Diwan et al. | Article 8226
J Pure Appl Microbiol. 2023;17(1):211-221. doi: 10.22207/JPAM.17.1.10
Received: 9 November 2022 | Accepted: 04 January 2023
Published Online: 24 January 2023

P-ISSN: 0973-7510; E-ISSN: 2581-690X

RESEARCH ARTICLE OPEN ACCESS

Biomedical Waste Management: An Assessment of Knowledge, Attitude and Practice among Healthcare Workers in Tertiary Care Hospital, Chhattisgarh

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Abstract

In the current scenario, medical concern is fundamental for everyone's existence in addition to well-being, but the waste produced as of healthcare facilities signifies an actual concern in our surroundings. One of the healthcare workers (HCWs) most crucial duties is to handle biomedical waste (BMW) created in a healthcare institution properly since inappropriate management of BMW not only puts both individuals and the environment at risk but might also lead to lawful act opposed to healthcare workers and hospital authority. Current research plan intended to assess biomedical waste management in a tertiary care hospital in Raipur, Chhattisgarh. A facility-based cross-sectional observational study was conducted at Dr. Bhimrao Ambedkar Memorial Hospital, Raipur; Chhattisgarh from July 2021 to August 2021. Assessment of knowledge, attitude, and observation was done by interviewing 105 healthcare workers, selected by simple random sampling, using a predesigned, semi-structured questionnaire. The analysis revealed that medical staff had good knowledge, attitude and practice of biomedical waste management than the paramedical professionals or non-medical workers. There is an imperative need for orientation training to protect themselves, and citizens visiting this healthcare facility and close by communities.

Keywords: Biomedical Waste, Knowledge, Biomedical Waste Management, Attitude, Tertiary Care Hospital, Health Care Workers

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Citation: T Diwan, K Jain, N Singh, N Verma, V Jain. Biomedical Waste Management: An Assessment of Knowledge, Attitude and Practice among Healthcare Workers in Tertiary Care Hospital, Chhattisgarh. *J Pure Appl Microbiol.* 2023;17(1):211-221. doi: 10.22207/JPAM.17.1.10

INTRODUCTION

Undoubtedly one of the most crucial jobs of a healthcare professional is to handle biomedical waste (BMW) produced in healthcare facilities properly. Biomedical wastes (BMW) "Wastes generated during analysis, handling, procedure, in research activities, immunization, as well as the production of biological molecules needs to be regulated, treated and disposal facilities to cope with the possible management strategies, and challenges.[1] In a healthcare context, it is very obvious that biological waste is generated during patient care activities that could be harmful to both individuals and the environment. Soiled gauze, dressings, needles and syringes, injections, tubes such as urinary catheters, etc., are examples of this trash. This garbage is frequently referred to as bio-medical waste (BMW) and is also known as clinical waste, medical trash, and healthcare waste. These wastes only make up about 15–25% of the overall trash produced in a hospital.[2] Additionally, it covers the medication that patients excrete, such as iodinated contrast material, chemical and pharmaceutical residues, and drug-active ingredients and metabolites.[3] According to the WHO healthcare waste report from 2018, over 85% of the total volume of BMW is classified as non-hazardous waste, and the remaining 20% is classified as infectious hazardous waste. Hazardous Biomedical Waste (HBMW) improperly disposed of poses serious concerns as it serves as a breeding ground for a wide range of pathogenic germs. If not properly controlled, pathogens found in HBMW might go into the person body by a cut, scratch, or puncture in the skin membrane, a mucosal membrane, inhalation, or breakdown.[4] In Greece, India, Brazil, Iran, and Pakistan, little research mentioned, the prevalence of direct transmission of viral infection in waste collectors might be linked to improper disposal of biomedical waste.[5] Therefore, successful managing of HBMW is extremely essential to manage the very frequent communication of infections. Looking into this background, the World Health Organization (WHO) heading for the core principles in June 2017 by stressing the correct resource venture and entire assurance to ease healthiness adversities and ecological contamination and toxic waste.[6] Hospital-generated waste supervision is one of the essential tasks as its inappropriate supervision cause hazard to the medical personnel, waste supervisor, suffers, group of people, and mainly the environment. It is found in the literature that segregation at the source of generation needs to be strengthened by regular monitoring.[7] The safe disposal of hazardous medical waste can help protect the community from several negative impacts and save many lives. Adequate awareness about the health risk of hospital waste, appropriate handling procedures, and application of safety measures can all help.[8] The three main goals to take into account for safe healthcare practice are measuring the amount of knowledge, examining the attitude, and monitoring the practice of healthcare practitioners for biomedical waste management (BMW).[9] Therefore, the current study is planned to evaluate biomedical waste management (BMW) in public healthcare facilities.

MATERIALS AND METHODS

This descriptive cross-sectional observational study was conducted to assess the biomedical waste management in Tertiary Care Hospital, Dr. Bhim Rao Ambedkar Memorial Hospital (BRAMH), Raipur, Chhattisgarh from July-August 2021. Healthcare workers including clinicians, nurses, lab technicians, and cleaning staff were selected who were available and ready to take part in the study by simple random sampling. A predesigned semi-structured questionnaire was applied to assess the knowledge of facts, attitude, and practice of study participants. A total of 120 health care workers were approached for interview. Among them 15 subjects did not give consent and considered as non-respondent whereas 105 healthcare workers were involved and majority of study the subjects were doctors. The sample size was calculated statistically on the basis of knowledge (p1) 64% and attitude (p2) 88% on biomedical waste management based on previous research done,[10] considering a 90% confidence interval and allowing a 10% margin of error and 10% non-response rate. The information were composed by means of a predesigned, semi-structured questionnaire and observational worksheet reviewing the literature and biomedical waste management guidelines

2016.[11] The survey comprised of 4 sections. The first section included socio-demographic variables of study subjects. Second part included questions regarding knowledge and third section included attitude of HCWs towards BMWM and fourth section included observation checklist assessing the practice of healthcare workers regarding BMWM. Oral informed consent was obtained from each study subject. Confidentiality and anonymity of information of study subjects were maintained. Participants who did not give consent were excluded from the study. The demographic variables such as age, gender, category of health care workers, and nature of employment, in-service training, and years of work experience were included. The knowledge questionnaire consisted of 11 questions. Answers were recorded as correct or incorrect respectively. The attitude tool consisted of 3 points Likert scale (agree, disagree, cannot comment) of 5 questions in which one was the correct response. The observation checklist consisted of 18 questions and responses were recorded in terms of yes or no. The overall mean of knowledge score was calculated. The value equal and above mean was considered adequate and score below mean was considered inadequate knowledge. Similarly the equal to and above mean value was considered favorable and below mean value was considered unfavorable for attitude. Five proxy indicators (color coding of bins, inner lining of bins, segregation of waste, discard of sharp in puncture-proof box, the yellow bag containing only anatomical waste), as per BMW management rule 2016,[12] were considered to analyze the practice of biomedical waste at the facility. Based on these proxy indicators if it is fallen into 33%, between 34-66%, or above 66% it was be considered poor, average, or good biomedical waste management respectively and categorized as red, yellow, and green zone respectively. Results data were expressed in form of percentages and frequencies for all categories.

RESULTS

In this descriptive cross-sectional observational study, health care workers including doctors, nurses, laboratory technicians, and sanitary staff were included to assess the biomedical waste management, practice, and knowledge in a hospital-based facility in a government hospital, Dr. Bhim Rao Ambedkar Memorial Hospital (BRAHM), Raipur, Chhattisgarh from July- August 2021. In order to evaluate the knowledge, attitude, and practice of study participants, subjects who were willing to participate in the study were interviewed based on a predesigned semi-structured questionnaire. A total of 120 health care workers were approached for interview. Among them 15 subjects did not give consent and considered as non-respondent whereas 105 healthcare workers were involved.

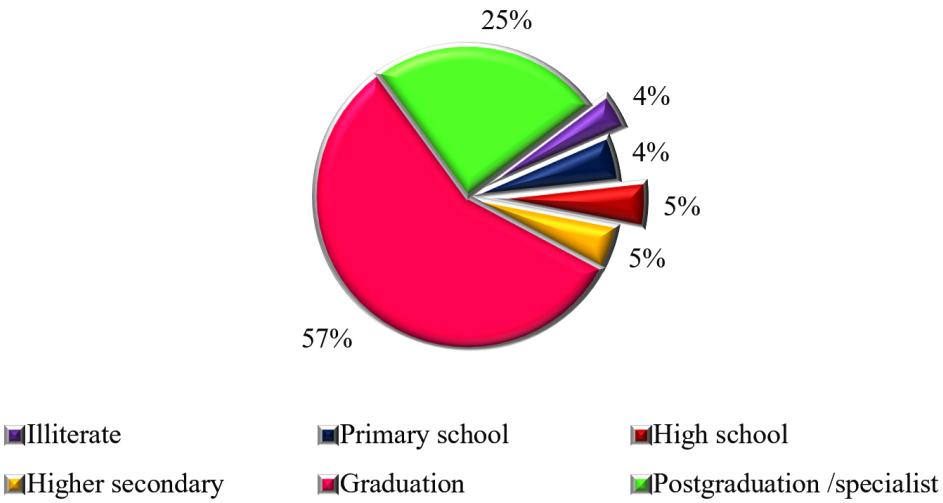

Figure. Distribution of Study Subjects as per Educational Qualification

Table 1. The response to the items relating to the respondent's knowledge of Biomedical Waste Management

Parameters	Doctors (n=48)	Nurse (n=33)	Lab technician (n=2)	Sanitary staff (n=22)
Do you know about biomedical waste generation and legislation? A. Yes B. No	48(100%)	32(96.9%)	02(100%)	18(81.8%)
Which statement describes biomedical waste? A. Kitchen Waste B. Waste generated from healthcare facilities	47(97.1%)	29(87.8%)	0(0%)	14(63.6%)
According to the Biomedical Waste (Management and Handling) Rules, waste should not be stored beyond: A. 24 Hours B. 48 Hours C. 72 Hours	10(20%)	05(15.1%)	0(0%)	06(27%)
Do you need a separate permit to transport biomedical waste? A. Yes B. No	44(91.6%)	28(84.8%)	02(100%)	18(81.8%)
Do you know about color coding segregation of biomedical waste? A. Yes B. No	47(97.9%)	32(96.9%)	02(100%)	16(72.7%)
Objects that may be capable of causing punctures or cuts, that may have been exposed to blood or body fluids including scalpels, needles are considered biomedical waste. In which bin should these objects be segregated? A. Yellow B. Red C. Blue D. White	42(89.3%)	22(66.7%)	01(50%)	16(72.7%)
The approximate proportion of infectious among total waste generated from a health care facility is: A. 10-20% B. 30-40% C. 50-60%	08(16.6%)	05(15.1%)	0(0%)	03(13.63%)
Is needle-stick injury a concern? A. Yes B. No	47(97.9%)	33(100%)	02(100%)	21(95.5%)
Do you recap the used needle? A. Yes B. No	09(18.7%)	15(45.5%)	02(100%)	06(27%)
Do you discard the used needle immediately? A. Yes B. No	48(100%)	33(100%)	02(100%)	21(95%)
Are you aware of the consequences of needle-stick injury? A. Yes B. No	48(100%)	33(100%)	02(100%)	18(81.8%)

Table 2. The response to the items relating to the respondent's attitude regarding Biomedical Waste Management

Parameters	Agree	Disagree	Cannot comment
Waste management is teamwork not single class of people is responsible for safety management?	104(99.04%)	0(0%)	1(0.9%)
Do you think that the hospital should organize separate training to upgrade existing knowledge about biomedical waste management?	102(97.14%)	0(0%)	3(2.85%)
Will you like to attend voluntary programs that enhance and upgrade your knowledge about waste management?	102(97.14%)	0(0%)	3(2.85%)
Do you think that labeling the container before filling it with waste is of any clinical significance?	101(96.19%)	0(0%)	4(3.80%)
Do you think Health Care Worker should wear Personal Protective Equipment while handling Biomedical wastes?	100(95.23%)	1(0.9%)	4(3.80%)

Table 3. Compliance observations to the BMWM and Handling rule 2016

Variables	Frequency (n=1)	Percentage (%)
Whether the Injury register is present or not A. Yes B. No	0	0
Immunization of all the employees, Hepatitis B & Tetanus A. Yes B. No	1	100
Has the monthly record of BMW generated in terms of category as specified in BMW management Rule2016 A. Yes B. No	1	100
An existing committee or newly constituted committee for review and monitoring of BMW management as BMWM and handling rule 2016 A. Yes B. No	1	100
Annual Report on bio-medical waste management submitted to State Pollution Control Board (SPCB) A. Yes B. No	1	100
Minutes of the meeting of Bio-Medical Waste Management Committee A. Yes B. No	1	100
Page/web link in its website for displaying the information pertaining to their hospital A. Yes B. No	1	100

Out of 105 healthcare workers majority of study subjects were doctors (45.71%), nurses (31.42%), lab technician (1.90%) and sanitary staffs (20.95%), respectively. 58.09% of study subjects belonged to 21-30 years of age, 28.57% of study subjects belonged to 31-40 years of age, 10.47% of study subjects belonged to 41-50 years of age, 1.90% study subjects belonged to 51-60 years of age and 0.95% of study subjects belonged to 61-70 years of age. The majority (75.24%) of the study subjects were female. 3.80% of study subjects were illiterate, 4.76% are studied up to primary school, 4.76% were studied up to high school, 4.76% are studied up to higher secondary, 57.14 were graduates and 24.76% are postgraduate (Figure). 45.71% of study subjects had 0-1 year of

Table 4. The response to the items relating to the observation of Biomedical Waste Management

Parameters	Frequency	Percentage (%)
Work instructions for segregation and handling of Biomedical waste has been displayed prominently A. Yes B. No	31	59.61
Placement of 4 color coded bins as per biomedical waste management rule 2016. A. Yes B. No	33	63.4
Bins placed on stand A. Yes B. No	0	0
Biomedical waste bins are covered A. Yes B. No	3	5.7
Lining on inner side by similarly colored waste bags as per Biomedical waste management rule 2016. A. Yes B. No	49	94.2
Segregation of BMW is done as per BMW management rule, 2016 A. Yes B. No	39	75
The Staff uses needle cutters for cutting/burning the syringe hub A. Yes B. No	33	63.4
Sharp Waste is stored in Puncture proof containers A. Yes B. No	33	63.4
Is the biohazard symbol imprinted over waste bags? A. Yes B. No	50	96.15
Does yellow bag contain only anatomical waste and soiled infected waste? A. Yes B. No	33	63.4
Accident Report submitted to State Pollution Control Board (SPCB) including “NIL” report A. Yes B. No	52	100

work experience, 20.95% of study subjects had 1-5 years of work experience, 15.23% of study subjects had 5-10 years of work experience and 18.09% had >10 years of work experience. 47.60% of study subjects had received in-service training for biomedical waste management whereas 52.40% had not received in-service training for biomedical waste management. 19.1% of study subjects were temporary employees in the hospital and 80.9% of study subjects were permanent employees in the hospital. Response to the items relating to respondents’ knowledge of biomedical waste management is represented in (Table 1). According to these findings, 100% of doctors and lab technicians were aware of biomedical waste generation and legislation. 97.1% of doctors were aware of the meaning of biomedical waste; however, very poor response was recorded about the knowledge of storage of biomedical waste among all. Lack of knowledge existed on the separation of devices, such as scalpels and needles that could be infectious and cause punctures or cuts after coming into contact with blood or bodily fluids. 100% lab technicians,

nurses and 97.9% of doctors were concerned of needle injury but recapping practice of needle were found to be as 18.7%, 45.5%, 100% and 27% among doctors, nurses, lab technicians and sanitary staff respectively. 100% doctors, nurses, lab technicians were aware of proper discard and consequences of the needle injuries. Responses to the items relating to respondent's attitudes regarding biomedical waste management are given in Table 2. According to these data 99.04% healthcare were agreeing with statement that biomedical waste management is a team work not responsibility of a single person. Upon interview it was observed that 97.14% of the healthcare worker were in need to get of separate training regarding biomedical waste to upgrade their existing knowledge and skills while working in the workplace whereas 97.14% were ready to attend the voluntary programme related to biomedical waste training to enhance their knowledge. 96.19% of healthcare workers agreed that labeling waste containers before filling waste is helpful for proper segregation and discard in an appropriate way as well as 95.23% of respondents agreed that wearing PPE at the time of handling biomedical waste is one of the important practices to be followed. According to observational parameters (Table 3 & 4) 100% of records were matched for the accident report submitted to State Pollution Control Board (SPCB) including the "NIL" report, all healthcare workers were immunized to Hepatitis B and Tetanus, a monthly record of BMW generated in terms of category as specified in BMW management rule 2016. An existing committee or newly constituted committee for review and monitoring of BMW management, as per BMWM and handling rule 2016, was there to gather the information related to biomedical waste. Waste bin stands were not found in any of the 52 (0%) areas as well as injury register was not maintained in the record section of BMW of the hospital. Minutes of meeting of biomedical waste committee and web link for display of information of BMWs were maintained by the BMW hospital in-charge at the time of survey. On survey it was observed that only 63.4% sharp waste was stored in a puncture-proof container, anatomical waste was stored in a yellow bag, placement of four colored coded waste bags was kept and the staff was found to be using needle cutters for cutting or burning the syringe hub. Only 59.61% of areas were waste segregation and handling displayed prominently although it was observed that waste segregation was being followed according to rule BMW 2016. Based on the five proxy indicators (Table 5) only 20 places 38.46% and the rest 32 places 61.53% area are were spared. In this study result based on five proxy indicators was positive for 38.46% therefore it laid in the orange zone.

DISCUSSION

Large volumes of toxic and potentially communicable trash are generated daily in hospitals and other healthcare facilities. Biomedical waste generated in hospitals is improperly managed and disposed of in a chaotic manner, which has a variety of negative health effects on the general public, the staff working in healthcare facilities, and the environment. This poses a serious threat to the environment and public health, so it needs special care before being disposed of. Healthcare accommodations have accountability to safeguard the environment and public health. Consequently, training for healthcare workers for effective BMW waste management is extremely important. In our findings based on proxy indicators, adequate knowledge for appropriate BMW waste management practice was recorded at 32.38% which is poor and they need to upgrade their skill and knowledge further for personal and environmental protection. This might be a result of the lack of different facilities offering training opportunities for healthcare personnel or not having access to and using BMW Waste Management Guidelines or a different national health sector information. Similarly, it has been found that study participants had inadequate knowledge, 45 % and 40.5 % study about biomedical waste management and practice, research conducted in Nigeria and Sri Lanka respectively.[13] Very poor finding was recorded about the knowledge of storage of biomedical waste among all healthcare workers which needs to be improved a lot. According to a survey done in Andhra Pradesh, 463 undergraduate students at the ASRAM Medical College of Andhra Pradesh (216 men and 247 women) had heard of BMW; some of them were aware that it poses health risks. However, there was little understanding

Table 5. Distribution of study area as per five proxy indicators

Five Proxy Indicators	Followed in hospital areas (n=52)	Unfollowed in hospital areas (n=52)
a. Placement of 4 color-coded bins a. Lining on inner side by the similarly colored waste bag b. Segregation of BMW is done as per rule 2016 c. Sharp waste is stored in puncture proof containers d. yellow bag contain only anatomical waste and soiled infected waste	20 (38.46%)	32 (61.53%)

of the types of wastes, how long they should be stored, who should be responsible for them, the types of bags used for collection, and how to recognize the biohazard mark.[14] It was noticed in our findings that the recapping practice of needles was found to be poor among healthcare staff as well as only 63.4% of sharp were being disposed of in puncture-proof containers which could be more dangerous for the personnel as well as the surroundings. If we notice, according to our findings there is lack of information about knowledge in color coding, waste segregation, storage, sharp injury, and consequences of the needles/ sharp injury data record related to biomedical waste management. It has found that doctors, nurses, lab technicians were more aware than that of sanitary staffs. A good training for up gradation of knowledge, risk and awareness of biomedical waste practice is must and further needed in our healthcare facility. It has been noticed that training impacts positively in better practice handling and storage of biomedical waste. The study was carried out in a healthcare facility to evaluate the effect of training, assessments, edification/operations, and mindfulness level amongst healthcare workers, doctors, nurses, and associated staff, assessed by a pretested questionnaire, on the awareness and practice of BMW. According to audit and re-audit reports, awareness of the segregation of cytotoxic drugs augmented from 53% to 76%, that of the segregation and disposal of sharps increased from 90% to 98%, that of infectious plastics increased from 72% to 83%, and that of the different color bags used for segregation increased from 67% to 85%, all statistically significant increases. Sharps awareness has also statistically significantly increased from 86% to 96%, noninfectious waste segregation from 86% to 97%, and PPE awareness has increased from 77% to 96%.[14] However, only 92.38% of the study contestants had information of color-coding seclusion which is more than 78.3% conducted in health care personnel in teaching institutions of Haryana India.[15] About 77.14% of study participants have knowledge of disposing of sharp objects in puncture-proof white bins which is better than in northwest Ethiopia were knowledge was 86.3%. About 96.19% of study participants have proper knowledge regarding discarding of needle immediately after used which is better than 80% knowledge of study participants of similar study held at Haryana India.[15] The complete satisfactory attitude score of health care professionals was 91.4% which was better than the study from Nigeria. Likely due to methodological differences or the dedication of healthcare workers to waste management, the majority of survey participants in Sri Lanka and nearly all participants of the study in the Indian state of Tripura had good attitudes. In respect to waste segregation, 99.04% of participants agreed that BMW Waste Management is teamwork. About 97.14% of participants agreed that training in biomedical waste management is necessary. About 97.14% of participants agreed to voluntarily train on BMW Waste Management. About 95.23% of participants agreed of wearing PPE while handling BMW. A similar study was found in a PHC of Lucknow in which about 62.92% of studied participants agreed that BMW waste management is teamwork, and 92.13% of study participants agreed to voluntarily attend BMW waste management programs.[16] Biomedical waste management guidelines were available at tertiary care centers (93%) and secondary care centers (51.5%). Availability of color-coded lining, segregation process, hub cutter, and transportation of BMWs was not satisfactory at all types of health facilities.[17]

Waste produced was 0.52 kgs/day in tertiary care hospital. In-patient areas contribute to 71.6% of waste generated. The color-coded bins were not placed on stand as well as closed fitting covers on them were missing in majority of wards. 53.18% of the study participants did not sort waste from the moment it is produced, whereas 46.82% of the responses observed that rules for sorting and packaging waste were respected by staff. 46.82% of them separated their waste at the source and only 28.66% of the participants proceed with the separation of waste, while the remaining 71.34% did not respect it.[18] Almost half of the nurses (48%) had excellent knowledge (>70% score) about biomedical waste management and one-fifth (18%) of them displayed poor knowledge (<50% score) about the same.[19] 2056.8%, 66.2% and 77.4% of the health care workers had adequate knowledge, favorable attitude, and adequate practice score, respectively.[12] The knowledge among healthcare workers was satisfactory, but comparatively group D workers were lagging behind. All of the health care workers had a good attitude towards BMW management but practices on BMW management needs improvement mostly among group D workers as per the study done by Basavaraj et al.[20] In another study, 105 (41%) healthcare professionals had excellent knowledge, 87 (34%) had good knowledge, and 64 (25%) had poor knowledge regarding practice, 72 (28.1%) HCPs used and discarded PPE while handling biomedical wastes. Additionally, 88 (34.4%) followed proper hand hygiene before and after each procedure and whenever needed. Physicians, nurses, and respiratory therapists had a more favourable attitude than other HCPs.[21] A total of 450 health care professionals (HCPs) participated in the training program. Cognitive domain score increased from 16.3 ± 2.4 to 21.3 ± 2.0 from pre to post test, respectively. In psychomotor domain, pre and post test scores for HH were 8.3 ± 3.5 and 14.3 ± 1.4, for BMWM.[22] There was deficiencies in the knowledge and practices of BMW management and also the lack of training among various categories of operation room personnel. The attitude was found favourable among all healthcare personnel, they were not armed with appropriate and adequate knowledge to translate into favourable and right practices with respect to BMW.[23] The proportion of health care workers who had good practices in biomedical waste management was 49.4%. Participants who had MSc education level and bachelor's degree, got training on biomedical waste management access to color-coded bins in their working department and those who had good attitude were significantly associated with biomedical waste management practices in private hospitals.[24] The other study discovered deficiencies and inefficiencies in the current waste management system, which could exacerbate vaccine-waste mishandling and leakage into the environment, resulting in a new environmental crisis.[25]

CONCLUSION

The current study came to the conclusion that medical staff has good knowledge, attitude and practice about biological waste management than the paramedical and non-medical professionals. Because the workers regularly manage and handle biomedical waste, there is an imperative necessity for orientation on the subject for the entire healthcare workforce, particularly para and non-medical workers, in order to guard both them and those visiting the hospital and the surrounding community. A separate committee that was constituted solely for the purpose of enforcing rules relating to the harmless supervision and treatment of healthcare waste is also required, as is the rigorous application of biomedical waste management guidelines and routine oversight and monitoring by that commission. In wrapping up, the government of India has sufficient rules and regulations regarding the disposal of BMWs; however, the existing standards of conduct are not sufficient. It is urgently important to raise public knowledge of the laws and their stringent enforcement.

Recommendations

- Hospital executives should communicate regular employee training sessions, as well as Pollution Control Boards should monitor effectively and frequently.
- Biomedical waste management Committee should supervise and monitor the implementation of rules and guidelines

regarding safe biomedical waste management.

- Accessibility of all color-coded bins in the departments /working sections should be available with inner lining and stands.
- Routine training camps should be organized to upgrade skills and knowledge.
- Routine evaluation of the employees should be done.
- Exclusive sensitization training programs should be planned for floor sweepers, housekeeping staff, and daily wage labors in the local verbal programme highlighting the importance of using personal protective procedures.
- Multicentric longitudinal study should be planned for biomedical waste management practice in Chhattisgarh, India, as poor practice may lead to various hospital-acquired infections not only among healthcare workers but also in other parts of society.

ACKNOWLEDGMENTS

None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

KJ, VJ, NV and NS conceptualized and designed the study. TD collected data. NS and TD performed experiments, compiled results and wrote the manuscript. NV, KJ, and VJ supervised the study. All authors read and approved the final manuscript for publication.

FUNDING

This study was supported by National Health Mission (NHM), and the Department of Health & Family Welfare, Raipur, Chhattisgarh, India with letter No./NUHM/2021/663/795.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

Not applicable.

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