Knowledge, Attitude And Practices Regarding Management Of Biomedical Waste Among House Officer And Nursing Staff In Teaching Hospitals Of District South, Karachi

Asadullah[1], Nazia Jameel[2], Syed Imtiaz Ahmed Jafery[3], Syed Muhammad Zulfiqar Ahmed Naqvi[4], Farhat Jahan[5]

Abstract

Objective: To determine the knowledge, attitude and practices regarding management of biomedical waste among the house officers and nursing staff in teaching hospitals of District South, Karachi.

Methods: A cross sectional knowledge, attitude and practice survey was conducted from November 2018 to April 2019 among the house officer and the nursing staff working at different teaching hospitals of District South, Karachi. A total of 196 house officers and staff nurses were included in the study after checking their eligibility. A structured questionnaire was used by the principal investigator to interview the study participants. SPSS version 20 was used for data entry with chi-square test applied for inferential analysis. A p-value <0.05 was considered statistically significant.

Results: The mean age of the participants was 23.13 ± 10.28 years whereas 116 (59.2%) of them were females. The study results showed that only 59.2% (n= 58) of the house officers and 54.1% (n= 53) of the nursing staff disposed of biomedical waste in specified color coded containers whereas only 51.0% (n= 50) of the house officers and 45.9% (n= 45) of the nursing staff segregated the biomedical waste according to different categories. Moreover, 139 (70.9%) participants had adequate knowledge, 171 (87.2%) participants had adequate attitude whereas 127 (64.8%) participants had adequate practices regarding biomedical waste management Furthermore, only the age of the study participants was significantly associated with the knowledge level (p=0.020) whereas none of the participant characteristics were found to be significantly associated with their attitude and practices.

Conclusion: It was found that a majority of study participants had adequate knowledge, attitude and practices regarding biomedical waste management. Moreover, their age was found to be significantly associated with their knowledge level though none of their characteristics were found to be significantly associated with their attitude and practices.

Key words: Knowledge, Attitude, Medical Waste, Health Personnel, Hospitals

IRB: Approved by the Institutional Review Board of Baqai Institute of Health Sciences. Ref# FHM 268-2019/ MPH student/ Batch 26. Dated: 21st January 2019.

Citation: Asadullah, Jameel N, Jafery SIA, Naqvi SMZA, Jahan F. Knowledge, Attitude And Practices Regarding Management Of Biomedical Waste Among House Officer And Nursing Staff In Teaching Hospitals Of District South, Karachi [Online]. Annals ASH & KMDC 2023;28

(ASH & KMDC 28(2):104;2023)

Introduction

Healthcare waste contains potentially harmful microorganisms that can infect hospitalized patients, healthcare workers as well as the general public. The World Health Organization has classified biomedical waste into eight categories; General Waste, Pathological, Radioactive, Chemical, Infectious to potentially infectious waste, Sharps, Pharmaceuticals and Pressurized containers etc[1].

Major sources of biomedical waste include hospitals, nursing homes, dispensaries, primary healthcare centers, research centers, veterinary institutions, blood banks and mortuaries while minor sources include physicians' or dentists' clinics, slaughter houses, blood donation sites, vaccination centers, acupuncturists, psychiatric clinics, cosmetic piercing, funeral services and institutions for disabled persons[2].

The generation of hospital wastes has increased remarkably in recent years due to an increase in the population, the healthcare facilities

[1,5] Department of Pharmacology, Shaheed Mohtarma Benazir Bhutto Medical College
[2,3,4] Department of Community Medicine, Baqai Medical University

Correspondence: Dr. Asadullah
Department of Pharmacology, Shaheed Mohtarma Benazir Bhutto Medical College
Email: drasadali361@gmail.com
Date of Submission: 19th February 2020
Date of Acceptance: 15th May 2023

and the use of disposable medical products[3]. According to a recent review, developing countries in Asia are mostly densely populated, and usually resource constrained. As a result, they fail to appropriately practice healthcare waste management. Moreover, lack of proper waste segregation, collection, safe storage, transportation, and disposal is common in health facilities of these countries[4]. Moreover, in developing countries, management of biomedical wastes has become one of the major problems due to increase in the use of disposable goods. These countries have to deal with problems of inappropriate segregation and disposal of hazardous biomedical waste[5]. In majority of such countries, hazardous wastes are dumped into municipal camps and roads or incinerated openly[6]. A recent review from Pakistan reported repacking of used hospital plastic items, their open dumping on land, and their disposal in the ocean[7]. Improper handling of medical waste has been shown to have wearing effects on the environment, including water quality and risk of spreading diseases[8].

In Pakistan, each hospital essentially acts in accordance with the Waste Management Rules, 2005. Furthermore, it is required to make sure its level of service and waste management system is according to international standards[9]. It is therefore very important to appropriately collect, separate, store, transport, treat and dispose of biomedical waste to prevent nosocomial or hospital acquired infections[2].

Inadequate and inappropriate information of handling of biomedical waste has serious health consequences and a significant effect on the environment as well. A recent research from Myanmar reported that even though basic awareness of healthcare staff about the risk and safe handling of medical waste was good, the dissemination of guidelines and monitoring of compliance were major issues[10]. Lack of such knowledge can lead to improper attitude and inappropriate practices that can result in hospitals becoming a hub of spreading disease rather than working towards eliminating them. House officers and nursing staff are very important components of healthcare system so they should have adequate knowledge, attitude and practices of biomedical waste management. Subsequently their awareness in relation to different aspects of biomedical waste management should be assessed regularly[11]. This study therefore focused on the knowledge, attitude and practices regarding management of bio-medical waste among House officer and nursing staff worki-ng in teaching hospitals of District South, Karachi.

Materials and Methods

A cross sectional knowledge, attitude and practice survey was conducted from November 2018 to April 2019 among the house officer and the nursing staff working at teaching hospitals of District South, Karachi. Taking the percentage frequency of the study outcome as 50% for most liberal estimate, with 95% confidence interval and 7% precision, the minimum required sample size was calculated to be 196 participants. After checking their eligibility and taking their written inform consent, a total of 196 house officers and staff nurses, 98 each, were selected using simple random sampling. House officers and nursing staff of the teaching hospitals were included in the study whereas those unwilling to provide verbal informed consent were excluded from the study.

The principal investigator interviewed the participants with the help of the study questionnaire. It was pre-tested on 5% of the sample size, analyzed for reliability and modified accordingly to yield a Cronbach's alpha value of 0.703. The questionnaire contained five questions about demographic characteristics as well as seven questions about knowledge and six questions each about attitude and practices of the house officers and the nursing staff regarding management of healthcare waste. It was given to the participants and taken back once they had filled it.

At the completion of the data collection, all the responses of the house officers and the nursing staff were coded by giving the value of 1 to a correct response and a value of 0 to an incorrect response. By adding the scores of each participant, total knowledge, attitude and practice scores

were calculated. Participants who correctly responded 70% of the respective questions were categorized as having adequate knowledge, attitude and practices regarding biomedical waste management.

Data were entered and analyzed on SPSS version 20. In descriptive analysis, frequencies and percentages for categorical variables while means and standard derivations for continuous variables were calculated. Chi-square test was applied for inferential analysis and a p-value <0.05 was considered statistically significant.

Results

A total of 196 participants were included in the study whereas the response rate was 100%. The study findings revealed that the mean age of the participants was 23.13 ± 10.28 years, 116 (59.2%) of them were less than 30 years old, 116 (59.2%) of them were females, 144 (73.5%) of them had monthly income between 25,000 to 75,000 rupees whereas 140 (71.4%) of them had up to one year experience.

The study results further showed that 82.7% (n= 81) of the house officers and 92.9% (n= 91) of the nursing staff were aware of the term biomedical waste, 79.9% (n= 78) of the house officers and 89.8% (n= 88) of the nursing staff were aware that all biomedical wastes are hazardous, 90.8% (n= 89) of the house officers and 96.9% (n= 95) of the nursing staff were aware that biomedical waste can transmit infectious diseases like HIV/Hepatitis, 99.0% (n= 97) of the house officers and 96.9% (n= 95) of the nursing staff were aware that needle-stick injury should be a cause of concern, 75.5% (n= 74) of the house officers and 82.7% (n= 81) of the nursing staff were aware that biomedical waste should not be stored for more than 48 hours, 72.4% (n= 71) of the house officers and 85.7% (n=84) of the nursing staff were aware about the biomedical waste management process whereas 72.4% (n= 71) of the house officers and 62.2% (n= 61) of the nursing staff were aware about the color coding of biomedical waste containers; 96.9% (n=95) of the house officers and 92.9% (n= 91) of the nursing staff though that biomedical waste management rules are necessary, 96.9% (n= 95) of the house officers and 99.0% (n= 97) of the nursing staff thought that biomedical waste management is compulsory for health care delivery, 89.8% (n= 88) of the house officers and 73.5% (n= 72) of the nursing staff thought that labeling the container before filling it with waste is important, 90.8% (n= 89) of the house officers and 81.6% (n= 80) of the nursing staff thought that use of color coded containers for biomedical waste disposal is important, 98.0% (n= 96) of the house officers and 98.0% (n= 96) of the nursing staff thought that wearing personal protective equipment is necessary whereas 99.0% (n= 97) of the house officers and 94.9% (n= 93) of the nursing staff were of the opinion that biomedical waste management is a team work; 86.7% (n= 85) of the house officers and 95.9% (n= 94) of the nursing staff recapped the used needle before disposal, 96.9% (n= 95) of the house officers and 100% (n= 98) of the nursing staff discarded the used needle immediately, 89. 8% (n= 88) of the house officers and 91.8% (n= 90) of the nursing staff disposed of sharps in puncture proof bags and containers, 93.9% (n= 92) of the house officers and 100% (n= 98) of the nursing staff washed hands before and after handling biomedical waste, 59.2% (n= 58) of the house officers and 54.1% (n= 53) of the nursing staff disposed of biomedical waste in specified color coded containers whereas 51.0% (n= 50) of the house officers and 45.9% (n= 45) of the nursing staff segregated the biomedical waste according to different categories (table 1).

Table 1. Correct responses of Knowledge, Attitude and Practice related questions by House Officers and Nurses

Knowledge, Attitude and Practice Assessment	House Officers n (%)	Nurses n (%)
Are you aware of the term 'biomedical waste'?	81 (82.7)	91 (92.9)
Are all biomedical wastes hazardous?	78 (79.6)	88 (89.8)
Can biomedical waste transmit infectious diseases like HIV/Hepatitis?	89 (90.8)	95 (96.9)
Should needle-stick injury be a cause of concern?	97 (99.0)	95 (96.9)
Biomedical waste should not be stored for more than 48 hours?	74 (75.5)	81 (82.7)
Do you know about biomedical waste management process?	71 (72.4)	84 (85.7)
Are you aware of color coding of biomedical waste containers?	71 (72.4)	61 (62.2)
Is there any necessity of biomedical waste management rules?	95 (96.9)	91 (92.9)
Biomedical waste management is compulsory for health care delivery?	95 (96.9)	97 (99.0)
Labeling the container before filling it with waste is important?	88 (89.8)	72 (73.5)
Use of color coded containers for biomedical waste disposal is important?	89 (90.8)	80 (81.6)
Wearing personal protective equipment is necessary?	96 (98.0)	96 (98.0)
Biomedical waste management is a team work?	97 (99.0)	93 (94.9)
Do you recap the used needle before disposal?	85 (86.7)	94 (95.9)
Do you discard the used needle immediately?	95 (96.9)	98 (100)
Do you dispose of sharps in puncture proof bags and containers?	88 (89.8)	90 (91.8)
Do you wash hands before and after handling biomedical waste?	92 (93.9)	98 (100)
Do you dispose of biomedical waste in specified color coded containers?	58 (59.2)	53 (54.1)
Do you segregate the biomedical waste according to different categories?	50 (51.0)	45 (45.9)

The study results also showed that 139 (70.9%) participants had adequate knowledge, 171 (87.2%) participants had adequate attitude whereas 127 (64.8%) participants had adequate practices regarding biomedical waste management (figure 1).

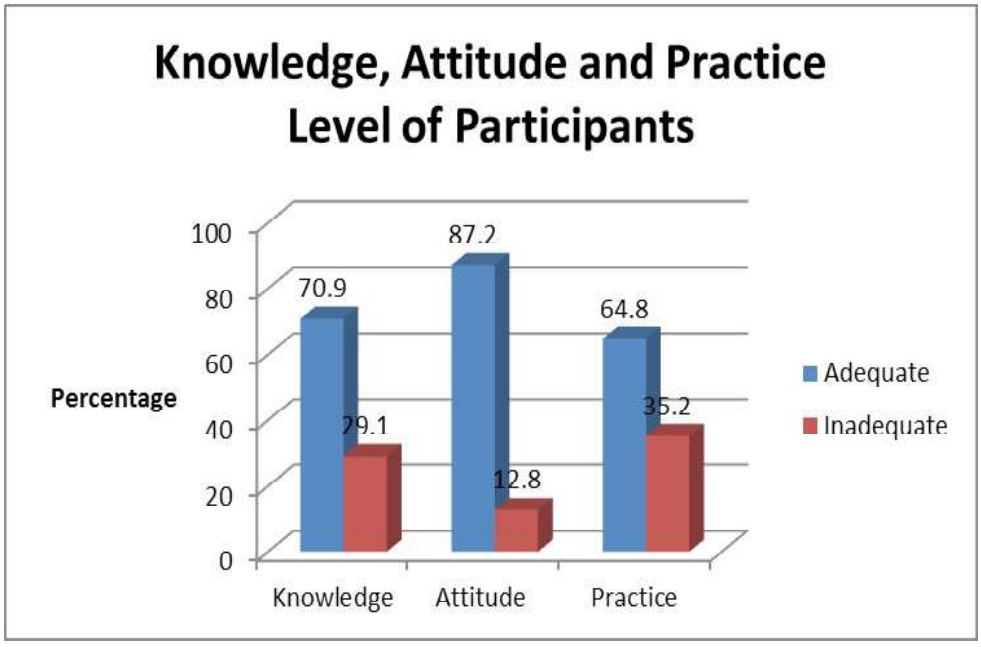

Fig 1. Knowledge, Attitude and Practice Level of Participants

While checking associations between participant characteristics and their knowledge, attitude and practice level it was found that only their age was significantly associated with their knowledge level (p=0.020) where the participants who were aged 30 years or more were more likely to have adequate knowledge than those who were less than 30 years old (80.0% vs. 64.7%) whereas none of the participant characteristics were found to be significantly associated with their attitude and practices (table 2).

Table 2. Association of Participant Characteristics with their Knowledge, Attitude and Practice Level

Participant Characteristics (n=196)	Knowledge		p	Attitude		p	Practice		p
	Adequate n (%)	Inadequate n (%)		Adequate n (%)	Inadequate n (%)		Adequate n (%)	Inadequate n (%)	
Age									
Less than 30 Years	75 (64.7)	41 (35.3)	0.02	104 (89.7)	12 (10.3)	0.223	79 (68.1)	37 (31.9)	0.243
30 Years or More	64 (80.0)	16 (20.0)		67 (83.8)	13 (16.2)		48 (60.0)	32 (40.0)	
Gender									
Male	55 (68.8)	25 (31.2)	0.579	67 (83.8)	13 (16.2)	0.223	52 (65.0)	28 (35.0)	0.96
Female	84 (72.4)	32 (27.6)		104 (89.7)	12 (10.3)		75 (64.7)	41 (35.3)	
Monthly Income									
Less than 25000 Rs.	10 (55.6)	8 (44.4)	0.273	15 (83.3)	3 (16.7)	0.243	11 (61.1)	7 (38.9)	0.426
26000 to 75000 Rs.	103 (71.5)	41 (28.5)		129 (89.6)	15 (10.4)		97 (67.4)	47 (32.6)	
More than 75000 Rs.	26 (76.5)	8 (23.5)		27 (79.4)	7 (20.6)		19 (55.9)	15 (44.1)	
Profession									
House Officer	65 (66.3)	33 (33.7)	0.157	90 (91.8)	8 (8.2)	0.054	68 (69.4)	30 (30.6)	0.178
Nurse	74 (75.5)	24 (24.5)		81 (82.7)	17 (17.3)		59 (60.2)	39 (39.8)	
Experience									
Up to 1 Year	96 (68.6)	44 (31.4)	0.253	126 (90.0)	14 (10.0)	0.068	95 (67.9)	45 (32.1)	0.156
More than 1 Year	43 (76.8)	13 (23.2)		45 (80.4)	11 (19.6)		32 (57.1)	24 (42.9)	

Discussion

This study was an effort to investigate the knowledge, attitude and practices of house officers and nursing staff regarding biomedical waste management.

The study findings revealed that 79.6% of the house officers and 89.8% of the nurses were aware that all biomedical waste is hazardous. Likewise, Gupta NK et al., in 2016 reported that 100% of medical officers and 95.0% of staff nurses had knowledge regarding hazards of biomedical waste[12]. Such a finding showed that the level of knowledge about hazards of biomedical waste is good among healthcare workers.

Furthermore, 99.0% of the house officers and 96.9% of the nurses knew that needle-stick injury should be a cause of concern. Similarly, Deress T et al., in 2018 reported that 100% of doctors and 90.2% of nurses were concerned about needle-stick injuries[13]. Such a finding was very significant as it showed that almost all of the healthcare workers interviewed were aware of the dangers of needle stick injuries and therefore can be reasonably expected to take the precautionary measures against them.

Moreover, 72.4% of the house officers and 62%. 2% of the nurses were aware of the color coding of waste containers. Gupta NK et al., in 2016 though reported that 53.3% of medical officers and 35% of staff nurses were aware about color-coding of waste containers[12]. Moreover, Parida A et al., in 2019 reported that 82% of the healthcare workers knew about the different color-coded bins used for waste segregation[14]. Likewise, Nosheen F et al., in 2022 reported 71.6% of healthcare professionals to have such knowledge[15]. These findings show that with the passage of time, the knowledge of healthcare workers about the color coding of waste containers is increasing.

The study findings further revealed that 96.9% of the house officers and 92.9% of the nurses were of the opinion that biomedical waste management rules are necessary. Similarly, Gupta NK et al., in 2016 reported that 93% of medical officers and 55.0% of staff nurses had knowledge regarding biomedical waste generation and legislation[12]. Encouragingly, this finding shows that the nurses in this study had considerably better attitude about biomedical waste management rules than previously reported.

Moreover, 96.9% of the house officers and 99.0% of the nurses were of the opinion that biomedical waste management is compulsory for health care delivery. Gupta NK et al., in 2016 also reported that almost all healthcare workers were concerned about management of biomedical waste properly[12].

The study result also showed that 96.9% of the house officers and 100% of the nurses discarded the used needles immediately. Gupta NK et al., in 2016 reported that more than 80% of all health care personnel interviewed were aware about discarding used needles immediately[12]. Used needles, if not immediately discarded, can easily become a source of infection transmission among healthcare workers.

They study results further showed that only 51.0% of the house officers and 45.9% of the nurses segregated the biomedical waste according to different categories. Similarly, Odonkor ST & Mahami T in 2020 reported only 47.5% of the respondents to practice waste segregation at the sources of generation[16]. This finding shows that waste segregation is among the most neglected component of biomedical waste management practices and therefore requires special attention.

The study results showed that 87.2% of the participants had adequate attitude towards biomedical waste management. Likewise, Olaifa A et al., in 2018 reported over half of the healthcare workers interviewed to have a good attitude towards the appropriate disposal of healthcare waste[17].

The study results further showed that 64.8% participants had adequate practices regarding biomedical waste management. Likewise, Assemu DM et al., in 2020 reported 65% of the total respondents to have good practice of healthcare waste management[18]. Similarly, Wafula ST et al., in 2019 also reported 74.0% of the healthcare workers interviewed to have satisfactory healthcare waste management practices[19]. Literature recommends involvement of healthcare workers in development of medical waste management policies to enhance compliance[20].

The study result showed that older healthcare workers were more likely to have adequate knowledge regarding biomedical waste management than those who were younger. Unlike the study results though, Doylo T et al., in 2019 reported younger healthcare worker to have better knowledge than those who were older[21]. As they get older, healthcare workers can be reasonably expected to gain more knowledge with their increasing experience.

Moreover, gender of the participants was not found to be significantly associated with their knowledge of biomedical waste management. Similarly, Doylo T et al., in 2019 did not find gender of the respondents to be significantly associated with their knowledge of biomedical waste management[21].

The study results did not show age or gender of the participants to be significantly associated with their biomedical waste management practices. Likewise, Doylo T et al., in 2019 did not find age or gender of the respondents to be significantly associated with their practices of biomedical waste management[21].

The study result did not show association of profession of healthcare workers with their knowledge, attitude or practices regarding biomedical waste management. Unlike the study results though, Al Balushi AY et al., in 2018 reported nurses to have better knowledge, attitude and practices than doctors, housekeeping staff and laboratory technicians regarding biomedical waste management[22]. Moreover, Rao D et al., in 2018 reported that doctors had better knowledge while nurses and laboratory technicians had better practices regarding biomedical waste management[23]. The knowledge and practice of healthcare workers regarding biomedical waste management can be expected to differ on the basis of their profession due to obvious dissimilarities in their respective curriculums.

Furthermore, duration of experience of the participants was not found to be significantly associated with their practices of biomedical waste management. Unlike the study results though, Akkajit P

et al., in 2020 showed the duration of experience to be a significant factor influencing medical waste management practice[24]. It can be reasonably expected that healthcare workers with greater working experience should be more familiar with recommended biomedical waste management practices.

This study had certain limitations. Firstly, being a cross-sectional study, the results may suffer from limitation in recall, an inherent weakness of a cross-sectional study design. Secondly, due to a moderate sample size, it is acknowledged that the generalizability of study findings is limited.

In light of study findings, it is recommended that house officers and nursing staff should be made aware of biomedical waste management related knowledge, so that their attitude and practices could improve. This in turn will enable them to segregate and dispose of biomedical waste in a safe manner in order to protect themselves, the people at risk as well as their environment.

Conclusion

It was found that a majority of study participants had adequate knowledge, attitude and practices regarding biomedical waste management. Moreover, only their age was found to be significantly associated with their knowledge whereas none of their characteristics were significantly associated with their attitude and practices.

Conflict of Interest

Authors have no conflict o interest and no grant or funding from any organization.

References

1. Health-care Waste: World Health Organization. Available from: https://www.who.int/en/news-room/fact-sheets/detail/health-care-waste.Accessesd 24th February, 2023.
2. Mathur P, Patan S, Shobhawat AS. Need of biomedical waste management system in hospitals-An emerging issue-a review. Curr World Environ. 2012;7(1):117.[DOI:10.12944/CWE.7.1.18]. Availablefrom: http://www.cwejournal.org/vol7no1/need-of-biomedical-waste-management-system-in-hospitals-an-emerging-issue-a-review. Accessed on 5th May 2023.
3. Zafar S. Medical waste management in developing countries. Available from: https://www.vivis.de/wp-content/uploads/WM9/2019_WM_351-358_Zafar.pdf Accessesd 24th February, 2023.
4. Khan BA, Cheng L, Khan AA, Ahmed H. Healthcare waste management in Asian developing countries: A mini review. Waste Manag Res. 2019;37(9):863-75.[DOI:10.1177/0734242X19857470]. Available from: https://journals.sagepu .com/doi/10.1177/0734242X19857470?url_ver= Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed. Accessed on 5th May 2023.
5. Manasi S, Umamani KS, Latha N. Biomedical Waste Management: Issues and Concerns-a Ward-level Study of Bangalore City. Institute for Social and Economic Change; 2014. Available from:http://www.isec.ac.in/WP%20312%20-%20Manasi,%20Umamani%20and%20Latha_Final.pdf. Accessed on 5th May 2023.
6. Ghura AS, Kutty CS. Bio Medical Waste A Corporate Responsibility Dilemma in INDIA. National Solid Waste Association of India. 2016. Available from: https://www.nswai.org/docs/Bio%20Med ical %20 Waste %20A %20 Corporate %20 Responsibility%20Dilemma%20in%20INDIA.pdf. Accessed on 5th May 2023.
7. Gill YQ, Khurshid M, Abid U, Ijaz MW. Review of hospital plastic waste management strategies for Pakistan. Environ Sci Pollut Res Int. 2022;29(7):9408.[DOI:10.1007/s11356-021-17731-9]. Availablefrom:https://link.springer.com/article/10.1007/s11356-021-17731-9. Accessed on 5th May 2023.
8. Chisholm JM, Zamani R, Negm AM, Said N, Dibaj M, Akrami M. Sustainable waste management of medical waste in African developing countries: A narrative review. Waste Manage Res. 2021;39(9):1149.[DOI: 10.1177/0734242X211029175]. Available from: https://journals.sagepub.com/doi/full/10. 1177/0734242X211029175. Accessed on 5th May 2023.
9. Arshad N, Nayyar S, Amin F, Mahmood KT. Hospital waste disposal: A review article. J Pharm Sci Res. 2011;3(8):1412. Available from: https://www.jpsr.pharmainfo.in/Documents/Volumes/Vol3Issue08/jpsr%2003110809.pdf. Accessed on 5th May 2023.
10. Aung TS, Luan S, Xu Q. Application of multi-criteria-decision approach for the analysis of medical waste management systems in Myanmar. J Clean Prod. 2019;222:733-45. [DOI: 10.1016/j.jclepro.2019.03.049]. Available from: https://www. sciencedirect.com/science/article/abs/pii/S0959652619307383. Accessed on 5th May 2023.
11. Ajai S, Nath SR. Knowledge, attitude and practices of biomedical waste management amongst staff of institutional trauma center level II.Int J Res Health Sci. 2013;1(2):62-8. Available from:

https://ijrhs.org/article/2015/3/4-10. Accessed on 5th May 2023.

12. Gupta NK, Shukla M, Tyagi S. Knowledge, attitude and practices of biomedical waste management among health care personnel in selected primary health care centers in Lucknow. Int J Community Med Public Health. 2016 Jan;3(1):309. [DOI: 10.18 203/2394-6040.ijcmph20151582]. Available from: https://ijcmph.com/index.php/ijcmph/article/view/ 697. Accessed on 5th May 2023.

13. Deress T, Hassen F, Adane K, Tsegaye A. Assessment of Knowledge, Attitude, and Practice about Biomedical Waste Management and Associated Factors among the Healthcare Professionals at Debre Markos Town Healthcare Facilities, Northwest Ethiopia. J Environ Public Health. 2018 Oct 2;2018:7672981. [DOI:10.1155/2018/76 72981]. Available from: https://www.hindawi.co m/ journals/jeph/2018/7672981/. Accessed on 5th May 2023.

14. Parida A, Capoor MR, Bhowmik KT. Knowledge, attitude, and practices of Bio-medical Waste Management rules, 2016; Bio-medical Waste Management (amendment) rules, 2018; and Solid Waste Rules, 2016, among health-care workers in a tertiary care setup. J Lab Physicians. 2019; 11(4):292-9. [DOI: 10.4103/JLP.JLP_88_19]. Available from: https://www.ncbi.nlm.nih.gov/pmc/artic les/PMC6943866/. Accessed on 5th May 2023.

15. Nosheen F, Malik N, Mehmood Z, Jabeen F, Mahmood A, Ibrahim M, et al. Biomedical waste management associated with infectious diseases among health care professionals in apex hospitals of a typical south Asian city. Environ Res. 2022;215(Pt 2):114240. [DOI:10.1016/j.envres.20 22.114240]. Available from: https://www.scien cedi rect.com/science/article/abs/pii/S001393512201 5675?via%3Dihub. Accessed on 5th May 2023.

16. Odonkor ST, Mahami T. Healthcare waste management in Ghanaian hospitals: Associated public health and environmental challenges. Waste Manag Res. 2020;1:9. [DOI:10.1177/0734 242 X2 0914748]. Available from:https://journals.sage pub. com/doi/10.1177/0734242X20914748 ?url_ ver=Z3 9.88-2003&rfr_id=ori:rid:crossref.org &rfr_da t= cr_ pub%20%200pubmed. Accessed on 5th May 2023.

17. Olaifa A, Govender RD, Ross AJ. Knowledge, attitudes and practices of healthcare workers about healthcare waste management at a district hospital in KwaZulu-Natal. S Afr Fam Pract. 2018; 60(5): 137-45.[DOI:10.1080/20786190.2018.1432137]. Available from: https://www.tandfonline.com/doi/full /10.1080/20786190.2018.1432137. Accessed on 5th May 2023.

18. Assemu DM, Tafere TE, Gelaw YM, Bantie GM. Healthcare Waste Management Practice and Associated Factors among Private and Public Hospitals of Bahir Dar City Administration. J Environ Public Health. 2020 Oct 22;2020:7837564-. [DOI: 10.1155/2020/7837564]. Available from: https:// www.hindawi.com/journals/jeph/2020/7837564/. Accessed on 5th May 2023.

19. Wafula ST, Musiime J, Oporia F. Health care waste management among health workers and associated factors in primary health care facilities in Kampala City, Uganda: a cross-sectional study. BMC Public Health. 2019 Dec;19:1-0. [DOI:10.1 186/s12889-019-6528-4]. Available from: htt ps://b mcpublichealth.biomedcentral.com/articles/10.11 86/s12889-019-6528-4. Accessed on 5th May 2023

20. Mugabi B, Hattingh S, Chima SC. Assessing knowledge, attitudes, and practices of healthcare workers regarding medical waste management at a tertiary hospital in Botswana: A cross-sectional quantitative study. Nigerian J Clin Pract. 2018 Dec 1;21(12):1627-38. [DOI: 10.4103/njcp.njc p_270_ 17]. Available from: https://pubmed.ncbi.nlm.nih. gov/30560828/. Accessed on 5th May 2023.

21. Doylo T, Alemayehu T, Baraki N. Knowledge and Practice of Health Workers about Healthcare Waste Management in Public Health Facilities in Eastern Ethiopia. J Community Health. 2019 Apr;44(2):284-91.[DOI:10.1007/s10900-018-058 4-z.]. Available from: https://link.springer.com/article/ 10.1007/s10900-018-0584-z. Accessed on 5th May 2023.

22 Al Balushi AY, Ullah M, Makhamri A, Alalawi F, Khalid M, Alghafri H. Knowledge, attitude and practice of biomedical waste management among health care personnel in a secondary care hospital of Al Buraimi Governorate, Sultanate of Oman. Glob J Health Sci. 2018;10(3):70. [DOI:10 .5539/gjhs.v10n3p70]. Available from: https://ww w.ccsenet.org/journal/index.php/gjhs/article/view/ 72561. Accessed on 5th May 2023.

23. Rao D, Dhakshaini MR, Kurthukoti A, Doddawad VG. Biomedical Waste Management: A Study on Assessment of Knowledge, Attitude and Practices among Health Care Professionals in a Tertiary Care Teaching Hospital. Biomed Pharmacol J. 2018;11(3):1737-43. [DOI:10.13005/bpj/1543]. Av ailable from: https://biomedpharmajournal.org/vol 11no3/biomedical-waste-management-a-stud y-on -assessment-of-knowledge-attitude-and-prac-tices-amo ng- health-care-professionals-in-a- terti ary-care-teaching-hospital-2/. Accessed on 5th May 2023.

24. Akkajit P, Romin H, Assawadithalerd M. Assessment of Knowledge, Attitude, and Practice in respect of Medical Waste Management among Healthcare Workers in Clinics. J Environ Public Health. 2020 Sep 28;2020:8745472. [DOI: 10.11 55/2020/8745472]. Available from: https://www.hi ndawi.com/journals/jeph/2020/8745472/.Access ed on 5th May 2023.