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A cross-sectional study on biomedical waste management among nursing students of tertiary care hospital

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Abstract:

Background: Hospital waste is highly infectious. For smooth functioning of any hospital proper disposal of waste is an essential component. Guidelines have been implemented and updated from time to time for waste disposal. Each functionary must be trained with waste disposal guidelines.

MethodsA cross-sectional study was done among first, second- and third-year nursing students. Permission from principal of nursing college was also obtained. A pretested semi-structured questionnaire was used for collecting their Demographic information, knowledge, attitude and practice about hospital waste management.As per the number of batches and response among them 191 nursing students were covered.

Statistical Analysis: Data was exported in excel sheet and analysed using SPSS software. Comparison of knowledge, attitude and practice scores among first, second- and third-year nursing students was done using ANOVA test. p-values less than 0.05 were considered statistically significant at 95% confidence level**.** For open ended question's themes were generated and tabulated.

Results: Adequate knowledge, favourable attitude and adequate practice was observed among 128 (67.01%), 116 (60.73%) and 129 (67.54%) participants respectively.Statistic values after applying test of association were, between levels of knowledge and attitude (Fisher exact

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value=10.88, df=2, p value= 0.00), knowledge and practice (Fisher exact value=22.76, df=2, p value= 0.00) and attitude and practice (Fisher exact value=27.05, df=4, p value= 0.00)

Conclusion: There is need to improve knowledge of nursing students as they are future staff cadre who have to work day and night in hospital environment and must be aware about BMW. Barriers in BMW disposal were shared by the students.

Key Words: Biomedical waste, nursing students, knowledge, attitude and practice scores

Introduction:

Generation of biomedical waste is an unavoidable outcome of hospital care and practices.[1]

Hospital waste is highly infectious. For smooth functioning of any hospital proper disposal of waste is an essential component. Guidelines have been implemented and updated from time to time for waste disposal. Each functionary must be trained with waste disposal guidelines.

Poor awareness of all categories of health workers and improper management of biomedical waste poses a risk for health and environment.[2]

The objectives of Bio Medical Waste Management are to effective reduction of waste volume, proper collection, segregation, transport and economical disposal of waste to prevent harm resulting from it, retrieve reusable materials.[3]

Nurses are constantly involved in hospital work and patient management related events that require bio-medical waste management like collection, segregation, transport and its proper disposal. Attitudes and practices regarding proper handling and disposal of medical waste depend upon awareness about hospital waste management guidelines.

It is very much important to impart right and fair knowledge about hospital waste management among nursing students at the very beginning of their carrier as they have to carry lots of responsibilities in the future.

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Therefore, to assess their knowledge, attitude and practices about hospital bio-medical waste management among nursing students of tertiary care hospital this study was planned. At the same time, we have also compared the knowledge, attitude and practices towards hospital bio-medical waste management among first to third year nursing students.

Aims and Objectives:

1. To assess the knowledge, attitude and practices about hospital bio-medical waste management among nursing students.
2. Comparison of knowledge, attitude and practice scores of hospital waste management among first, second- and third-year nursing students.
3. To document what are the barriers in implementing hospital waste management guidelines.
4. To document their suggestions for improvement of hospital waste management.

Material and Methods:

A cross-sectional study was done among first, second- and third-year nursing students. Ethical clearance from Institutional Ethical Committee was obtained. Permission from principal of nursing college was also obtained.

Students were approached in the nursing college attached to our tertiary care hospital.

Participantswere briefedaboutthebackgroundandpurposeofthestudy. Before filling up the questionnaire informedconsent from participants wasobtained. They were informed that their participation is voluntarily.

A pretested semi-structured questionnaire was used for collecting their Demographic information, knowledge, attitude and practice about hospital waste management. Pilot testing was done to look out feasibility of study and solve queries in questionnaire filling. WhatsApp group and fillable google form for questionnaire was made for smooth data collection. Students were guided how to fill up the responses.

Inclusion Criteria

1) Nursing students.
2) Participants who give informed consent.

Exclusion Criteria

1) Participants not willing to participate.

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Design:A cross-sectional study.

Study group: Nursing students

Sampling: Purposive sampling

Study was done among nursing students of nursing college, Government Medical College.

Inclusion criteria:

1) Nursing students.
2) Participants who give informed consent.

Exclusion criteria:

Participants not willing to participate.

Outcome parameters, primary and secondary: Averages, proportions, knowledge, attitude and practice scores were calculated.

Assessment tools/ scales:

Assessment of Knowledge, attitude and practice about hospital waste management was done using close ended questions. For identifying the barriers in implementation of hospital waste management guidelines and documenting their suggestions for improvement of hospital waste management open ended questions were asked.

1) **Knowledge Assessment**. It was done using 26 multiple-choice questions and each question had either three or four possible options. Knowledge questions were scored either "1" or "0 for the correct and incorrect response, respectively." The total knowledge score for each study participant was computed, and the possible score ranged from 0 to 21. Then, the overall knowledge score was computed by summation of all the individual study participants' total knowledge scores. Finally, the mean score was calculated by dividing the overall knowledge score by the number of study participants. Knowledge scores below and above or equal to the mean score was assigned for inadequate and adequate knowledge,
   respectively.[4, 5]

(2) **Attitude Assessment**. It comprised of 16 Likert items. A five-point Likert scale of measurement to represent scores, such as "Strongly Disagree," "Disagree," "Neutral,"

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"Agree," and "Strongly Agree" and were given numerical scores 1, 2, 3, 4, and 5, respectively. For negatively phrased statements, scores were reversely coded during the data entry period as 5, 4, 3, 2, and 1. Then, the composite score for each study participant was computed which ranged from 16 to 80. The overall attitude score was calculated by adding all the study participants' attitude scores, and the mean score was computed by dividing the overall attitude score by the number of study participants. Finally, attitude scores below the mean and above or equal to mean score was assigned for unfavourable and favourable attitude, respectively.[5]

(3) **Practice Assessment**. Eight multiple-choice practice questions were used, and they were dichotomized by giving "1" or "0" point for correct and incorrect responses, respectively. Total individual and overall practice scores were also calculated. Then, the mean score was calculated by dividing the overall practice score by the number of study participants. Practice scores below the mean and above or equal to the mean score was assigned for inadequate and adequate practice, respectively.[5]

Sample size: All students of first, second- and third-year nursing were approached. Batch wise list of students was obtained from nursing college. As per the number of batches and response among them 191 nursing students were covered.

Statistical Analysis: Data was exported in excel sheet and analysed using SPSS software. Mean, standard deviation, proportions were calculated. Scores for knowledge, attitude and practice were also calculated and categorized as adequate and inadequate knowledge, favourable and unfavourable attitude and adequate and inadequate practice. Comparison of knowledge, attitude and practice scores among first, second- and third-year nursing students was done using ANOVAtest. p-values less than 0.05 were considered statistically significant at 95% confidence level**.** For open ended question's themes were generated and tabulated.

Observations and Results:

Knowledge, attitude and practice regarding biomedical waste management are shown in Table 1, 2 and 3 respectively.

Average knowledge, attitude and practice scores observed among study participants were 17.0, 61.29 and 5.10 respectively. Adequate knowledge, favourable attitude and

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adequate practice was observed among 128 (67.01%), 116 (60.73%) and 129 (67.54%) participants respectively.

Statistic values after applying test of association were, between levels of knowledge and attitude (Fisher exact value=10.88, df=2, p value= 0.00), knowledge and practice (Fisher exact value=22.76, df=2, p value= 0.00) and attitude and practice (Fisher exact value=27.05, df=4, p value= 0.00)

Average knowledge, attitude and practice scores were compared among first, second- and third-year nursing students using ANOVA test. Association of average knowledge scores, attitude scores and practice scores among first, second- and third-year students were statistically significant with p values < 0.05***(Table 4)***

When asked about roles and responsibilities of nursing students for biomedical waste management said statements were; To follow all rules of BMW as per guidelines, segregate and discard waste by proper color code, not to mix the waste of all four bags, maintain hand hygiene and use of hand gloves, prevention of infection, clean the waste properly with disinfectant if it is recyclable, not to overload the bags and avoid needle stick injury.100 (52.35%) students have no idea about what is their role and responsibility as a nursing student for biomedical waste management.In descending order sources of information for biomedical waste management among nursing students were health team members, teachers, friends, mass media and training.30(15.70%) students got information about biomedical waste management through self-reading.

121(63.4%) of nursing students were willing to attend the training on biomedical waste management.When asked about how this training on biomedical waste management will be of help to them, nursing students gave following replies; It will help to create knowledge about BMW and its rules, prevent hospital acquired infections and for safe clinical practice which will ultimately be good for their health, help to create clean city by reduction of land pollution as segregated waste is disposed of properly.20(10.04%) students don’t know or were unsure how this training on biomedical waste management will be of help to them.

The barriers in implementing waste management strategies include the following: lack of knowledge,lack of strategy/planning, lack of training in health care worker, improper segregation /mixing of waste, lack of time, lack of hospital facilities, lack of experience, careless behavior, poor communication etc.

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Suggestions for improving the biomedical waste management given by students in priority were to increase knowledge of staff through trainings/seminars, waste should be collected in separate bins and transporters and properly segregated, Make proper guidelines and follow them strictly, Don't mix waste with drinking water/disposal lands should be away from water resources /decrease pollution of other resources, to dispose needles and sharp objects in such a way that they cannot be reused, use of technology in such a way that if waste is put in wrong bin an alarm is rung, Implementation of BMW starting from the lowest to (Primary care-PHC) highest level (Tertiary care-Medical colleges), to reduce unnecessary waste generation and provision of adequate staff members.

Discussion:

A large quantity of biomedical waste is generated in hospital setup. This waste contains infectious and hazardous materials that can cause harmful effect on the health of waste handlers. The waste thus has to be segregated at the level of its production so that handling it becomes easy. This study has been carried out to check the knowledge and assess the practice among the nursing students of a Tertiary Care Centre. As nursing students are the future health care providers of staff and they have to work and stay in hospital wards, OTs the whole day, they must have the knowledge about biomedical waste, its generation, segregation and disposal right from the beginning of their carrier. Moreover, awareness amongst them will be the crucial event in handling of biomedical waste. As per a study conducted by Ruma Dutta (2017) Inadequate and inappropriate knowledge regarding disposal of Bio-Medical Waste may have serious health consequences to those who handle it as well as can have a deleterious impact on the environment.[6]

In our study 171(89.5%) students were aware of color coding segregation and 123(64.4%) actually practice segregation in contrast to 66% of the students did not participate in segregation and recycling of solid waste as reported by Ehrampoush et al (2005).[7] Singh Ajai et al (2013) in their study observed, 71.4% of nursing staff were practicing the do's and don't of BMW management and also reported that 65% of nurses were practicing more than 70% of the correct practices as per their hospital norms.[8] 56.7% of practitioners segregated the BMW into different categories at source level and disposed in specified color coded containers in Ruma Dutta (2017) study.[6] Though good proportion of students were aware about colour coding segregation and this is a great milestone for biomedical waste management. In our study when students were asked about different categories of waste

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disposal as per color coded bags, 74(38.7%) of the nursing students were aware that expired/discarded medicines should be kept in yellow bag and rest of the students were not clear. 152(79.6%) were aware that urine bags and catheters biomedical waste should be disposed in red bag. This type of waste is frequently generated hence it's disposal should be done properly by segregation. Broken glass including medicine vials should be discarded in blue bag and 129(67.5%) of the nursing students were aware about this. There is requirement of proper awareness strategies and protocols to create requisite knowledge and its implementation. Moreover, when each and every member working in health setup especially students at learning stage learn about segregation of waste, waste management at higher levels will become easier.

169(88.5%) of the nursing students in our study were aware that there is existence of rules for bio medical waste management. Knowledge about rules is prerequisite for safe practicing of waste disposal. In a study by Chudasama RK(2013) majority of participants heard about the BMW and its management rules but less than half of the study participants have actually received training for BMW management. Their participants' overall knowledge was good but still they need good quality training to improve their current knowledge about BMW.[9] The study by Yadavannavar MC (2010) showed that the majority of staff (teaching and non-teaching) were conscious of the measures for safe collection and final disposal of BMW[10]; this is in contrast to the finding reported by Pandit et al. (2005)[11]

In a study by Radha R (2012), Pandit N.B (2005) and Saini S (2005) overall 8.1% of the study respondents had attended the external training programmes on BMW management on their own accord, but others too (~59%) of them communicated their willingness to do the same if opportunities arose in the future.[11,12,13] Whereas in our study 35(18.32%) have attended and 121 (63.4%) were willing to attend the training that shows their willingness to work for the betterment of public health. Moreover, 136(71.2%) study participants/students strongly agree/agree that they need training on BMW disposal. Informal and formal such trainings sessions should be carried out from time to time for knowledge upgradation and motivation of students.

In a study by N. B. Pandit (2005), all the doctors were aware about risks associated with hospital waste. 74% of all visited doctors said that HIV and Hepatitis-B are the two diseases, from which one should be careful[11] while in our study 141(73.8%) nurses where aware about this. Awareness sessions should cover risks associated with improper waste

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handling and its disposal. In a study by Kini B.S (2014), many consultants (24%), followed by nurses (23.3%), housekeeping staff (21.6%) and junior residents (17.6%) were not following various precautionary measures like getting immunized against hepatitis B, disinfecting sharps at the point of generation and that many had not undergone any formal training on biomedical waste management.[14]Whereas in our study 109(57.1%) were immunized against hepatitis, 143(73.3%) were disposing sharps in puncture proof containers and 35(18.32%) have attended training.Hospital guidelines must be set regarding immunization and training sessions on biomedical waste disposal for different cadres of staff as well as students. A study by MoketeMotlatla, (2021), the majority of the participants at the tertiary hospital in the Northern Cape were aware of the bin for sharps and that the bin must be mounted on the wall. However, very few of these participants were aware that sharps should be disposed of when the container is three quarters full.[15] In our study 124(64.9%) students were aware that 2/3rd of the container should be only filled. Although participants were aware of the containers for the different healthcare risk waste (HCRW), less than 60% of them were not aware of the storage period of HCRW at hospital storage facility.[37] In our study 45(23.6%) students were aware that the biomedical waste should not be stored beyond 48 hours.

Mathur V (2011) in their study, the practice of reporting of injuries resulting from improperly disposed biomedical waste was found to be miserably low among the technical staff and was found to be completely absent among the non-technical sanitary staff.[16] In our study 84(43.6%) students consider reporting of needle stick injury as an extra burden on their work. In a study by Radha R (2012) The overall reporting of the injuries was only 13.3%, this was because most of the health care workers were unaware about the formal system of injury reporting which was existent in their own institution[12]while our study shows that 142 (74.3%) did reporting of major accident during handling of bio-medical in health care functionaries within 24 hrs. Reporting of injuries is important, at the same time there should be some feedback for improvement and reduction in future injuries. All the cadres of staff/students working within hospital must be aware of if there is any reporting system and its functionality.

In our study 66(34.6%) were recapping the used needles and 73(38.2%) were not recapping the needles, rest of the students don’t have any experience. According to Divya Rao (2018) in a study at tertiary care teaching hospital, recapping of needles is one of the

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important risk factors for needle stick injuries; the prevalence was very low in the organization.[17]This may be due to adequate number of needle cutters availability and its usage at most of the health centers as per the Government policy. Health Staff must know availability of needle cutter at proper place and its functionality and any guideline if needle cutter is not working for the time being.

In a study at Lucknow by Shalini Gupta (2014), the practice of washing hands before and after using the instrument was significantly higher among the respondents. More than one third (41.2%) of the respondents were using disinfecting solution and detergents method for pre-sterilization cleaning and asepsis storage. This practice was higher among the respondents of institutional (42.6%) followed by commercial (37%) and charitable (36.4%) labs. The level of awareness about universal work precautions amongst laboratory technicians is low as only 20.8% of them had heard about the term and only 37.5% of these could correctly state the objectives.[18] In our study 159(83.2%) students were practicing hand hygiene in between all activities. Rest of the students must also follow hand hygiene practices. They must be instructions from time to time.

In a study by Malini (2015) HCWs expressed their difficulty in following norms due to nonavailability of gloves, gowns (PPE), needle destroyers, lack of colored bins and covers/bags, lack of supervision.[19]While our study identified the main barriers in implementing waste management strategies like: Lack of knowledge, lack of strategy/planning, lack of training in health care worker, improper segregation /mixing of waste, lack of time, lack of hospital facilities, lack of experience, careless behavior, poor communication etc. All the barriers seem to be very casual if all cadres of workers are doing there work religiously probably these barriers will seem to be of minimal importance only.

As per study by Deepika K (2019), CRRI s and Lab technicians were able to correctly identify the symbol of bio-hazard compared to the other groups.[20] In our study 155(81.2%) nursing students were able to identify the biohazard symbol and 156(81.7%) students said that it is necessary to have biohazard symbol on BMW bag. Thus, wherever they see this symbol they will maintain more care so as not to get infection. Deepika K (2019), mentioned that managing bio-medical waste is a joint effort all cadre of workers, students, nursing staff, class III and class IV workers all must contribute their efforts by learning, taking interest and to follow the guidelines for waste disposal.[20]

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Henry et al (1994), who performed a study at two privately owned community hospitals in two suburbs of Minneopolis, observed less than optimal levels of compliance of personal protective clothing among health care workers.[21] Abdul et al. (2003) had also made similar observations when they evaluated infection control practices in 44 clinical laboratories of Karachi, Pakistan and found that gloves were used in 2(4.54%) and protective gowns in 12 (27.27%) as personal protective clothing.[22] In our study 145 (75.9%) students were aware that personal protective equipment reduces risk of infection.

In a study by Henry et al (1994) varying percentages of health professionals understood that financial burden of the hospital is increased because of BMW management with higher percentage among lab technicians.[21] In our study 71(37.2%) students agreed that financial burden increases due to biomedical waste management. Henry et al (1994) mentioned in their study that the attitude of the paramedical staff who opened that the BMW management adds extra burden to their work is quite alarming. This is worrisome and such attitude must be changed and the significance of proper disposal and management of BMW should be stressed. It must not be addressed as an extra burden of work.[21]

In a study at Shimla by Kumar (2015), all the housekeeping staff interviewed in the various hospitals told that they closed the waste bags by tying the knot and carried them to the central waste storage facility in hands.[23] In a Study by Cheng YW (2009) mentioned that containers must be well-disinfected and secured so that only authorized personnel can have access to them.[24]In our study 151(79.1%) students agree that the containers should be closed before disposal and 144(75.2%) students agreed that the waste must be secured before disposal.

In current study average knowledge score among nursing students was 17 out of 26 total score. Average knowledge score was adequate among 128 (67.01%) students. In a study by Tenglikar PV[25], 2012 the knowledge regarding HCW among various staff working in nursing homes is commensurate with the educational level of different staff and in conformity with the study done by Deepali Deo et al (2006) where in, the average score was highest in medical staff (4.46), followed by paramedical staff (4.02) and least in non-medical staff (3.45)[26]. Year wise comparison of knowledge score among first, second- and third-year nursing students was statistically significant with p value < 0.05

In a study by Tenglikar PV[25], 2012, attitude towards any health behaviour depends primarily on the knowledge level of the subject by the individual and in proportion with the

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knowledge score and positive attitude towards HCW management was commensurate with knowledge level i.e., highest amongst doctors followed by nursing staff and housing staff. This too was observed in a similar study done by Deepali Deo *et al*.[26]In our study average attitude score was 61.29 and favourable attitude towards waste management was observed among 128 (67.01%) nursing students. Average practice score observed among students was 5.10 and adequate practice was followed by 129 (67.54%) students. The practice of HCW management score found in the Tenglikar PV study (2012) is comparable with others and at variance with a few.[25] Deepali Deo *et al*.[26](2006) in their study found that the average practical knowledge score was maximum in paramedical staff (3.46) followed by medical staff (2.97) and least in non-medical staff (2.35), similarly Saini.S. *et al.*[13](2005) in their study showed that in the comparison of knowledge, with attitude and practice, the people with high education such as consultants, residents and scientists had very good knowledge but relatively low percentage of this category of people have the same kind of attitude and practice. And the sanitary staff though had poor knowledge about the Biomedical waste rules but a good percentage of this category had positive attitude and practice habits. Whereas MC Yadavannavar*et al*.[10](2010) in their study found that the teaching staff of the hospital gave more correct responses (97.4%) to questions on knowledge, attitude and practices regarding BMW than the nonteaching staff (80%). Higher practical score found in the housing staff and nursing staff in a study by Tenglikar PV may be due to higher responsibilities assigned to them in handling HCW as well as their day to day contact with staff of common treatment facility who inform on alternate day basis about HCW management.[25]As our study participants are of the same educational background and almost similar socio-demographic parameters, association of knowledge, attitude and practice scores with socio-demographic variables was not done and only year wise comparison among first, second and third year nursing students was done.

Conclusion

Average knowledge, attitude and practice scores observed among study participants were 17.0, 61.29 and 5.10 respectively. Adequate knowledge, favourable attitude and adequate practice was observed among 128(67.01%), 116(60.73%) and 129(67.54%) participants respectively. There is need to improve knowledge of nursing students as they are future staff

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cadre who have to work day and night in hospital environment and must be aware about BMW. Barriers in BMW disposal were shared by the students. Their suggestions for BMW management can be useful in policy formulation and up-dation of existing policies.

Research has enabled us to identify the loopholes among nursing students biomedical waste management knowledge, attitude and practices. Research could assess what was being practiced in hospital setup and what needs to be improved. Training sessions can be organized time to time among the nursing staff so that after being trained the rules of biomedical waste management are properly implemented moreover students are willing for these sessions. Even queries of students were also solved regarding waste disposal.

Conflict of interest: None

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Criteria for inclusion in the authors'/contributors' list-All authors have contributed substantially at each stage of research conceptualization, proposal make-up, data collection, analysis and write-up.

Contributor details: All authors have made substantial contribution in carrying out research and preparation of manuscript.

Manuscript has been read and approved by all the authors, that the requirements for authorship as stated earlier in this document have been met, and that each author believes that the manuscript represents honest work.

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1. Neupane S. Legal service network and law resources portal, biomedical waste management in hospitals. Legal India. Available From: http://www. legalindia.in/bio-medical-waste-management-in hospitals. Accessed on 07/08/22
2. Kishore J, Ingle GK. Biomedical Waste Management in India. New Delhi: Century

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 4, 2020

Publications; 2004.

3. Guidelines for protecting the safety and health of health workers. NIOSH /health care workers guidelines /Chap 6.
4. M. Kumar, R. K. Singh, and V. R. Umesh, "Awareness and practices about biomedical waste among healthcare workers in tertiary care hospital of Haldwani, Nainital," National Journal of Medical Research, vol. 159, pp. 72-73, 2015.
5. N. Karmakar, S. S. Datta, A. Datta, K. Nag, K. Tripura, and P. Bhattacharjee, "A cross-sectional study on knowledge, attitude and practice of biomedical waste management by healthcare personnel in a tertiary care hospital of Agartala, Tripura. National Journal of Research in Community Medicine. 2016. Vol. 5, no. 3

6.Dutta R, Prashanth R, Parasuraman G, Jain T, Raja D, Dcruze L. Knowledge, attitude and practice of bio-medical waste management among private practitioners in Poonamallee taluk, Chennai. Int J Community Med Public Health 2017; 4: 2930-3

7. Ehrampoush, M.H., Baghiani Moghadam, M.H., Iranian Journal of Environmental Health Science Engineering. 2005; 2(2):26.

8. Singh Ajai, Srivastava Rajeshwar Nath. Knowledge, Attitude and Practices of Bio-Medical Waste Management Amongst Staff of Institutional Trauma Center Level II International Journal of Research in Health Sciences. July –Sept 2013;1(2):62-68

9.Chudasama RK, Rangoonwala M, Sheth A, Misra SKC, Kadri AM, Patel UV. Biomedical Waste Management: A study of knowledge, attitude and practice among health care personnel at tertiary care hospital in Rajkot. J Res Med Den Sci. 2013; 1:17-22

10.Yadavannavar MC, Berad AS, Jagirdar PB. Biomedical waste management: a study of knowledge, attitude and practices in a tertiary health care institution in Bijapur. Indian J Community Med 2010; 35: 170-171.

11.Pandit NB, Mehta HK, Kartha GP, Choudhary SK. Management of bio-medical waste: Awareness and practices in a district of Gujarat. Indian J Public Health. 2005; 49:245–7

12. Radha R. Assessment of existing knowledge, attitude, and practices regarding biomedical waste management among the health care workers in a tertiary care rural hospital. Int J

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 4, 2020

Health Sci Res. 2012;2(7):14-19.

13. Saini S, Nagarajan S.S, Sarma R.K. Knowledge, Attitude and Practices of Bio-Medical Waste Management Amongst Staff of a Tertiary Level Hospital in India. Journal of the Academy of Hospital Administration. 2005;17(2).
14. Kini B S, Kumar, Kumar S, Reddy M, Nabar A S, Kamath V G, Kamath A, Eshwari K, Knowledge, Attitudes and Practices regarding Biomedical Waste Management among staff of a tertiary healthcare centre in coastal Karnataka, J Pub Health Med Res (2014). 2(1): 20-4
15. Motlatla, M.; Maluleke, T.X. Assessment of Knowledge about Healthcare Risk Waste Management at a Tertiary Hospital in the Northern Cape Province, South Africa. Int. J Environ. Res. Public Health 2021, 18,449.
16. Mathur V, Dwivedi S, Hassan MA, Misra RP. Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. Indian J Community Med; 36: 143-5 (2011).
17. Divya Rao, Dhakshaini M.R, Kurthukoti A and Doddawad V.G. 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).
18. Shalini Gupta, Om Prakash Gupta, Yogendra Verma, Irfan Ahmad, Devendra Kumar, Saurabh Srivastava. Knowledge, Attitude and Practices of Health Care Professionals Regarding Biomedical Waste Management in Indian Oral Pathology Laboratories. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2014 5(4) p : 40
19. Malini A and Eshwar B. Knowledge, Attitude and Practice of Biomedical waste management among health care personnel in a tertiary care hospital in Puducherry. International Journal of Biomedical Research 2015; 6(03): 172-176.
20. Deepika, K. Knowledge Attitude and Practice of Biomedical Waste Management among Health Care Workers in a Tertiary Care Hospital, Coimbatore, India. Int. J. Curr.

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 4, 2020

Microbiol. App. Sci 2019. 8(07): 1893-1897.

21.Henry, K., S. Campbell, P. Collier and C.O. Williams: Compliance with universal precautions and needle handling and disposal practices among emergency department staff at two community hospitals. Am. J. Infect. Control, 22, 129-137 (1994)

22.Abdul, M.S., M.M. Adil, A. Altaf, SA Shah and Luby: infection control practices in clinical laboratories in Pakistan. Infect. Control Hosp. epidemiol. 24, 141-142 (2003)

23.Kumar S, Mazta SR, Gupta AK. Comparing the Biomedical Waste Management Practices in Major Public and Private Sector Hospitals of Shimla City. Int J Sci Stud 2015;2(11):112-118.

24.Cheng YW, Sung FC, Yang Y, Lo YH, Chung YT, Li KC. Medical waste production at hospitals and associated factors. Waste Management 2009;29: 440-4.

25. Tenglikar PV, Kumar GA, Kapate R, Reddy S and Vijayanath V. 2009. Knowledge Attitude and Practices of Health Care Waste Management amongst Staff of Nursing Homes of Gulbarga City. Journal of Pharmaceutical and Biomedical Sciences, 19 (19)1-3

26.Deepali Deo, Tak S B, Munde S S. "A Study of Knowledge Regarding Biomedical Waste Management among Employees of a Teaching Hospital in Rural Area". Journal of ISHWM. 2006 April; 5(1): 12-5.

Table 1: Assessment of Knowledge about biomedical waste management among study participants (n=191)

Sr.	Knowledge Statements	Frequency	Percent

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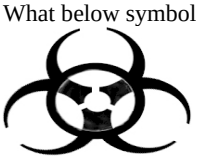
No			
1	**Biomedical waste (BMWs) is waste produced from medical activities generated during**		
	1. diagnosis, treatment	7	3.7
	2. immunization of human beings or animals	2	1.0
	3. research activities	2	1.0
	4. production or testing of biologicals	4	2.1
	5. Health Camps	2	1.0
	6. All of the above	172	90.1
	7. Don't know	2	1.0
2	**Are body fluid contaminated items considered as Biomedical waste?**		
	1. Yes	175	91.6
	2. No	11	5.8
	3. Don't Know	5	2.6
3	Percentage of infectious waste in hospitals is (approx)?		
	1. 15%	67	35.1
	2. 10%	53	27.7
	3. 1.5%	16	8.4
	4. 4%	13	6.8
	5. Don't Know	42	22.0
4	All Biomedical waste are not hazardous?		
	1. Yes	112	58.6
	2. No	70	36.6
	3. Don't Know	9	4.7
5	Disinfection of Biomedical waste doesn't decrease infection transmission?		
	1. Yes	62	32.5
	2. No	120	62.8
	3. Don't Know	9	4.7
6	Is there any existence of rules/Act for bio medical waste management?		
	1. Yes	169	88.5
	2. No	8	4.2
	3. Don't Know	14	7.3
7	What below symbol depicts 		
	1. Biohazard	155	81.2
	2. Cytotoxic	7	3.7
	3. Radiation hazard	9	4.7
	4. Explosive hazard	2	1
	5. Don't Know	18	9.4
8	There is no need of Pre-treatment & treatment should be provided to liquid waste generated in the health care functionaries.		
	1. Yes	70	36.6
	2. No	92	48.2
	3. Don't Know	29	15.2
9	Reporting of major accident occurred during handling of bio-medical in health care functionaries should be done within 24 hrs.		
	1. Yes	142	74.3
	2. No	13	6.8
	3. Don't Know	21	11.0
	4. Can be done later on	15	7.9
10	Is there any colour coding segregation of Biomedical waste (BMWs)?		
	1.Yes	171	89.5
	2. No	12	6.3
	3. Don't Know	8	4.2
11	In which bag expired/discarded medicines are kept?		
	1. Yellow bag	74	38.7
	2. White bag	10	5.2
	3. Red bag	24	12.6
	4. Blue bag	67	35.1
	5. Don't Know	16	8.4

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12	What is the colour coding of bag in hospitals to dispose of waste sharps (needles/scalpels, blades)?		
	1. Yellow bag		
	2. White bag/box	2	10
	3. Red bag	145	75.9
	4. Blue bag	12	6.3
	5. Don't Know	23	12.0
		9	4.7
13	Disposal of anatomical waste is done into which color bag?		
	1. Yellow bag	157	82.2
	2. Black bag	5	2.6
	3. Red bag	15	7.9
	4. Blue bag	6	3.1
	5. Don't Know	8	4.2
14	Urine bags and catheters biomedical waste will be disposed in		
	1. Yellow bag	17	8.9
	2. Black bag	5	2.6
	3. Red bag	152	79.6
	4. Blue bag	9	4.7
	5. Don't Know	8	4.2
15	Broken glass including medicine vials will be discarded in which bag		
	1. Yellow bag	5	2.6
	2. Black bag	28	14.7
	3. Red bag	17	8.9
	4. Blue bag	129	67.5
	5. Don't Know	12	6.3
16	Is it necessary to have Biohazard symbol on BMW bag?		
	1. Yes	156	81.7
	2. No	12	6.3
	3. Don't Know	10	5.2
	4. No knowledge about Biohazard symbol	13	6.8
17	HIV virus cannot be transmitted through BMWs		
	1. Yes	38	19.9
	2. No	141	73.8
	3. Don't Know	12	6.3
18	Hepatitis B virus (HBV) is cannot be transmitted through BMWs		
	1. Yes	39	20.4
	2. No	141	73.8
	3. Don't Know	11	5.8
19	Bio medical waste should not be stored beyond		
	1. 24 hours	87	45.5
	2. 48 hours.	45	23.6
	3. 36 hours	9	4.7
	4. 12 hours	28	14.7
	5. Don't Know	22	11.5
20	Personal protective equipment includes?		
	1. Gloves	1	0.5
	2. Mask	1	0.5
	3. Gown	2	1.0
	4. Apron	1	0.5
	5. Head cap		
	6. Goggles		
	7. All of the above	186	97.4
	8. Don't Know		
21	There is no role of wearing personal protective equipment in reducing the risk of infection?		
	1.Yes		
	2. No	36	18.8
	3. Don't Know	145	75.9
		10	5.2
22	There is no problem with needle stick/sharp injury?	25	13.1
	1.Yes	158	82.7
	2. No	8	4.2
	3. Don't Know		
23	Up to which level the bio medical waste bag has to be filled?		

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	1. Half 2. 2/3rd 3. Just below top level 4. No criterion 5. Don't Know	8 124 31 6 22	4.2 64.9 16.2 3.1 11.5
24	There is no need to close bio medical waste containers while transport? 1. Yes 2. No 3. Don't Know	 30 151 10	 15.7 79.1 5.2
25	There is no need to secure bio medical waste awaiting treatment/disposal? 1. Yes 2. No 3. Don't Know	 31 144 16	 16.2 75.2 8.4
26	Out of these bio medical waste disposal methods is/are? 1.Shredding 2.Compositing 3.Heat disinfection 4.Incineration 5.All of the above 6.Don't know	 3 6 4 10 154 14	 1.6 3.1 2.1 5.2 80.6 7.3

Table 2: Assessment of Attitude towards biomedical waste management among study Participants (n=191)

Sr. No.	Attitude statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Improperly managed biomedical waste may cause infection	105(55.0)	53(27.7)	14(7.3)	5(2.6)	14(7.3)
2	Proper biomedical waste handling is an important issue	86(45.0)	66(34.6)	9(4.7)	20(10.5)	10(5.2)
3	Safe biomedical waste needs a teamwork	80(41.9)	86(45)	13(6.8)	7(3.7)	5(2.6)
4	HIV post exposure prophylaxis help to prevent the development of HIV infection	32(16.8)	103(53.9)	31(16.2)	17(8.9)	8(4.2)
5	Reporting of needle stick injury is an extra burden on work	18(9.4)	66(34.6)	37(19.4)	50(26.2)	20(10.5)
6	BMWs be segregated into different categories at the point of generation?	48(25.1)	109(57.1)	24(12.6)	8(4.2)	2(1.0)
7	BMW segregation facilitates safe handling	55(28.8)	92(48.2)	23(12.0)	16(8.4)	5(2.6)
8	Segregation of waste at the source increases the risk of injury to waste holders	26(13.6)	73(38.2)	33(17.3)	41(21.5)	18(9.4)
9	Waste management is a responsibility	99(51.8)	73(38.2)	8(4.2)	5(2.6)	6(3.1)
10	Financial burden increases because of biomedical waste management	25(13.1)	46(24.1)	57(29.8)	51(26.7)	12(6.3)
11	Trainings should be conducted	74(38.7)	84(44)	18(9.4)	6(3.1)	9(4.7)

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	on biomedical waste management?					
12	Is there any necessity of biomedical waste management rules?	68(35.6)	92(48.2)	21(11.0)	4(2.1)	6(3.1)
13	Do you feel that BMW management is compulsorily needed for healthcare delivery?	108(56.5)	55(28.8)	17(8.9)	4(2.1)	7(3.7)
14	Will you advice your colleagues and juniors to follow colour coding for waste disposal	104(54.5)	68(35.6)	10(5.2)	4(2.1)	5(2.6)
15	Do you think your knowledge regarding biomedical waste management is adequate?	31(16.2)	80(41.9)	55(28.8)	22(11.5)	3(1.6)
16	Do you think you need training on biomedical waste management?	44(23.0)	92(48.2)	40(20.9)	9(4.7)	6(3.1)

Table 3: Assessment of Practice regarding biomedical waste management among study participants (n=191)

Sr. No.	Practice statement	Yes	No	No Experience	May be/Don't remember
1	Are you disposing sharps in puncture proof container	140(73.3)	17(8.9)	34(17.8)	-
2	Are you discarding used needles by hub cutter	114(59.7)	44(23)	33(17.3)	-
3	Are you not recapping the used needle	73(38.2)	66(34.6)	28(14.7)	24(12.6)
4	Are you disposing all domestic and kitchen waste dump into black colour bag	104(54.5)	51(26.7)	18(9.4)	18(9.4)
5	Are you disposing used gauze piece in yellow colour bag?	153(80.1)	13(6.8)	16(8.4)	9(4.7)
6	Are you practicing the segregation of infectious waste and Non-infectious waste?	123(64.4)	27(14.1)	33(17.3)	8(4.2)
7	Are you vaccinated for Hepatitis-B	109(57.1)	53(27.7)	-	29(15.2)
8	Are you practicing hand hygiene in between every activity?	159(83.2)	12(6.3)	-	20(10.5)

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Table 4: Comparison of average knowledge, attitude and practice scores regarding biomedical waste management among first, second and third year nursing students (n=191)

Nursing students	Average Knowledge score	Average Attitude score	Average Practice score	F-statistic value, df	p value
First Year	15.89	58.50	3.67	3.92, 2	0.02
Second Year	17.61	61.71	5.30	6.98, 2	0.00
Third Year	17.93	63.95	6.48	27.87, 2	0.00

Table 5: Barriers and suggestions in implementation of biomedical waste management

Sr. No.	**barriers in implementation of biomedical waste management (n=191)**	**Frequency**	**Percent (%)**
1	Lack of knowledge / lack of strategy / planning	45	23.56
2	Lack of training in health care worker	12	6.28
4	Improper segregation / mixing of waste	11	5.75
5	Lack of time	11	0.75
6	Lack of hospital facilities	8	4.18
7	Lack of experience	6	3.14
8	Careless behavior	5	2.61
9	Poor communication	4	2.09
10	Lack of staff	3	1.57
11	Improper team work	3	1.57
12	Lack of interest	1	0.52
13	Fear of getting infected	1	0.52
14	No barrier is noticed	1	0.52
15	Don’t know	80	41.88
Sr. No.	**Suggestions for improving the biomedical waste management**	**Frequency**	**Percent (%)**
1	To increase knowledge of staff through trainings/seminars	67	35.07
2	Proper segregation of waste through its collection in separate bags/bins	33	17.27
3	Establishment of proper guidelines and its implementation	30	15.70
4	Not to mix waste in drinking water/disposal lands should be away from water resources / decrease pollution of other resources	10	5.23
5	Reduce unnecessary waste generation	8	4.18
6	Provision of adequate staff members	2	1.04
7	To dispose needles and sharp objects properly to stop its reusage	1	0.52
8	Use of technology to have alarm system in bins to stop putting waste in wrong bin	1	0.52

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9	Implementation of BMW starting from the lowest to (Primary care-PHC) highest level (Tertiary care-Medical colleges)	1	0.52
10	Don't know /no more suggestions/all existing rules appear appropriate	50	26.17