk waste and non-risk waste. Generally, risk waste includes infectious waste, pathological, pharmaceutical, sharps, chemicals, geno-toxic and radioactive wastes. Non-risk waste includes garbage and general day to day waste 4 produced by food stuff leftovers and their packaging [10]. The World Health Organization has prepared a BMW management guideline to ensure safe management of the wastes from the HCFs [3]. The appropriate biomedical waste management (BMWM) process includes vital steps (segregation, storage, transportation, treatment, and disposal) which requires special attention [11]. According to these guidelines, as a minimum option, HCFs are required to segregate (separate) BMWs using three types of color-coded bins (black, yellow, and sharp box) [11]. In Oman, waste management practices have traditionally mirrored the linear economy model. In 2018, an estimate of 2.1 million tons of municipal waste were generated across the country. A total of 4,500 tons are healthcare waste which is generated annually in healthcare institutions across the Sultanate [12]. HCW should be segregated according to the standardized procedures, which will reduce HCW related threats to healthcare workers, disposal cost and the cost of treatment [13]. Proper management of HCW requires a combination of proper waste handling during generation, collection, storage, transportation and treatment. Identification of the causes of mismanagement and creation of supportive measures in the system are essential to develop HCWM procedures and guidelines [14]. Safe HCWM procedures should be reflected in budget allocation for HCWM, proper disposal methods, treatment guidelines and technologies including color coding practices [15]. Developed countries have formulated adequate policies, which are easily enforced as a result of access to sufficient resources. Developing countries, on the other hand, lack greatly in the ability to implement such policies owing to resource constraints [16]. Health care waste is classified as Sharp waste(e.g., hypodermic needles, scalpels etc.), Chemical waste (e.g., reagents, solvent etc.), Pathological waste (e.g., human tissues, body parts, fetus, etc.), Infectious waste (e.g., blood and body fluids etc.), Pressurized containers (e.g., gas cylinders, aerosol etc.), Pharmaceutical waste (e.g. out-dated medications, etc.), Genotoxic waste (e.g., cytotoxic drugs and genotoxic chemical) and Waste with high heavy metal content (e.g., batteries, thermometers etc.) [17].

METHOD

This was a descriptive, cross sectional study data was collected through structured self-administered questionnaire and structured interview for non-English speakers conducted from June to August 2021. Study participants included doctors, nursing staff, laboratorytechnologists, medical orderlies (health assistants), pharmacist and housekeeping staff working in primary healthcare institutions in Buraimi Governorate for at least six months full time during the conduction of study were included in the study. The participants were selected randomly to make the sample size of 201 with equal representation in each category in all primary health care institutions in Buraimi Governorate (6 health centers, 1 extended health center and 1 wilayate hospital (local). Those who were not willing to participate in the study, worked for less than six months in full time and those who were working in the administration or categories other than specified for this study, were excluded from the study.Data entry was done in Microsoft Excel. Data was analyzed using SPSS software version 22 and results were interpreted into percentages.

RESULTS

RESPONSE RATE AND CHARACTERISTICS OF THE RESPONDENTS.

A total of 201 questionnaires were distributed to the target group. After one month of questionnaire distribution, collection of questionnaires only 104 were received giving an overallresponse rate of 51.7 %. The overall response rate was considered to be "satisfactory". The response rate of 104 health care workers among eachcategory included doctors, 23 (22%); nurses, 43 (41%); laboratory technologist, 16 (15%); Pharmacist, 4 (4%); medical orderlies, 10 (10%) and housekeeping staff,8 (8%) with most age category range from 36-45 years (53%). Male comprised of 35 (34%) andfemale 69 (66%). 67 (65%) of the respondents had Working experience of more than 10 years and 5 (22%) hadworking experience 6-10 years (See Table 1 and Figure 1).

Table 1. A response and characteristic of the respondents.

Variables		Doctors (n=23)	Nurses (n=43)	Laboratory Technologists (n=16)	Pharmacist (n=4)	Medical Orderly (n=10)	Housekeeping Staff (n=8)	Total (n=104)
Age	20-35	4 (17%)	13 (30%)	6 (38%)	4 (100%)	4 (40%)	6 (75%)	**37 (36%)**
	36-45	13 (57%)	27 (63%)	9 (56%)	0 (0%)	4 (40%)	2 (25%)	**55 (53%)**
	46-55	6 (26%)	3 (7%)	1 (6%)	0 (0%)	2 (20%)	0 (0%)	**12 (11%)**
Gender no.(%)	Male	14 (61%)	3 (7%)	6 (38%)	3 (75%)	2 (20%)	7 (88%)	**35 (34%)**
	Female	9 (39%)	40 (93%)	10 (62%)	1 (25%)	8 (80%)	1 (12%)	**69 (66%)**
Working Experience no.(%)	<1-5y	3 (13%)	2 (5%)	3 (19%)	2 (50%)	0 (0%)	5 (63%)	**15 (14%)**
	6-10y	5 (22%)	9 (21%)	3 (19%)	0 (0%)	4 (40%)	1 (13%)	**22 (21%)**
	>10y	15 (65%)	32 (74%)	10 (62%)	2 (50%)	6 (60%)	2 (25%)	**67 (65%)**

Figure1: Healthcare Categories participated in this study.
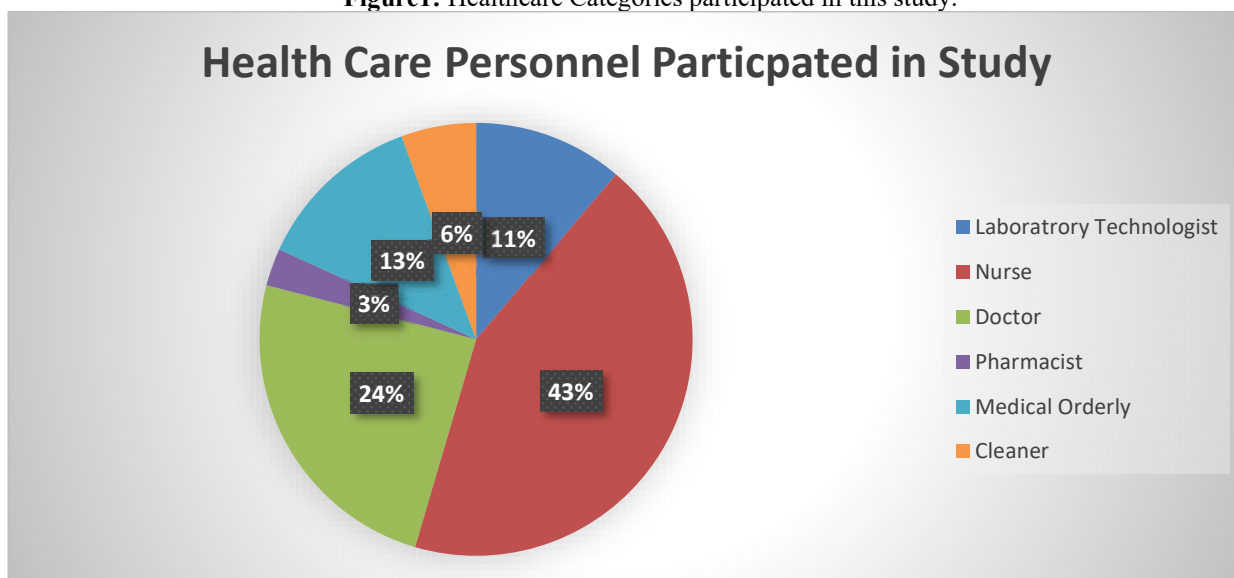
KNOWLEDGE ITEM

The knowledge of the participants was assessed by using Chi-Square test with *p*-value significance at ≤ 0.05. A total of 143 participants (23 doctors, 43 nurses, 16laboratorytechnologists, 4 pharmacists, 10 medical orderlies and 8 housekeeping staff) took part in the study. Table 2 shows knowledge of various health personnel regarding BMW management. Around 89% doctors, 96% nurses, 96 % laboratorytechnologists88% pharmacists, 78 medical orderlies and 89% of housekeeping staff knew about primary source and segregation of BMWwhich statistically significant (*P*=0.000). Knowledge regarding BMW Segregation into different categorieswas fairly good among doctors (91%), 87% nurses, 75% pharmacists and100% for laboratorytechnologists'medical orderlies and housekeeping staff knew about it (*P*=0.383). Awareness about color coding of containerswas least among medical orderlies (56%) followed by pharmacists (75%), doctors (94%), nurses 97%) and highest was among laboratorytechnologists and housekeeping staff (100%)which statistically significant (*P*=0.000). Hundred percent (100%) of doctors, pharmacists and medical orderlies use containers according to color coding and (95%) of nurses, (94%) of laboratorytechnologists and 88% of housekeeping staff use containers according to color coding (*P*=0.184). Hundred percent (100%) of pharmacists andlaboratorytechnologistsknewhow to use color coding containers while 98% of nurses, 91% of doctors, 88% of housekeeping staff and only 56% of medical orderlies knew how to use color coding containers(*P*=0.013). Only 67% medical orderlies as compared to 100% doctors, 97% nurses, 94%laboratorytechnologists, 88% housekeeping staffand 75% pharmacists knew about biohazard symbols (*P*=0.036). Doctors, nurses and laboratory technologists had very good knowledge about universal precautions (96%, 98%, 94%, respectively), while 80% of medical orderlies and only 75% of

pharmacists and housekeeping staffknew about them which highly significant (*P*=0.003). Knowledge about BMW management ruleswas least among medical orderlies (33%) followed by housekeeping staff (50%), laboratorytechnologists and pharmacists (75%), nurses (81%) and highest knowledge was among doctors (83%) (*P*=0.117). Doctors, laboratorytechnologists, pharmacists and housekeeping staffhad excellent knowledge about discarding needles (100%) while only 98% of nurses and 94% of medical orderliesknew about it and this was highly significant (*P*=0.002). Knowledge about diseases transmitted by BMW was excellent among all healthcare workers in this study (100%) (*P*=0.000).

Table 1: Knowledge of healthcare workers regarding BMW management

Knowledge on BMW management	Doctors (n=23) (%)	Nurses (n=43) (%)	Laboratory Technologists (n=16) (%)	Pharmacists (n=4) (%)	Medical Orderlies (n=10) (%)	Housekeeping Staff (n=8) (%)	Total (n=104)	*P*-Value
BMW Segregation into different categories.	23 (100%)	43 (100%)	16 (100%)	4 (100%)	9 (90%)	8 (100%)	103 (99%)	0.000
BMW Segregation at source.	21 (91%)	38 (88%)	16 (100%)	3 (75%)	10 (100%)	8 (100%)	96 (88%)	0.383
Awareness about color coding of containers.	22 (96%)	42 (98%)	16 (100%)	3 (75%)	5 (50%)	8 (100%)	101 (97%)	0.000
Use of color-coding containers.	23 (100%)	41 (95%)	15 (94%)	4 (100%)	10 (100%)	7 (88%)	100 (96%)	0.184
Understanding the use of Color coding of containers.	21 (91%)	42 (98%)	16 (100%)	4 (100%)	5 (50%)	7 (88%)	95 (91%)	0.013
Biohazard symbol.	23 (100%)	42 (98%)	15 (94%)	3 (75%)	7 (70%)	7 (88%)	97 (93%)	0.036
Universal precautions.	22 (96%)	42 (98%)	15 (94%)	3 (75%)	8 (80%)	6 (75%)	96 (92%)	**0.003**
BMW management rules.	19 (83%)	35 (81%)	12 (75%)	3 (75%)	3 (30%)	4 (50%)	76 (73%)	0.117
Discarding needles.	23 (100%)	42 (98%)	16 (100%)	4 (100%)	9 (90%)	8 (100%)	94 (90%)	**0.002**
Diseases transmitted by BMW.	23 (100%)	43 (100%)	16 (100%)	4 (100%)	10 (100%)	8 (100%)	104 (100%)	0.000

ATTITUDE ITEM

Table 2 shows attitude of healthcare workers regarding BMW Management. All the Pharmacists in our study thought that Segregation of waste at the source increases the risk of injury to waste holders, while 52% of doctors, 63% of nurses, 67% of medical orderlies, 50% of housekeeping staff and 38% of laboratory technologists thought the same (*P*=0.366).Hundred percent (100%) of nurses, laboratorytechnologists, pharmacists and housekeeping staff agree that occupational safety is a must while handling the waste and 96% of doctors and 98% of nurses agree on that statement (*P*=0.119). Hundred percent (100%) of pharmacists thought that reporting of needle stick injury extra burden on their work while 61 % of medical orderlies, 44% of laboratory technologists, 30% of doctors, 26% of nurses and 25% housekeeping staff shared the same feelings. 64% of participants in thisstudydisagree that reporting if needle stick injury is an extra burden on their work and this was a highly significant (*P*=0.004).

Hundred percent (100%) of laboratorytechnologists, pharmacists and housekeeping stafffelt that BMW management is a team work, while 97% of doctors, 98% of nurses and 78% of medical orderlies thought the same (*P*=0.000). All doctors, laboratorytechnologists, pharmacists, medical orderlies and housekeeping agree that use of color code for segregation of waste is a must, while 98% of nurses agree on the same (*P*=0.178). All doctors, laboratorytechnologists, pharmacists, 98% of nurses, 94% of medical orderlies and 88% housekeeping staff agree initiation of post-exposure prophylaxis as soon as possible after needle stick injury(*P*=0.101).Hundred percent (100%) of doctors, pharmacists and medical orderlies agree on reporting to concern authorities, if biomedical waste guidelines are not complied, while 90% of nurses, 88% of laboratory technologists and housekeeping staff agree on it (*P*=0.709).

Table 2: Attitude of healthcare workers regarding BMW management

Attitude on BMW Management	Doctors (n=23) (%)	Nurses (n=43) (%)	Laboratory Technologists (n=16) (%)	Pharmacists (n=4) (%)	Medical Orderlies (n=10) (%)	Housekeeping Staff (n=8) (%)	Total (n=104)	P-Value
Segregation of waste at the source increases the risk of injury to waste holders.	12 (52%)	27 (63%)	6 (38%)	4 (100%)	7 (67%)	4 (50%)	65 (63%)	0.366
Occupational safety while handling the waste is a must.	22 (96%)	42 (98%)	16 (100%)	4 (100%)	10 (100%)	8 (100%)	102 (98%)	0.119
Reporting of needle stick injury is an extra burden on work?	7 (30%)	11 (26%)	7 (44%)	4 (100%)	6 (61%)	2 (25%)	37 (36%)	**0.004**
Biomedical waste management is a team work	22 (97%)	42 (98%)	16 (100%)	4 (100%)	8 (78%)	8 (100%)	100 (96%)	0.000
Use of color code for segregation of waste is a must.	23 (100%)	42 (98%)	16 (100%)	4 (100%)	10 (100%)	8 (100%)	103 (99%)	0.178
Post-exposure prophylaxis should be initiated as soon as possible.	23 (100%)	42 (98%)	16 (100%)	4 (100%)	9 (94%)	7 (88%)	101 (97%)	0.101
Reporting to concern authorities, if center is not complying with the guidelines of biomedical waste management.	23 (100%)	39 (90%)	14 (88%)	4 (100%)	10 (100%)	7 (88%)	97 (93%)	0.709

PRACTICE ITEM

Table 3 shows various practices of health personnel on BMW Management. Hundred percent (100%) of pharmacists, laboratory technologists, medical orderlies and housekeeping staffsegregate waste into different categories at the point of origin, while 97% of doctors and nurses agree on that statement (P=0.618). More than 77% of doctors, 75% of pharmacists and housekeeping staff agree that sharp waste to be treated prior to disposal, while 63% of nurses, 50% of laboratory technologists and 44% of medical orderlies agree on it (P=0.598). All laboratory technologists, pharmacists and housekeeping staffdispose infectious waste in yellow colored plastic bags with biohazard symbol, while 98% of nurses, 97% of doctors and 89% of medical orderlies dispose infectious waste in yellow colored plastic bags with biohazard symbol(P=0.065).

Only, hundred percent (100%) of pharmacists use heavy duty (puncture proof) plastic container to collect the waste sharps and 94% of laboratory technologists, 88% of housekeeping, 84% of nursing and 83% of doctors and medical orderlies use it (P=0.153).Hundred percent (100%) of doctors, laboratory technologists, pharmacists and medical orderlies use personal protective devices (gloves) while handling biomedical waste, while 94% of nurses and 88% of housekeeping staff do so (P=0.040).All nurses, laboratory technologist,pharmacists and housekeeping staffin this study follow the system of recording and reporting injuries/accidents, while 94% of doctors and medical orderlies follow the same system for reporting (P=0.065).

Significantly, Hundred percent (100%) of doctors, laboratory technologists, pharmacists and housekeeping stafffollow the color coding for segregation of waste, while 98% of nurses and 89% of medical orderlies follow the color coding (P=0.002).Hundred percent (100%)of doctors andlaboratory technologists. This was significantly higher than other professions, like;98% of nurses, 78% of medical orderliesand 75% of pharmacists and housekeeping staff were found to be vaccinated against hepatitis B in our study(P=0.001). 100% of pharmacists and medical orderlies follow post exposure prophylaxis for per-cutaneous exposure, while, 94% of doctors and nurses, 88% of laboratory technologists and housekeeping staff follow the same(P=0.843).

Table 3: Practice of healthcare workers regarding BMW management

Practice on BMW management	Doctors (n=23) (%)	Nurses (n=43) (%)	Laboratory Technologists (n=16) (%)	Pharmacists (n=4) (%)	Medical Orderlies (n=10) (%)	Housekeeping Staff (n=8) (%)	Total (n=10)	P-Value
Segregate waste into different categories at the point of origin.	22 (97%)	41 (97%)	16 (100%)	4 (100%)	10 (100%)	8 (100%)	101 (97%)	0.618
Treat sharp waste prior to disposal.	17 (77%)	27 (63%)	8 (50%)	3 (75%)	4 (44%)	6 (75%)	65 (63%)	0.598
Dispose infectious waste in yellow colored plastic bags with biohazard symbol.	22 (97%)	42 (98%)	16 (100%)	4 (100%)	9 (89%)	8 (100%)	101 (97%)	0.065
Undergone training/lectures for biomedical waste management.	7 (31%)	27 (63%)	12 (75%)	3 (75%)	1 (11%)	7 (88%)	57 (55%)	**0.002**
Use heavy duty (puncture proof) plastic container to collect the waste sharps.	19 (83%)	36 (84%)	15 (94%)	4 (100%)	8 (83%)	7 (88%)	89 (86%)	0.153
Use personal protective devices (gloves) while handling biomedical waste.	23 (100%)	40 (94%)	16 (100%)	4 (100%)	10 (100%)	7 (88%)	100 (96%)	0.040
Follow the system of recording and reporting injuries/accidents.	22 (94%)	43 (100%)	16 (100%)	4 (100%)	9 (94%)	8 (100%)	102 (98%)	0.065
Follow the color coding for segregation of waste.	23 (100%)	42 (98%)	16 (100%)	4 (100%)	9 (89%)	8 (100%)	102 (98%)	**0.002**
Taken vaccination against hepatitis B.	23 (100%)	42 (98%)	16 (100%)	3 (75%)	8 (78%)	6 (75%)	98 (94%)	**0.001**
Following per-cutaneous exposure, do you follow post exposure prophylaxis.	22 (94%)	40 (94%)	14 (88%)	4 (100%)	10 (100%)	7 (88%)	97 (93%)	0.843

DISCUSSION

Most of questions regarding knowledge about BMW management answered by (91%) to (100%) for question about diseases transmitted, if managed BMW improperly. These high percentages may because of audit program which is conducted annually by DGHS for Buraimi Governorate for infection control and occupational health scopes. Also, the effective role of infection control focal points in healthcare institutions has a major role in developing the knowledge of healthcare professionals.Only, (71%) of health professionals answered that they have knowledge about BMW management rules and legalization. This was the lowest percentage of answers about knowledge about BMW management. This could be due to less awareness of healthcare professionals about the policies and guidelines which are includes all information about rules and legalization of BMW management in Ministry of Health.Ninety six percent (96%) of doctors correctly answered different questions about knowledge about BMW management, which is of the highest percentage among all healthcare professionals participated in this study.This finding was same as in a study done by Anand et al[20], where doctors got (91%) for answered correctly different questions about knowledge about BMW management.In the current study it was observed that knowledge about universal precautionswas significantly lower among pharmacist and housekeeping staffs than nurses, laboratory technicians and doctors. On the otherhand, it was significantly high about discarding needles for professional categories in this study, which a very important when dealing with biomedical wastes.

Attitude of all healthcare professionals towards BMW management was found to be positive in our study. It was consistentwith the findings of Tenglikar et al[21]where they found thatattitude of an individual towards any health behavior was directly proportional to knowledge level of thatindividual.Similar findings were seen in study by Singh et al[22].Majority of healthcare professionalsrealized that BMW managementis a team work and it did not create extra burden on theirwork as seen in study by Malini et al[23]. Forty nine percent (49%) of healthcare professionals participated in this study considered that reporting of needle stick injury is an extra burden on work and this was significantly a low score for such an important attitude. This may be due to the reporting in new electronic system for incidents and also filling up of needle stick injury forms for follow up of laboratory tests every month, which they consider it as double work. This consideration may result in future in under reporting of needle stick injuries by healthcare professionals.

Rational practices regarding BMW management werefollowed by most of healthcare professionals participated in this study on many occasions. Previous study by Malini et alreported that healthcare professionals practiced BMW managementbetter according to the rules [23]. Also, Malini et alestablished that majority of qualified health

professionalsfollowed appropriate BMW management practices.Maximum number of health staff followed properdisposal of BMW in specific containers similar to aprevious study[24]. Significantly, only 50% healthcare professionals participated in this study undergone training/lectures for biomedical waste management. Attending of training courses or lectures for BMW management may affect positively on healthcare professionals practices regarding BMW management. Also, significantly 98% of participated healthcare professional in this study follow the color coding for segregation of waste. This is very important to segregate waste easily while discarding after use.

The current study may comprise*"volunteer bias",* where some participants who had higherknowledge, attitude andpractices may have greater response in difference to those who have lower knowledge, attitude and practices. Due to*"social desirability bias",* possibly the participantsmay not state the fact particularly to the questions onattitude and practice. To minimize the *"social desirability bias"* and as well as *"non-response"* all participants areguaranteed for their anonymity and confidentiality of reports. Also, the study may have *"recall bias"* which theparticipants had to recall past knowledge to response the questions. Additionally, to decrease the "recall bias" astratified random sampling was selected to conduct the study. It was also observed that the lengthy questionnaire andbusy schedules could be source of bias for study.

CONCLUSION

Present study revealed that although most of healthcare professionals had overall good knowledge there were still some scope of improvement in BMW management. Guidelines should be laid down for continuous training program for all health professionals. BMW management rules should be strictly implemented at all levels. A formal injury reporting system due to sharps should be reported in all health care facilities, so that no injury is missed. Furthermore, to find a strategy to increase the number of health professionals who received hepatitis B vaccination, which an important to prevent healthcare professionals from getting hepatitis B infection.

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