



A Descriptive Cross-Sectional Study to Assess the Practice Regarding Biomedical Waste Management among Healthcare Workers at Selected Hospitals of District, Mohali, Punjab

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Abstract

Background: Biomedical waste management is essential for preventing healthcare-associated infections and environmental contamination. Proper waste segregation, handling, and disposal by healthcare workers are critical for ensuring patient safety and regulatory compliance.

Objectives: The objective of this study was to assess the practices regarding biomedical waste management among healthcare workers at selected hospitals of District Mohali, Punjab.

Methodology: A quantitative descriptive study was conducted at Behgal Cancer Hospital and Indus Superspeciality Hospital, Mohali, Punjab from March 2026 to May 2026. A total of 150 healthcare workers were selected using a convenient sampling technique. Data were collected using a self-structured observational practice checklist and analyzed using descriptive statistics (frequency, percentage, mean, median, and standard deviation) and inferential statistics (Chi-square test).

Results: Among 150 healthcare workers, 128 (85.3%) demonstrated good practice, 22 (14.7%) demonstrated average practice, and none demonstrated poor practice. The mean practice score was 39.51, the median was 41, and the standard deviation was 5.14. Practice scores showed significant associations with educational qualification, designation, professional experience, and working shift, whereas no significant association was observed with age and gender.

Conclusion: Most healthcare workers demonstrated good biomedical waste management practices. Continuous in-service education, periodic monitoring, reinforcement of Biomedical Waste Management Rules, and regular supervision are recommended to sustain compliance, improve identified practice gaps, and enhance patient safety and environmental protection.

Keywords: Biomedical waste management, healthcare workers, hospital waste, infection control, practice

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INTRODUCTION

Bio-Medical Waste refers to any waste that is produced during the process of diagnosing, treating, or immunizing humans or animals, conducting research activities, or manufacturing and testing biological products in health camps. This waste falls into the categories mentioned in Schedule – I.^[1] Recent studies have highlighted continuing challenges in biomedical waste management among healthcare personnel. Sahoo *et al.*

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reported that inappropriate biomedical waste segregation remained a concern among healthcare professionals in a tertiary-care teaching hospital in Eastern India, emphasizing the importance of staff training, monitoring, and appropriate infrastructure.^[2] Dengela and Sorato, in a study among healthcare workers in public healthcare facilities in Ethiopia, reported gaps in healthcare waste management practices and emphasized regular training, monitoring, and supervision to improve compliance.^[3]

Efficient management of biomedical waste is crucial in the healthcare industry. The lack of proper waste management, limited awareness about the health risks associated with biomedical waste, inadequate financial and human resources, and ineffective waste disposal control pose significant challenges in healthcare waste management.^[4]

India generates approximately 2 kg of biomedical waste per bed per day. This type of waste includes anatomical waste, cytotoxic waste, and sharps. Improper segregation of these wastes can lead to the spread of deadly infectious diseases such as HIV and Hepatitis C and B infections. It can also have negative effects on the environment and disrupt the ecological balance.^[5]

Having a thorough understanding of the rules and regulations surrounding biomedical waste management is crucial for healthcare employees. This knowledge will enable them to effectively dispose of waste in their organizations.^[6]

Effective management of biomedical waste starts with proper waste generation, segregation, storage, disinfection, and transfer to the disposal site. These steps are crucial in ensuring the safe and appropriate disposal of waste. Therefore, the expertise, professionalism, and dedication of the staff at healthcare institutes are crucial.^[7]

Healthcare workers play a crucial role in ensuring effective biomedical waste management because they are directly involved in waste generation and disposal processes. Their practices significantly influence infection control measures, patient safety, and maintenance of a safe hospital environment. The present study was undertaken to assess the practice regarding Biomedical Waste Management among healthcare workers at selected hospitals of District, Mohali, Punjab.

METHODOLOGY

Data collection

Study period

Data collection was carried out from April 25, 2026, to May 10, 2026, among 150 healthcare workers at Behgal Cancer Hospital, Mohali, Punjab and Indus Super Specialty Hospital, Mohali Punjab.

Research approach

A quantitative research approach was adopted for the present study to assess the practice regarding biomedical waste management among healthcare workers at selected Hospitals of District Mohali, Punjab.

Research design

A descriptive research design was used to assess the practices regarding biomedical waste management among healthcare workers at selected Hospitals of District Mohali, Punjab.

Research setting

The study was conducted at Behgal Cancer Hospital and Indus Superspecialty Hospital of Mohali district, Punjab.

Target population

The target population of present study was healthcare workers working in selected hospitals of Mohali district.

Sample size and sampling technique

A sample size of 150 healthcare workers was selected from the accessible population of healthcare workers in the selected hospitals of District Mohali, Punjab. The sample size was considered adequate for the descriptive assessment of biomedical waste management practices within the selected study setting and was feasible to recruit during the data collection period. A convenient sampling technique was used to select the participants who met the inclusion criteria and were available during the period of data collection.

Inclusion criteria

1. Healthcare workers who were available during the period of data collection
2. Healthcare workers who were willing to participate in the study
3. Healthcare workers who were working in the selected hospitals of District Mohali during the data collection period.

Exclusion criteria

1. Healthcare workers who were absent during data collection
2. Administrative staff and non-healthcare workers.

Description of final tool

The tool consisted of two sections:

Section A: Socio-demographic variables

This section included variables such as age, gender, educational qualification, designation, professional experience, type of hospital, working shift, and previous training on biomedical waste management.

Section B: Self-structured observational practice checklist

A self-structured observational checklist consisting of 45 items was used to assess the practice of healthcare workers regarding biomedical waste management. The checklist included items related to biomedical waste management practices such as segregation, color coding, handling, disposal, and use of personal protective measures. Each item was assessed through direct observation. A score of 1 was assigned for appropriate practice and 0 for inappropriate practice. The total possible score ranged from 0 to 45. The practice level was interpreted

as good practice (31–45), average practice (16–30), and poor practice (0–15).

Criteria measurement

Level of practice	Score
Good practice	31–45
Average practice	16–30
Poor practice	0–15

Validity of tool

The validity of tool was determined by expert's opinion. The tool was given to nursing and community experts. As per the guidance and suggestions from the experts, the suggested amendments were made in the tool after discussion with research supervisor.

Pilot study

The pilot study was conducted on 15 healthcare workers at ClearMedi Bahra Multispeciality Hospital, Kharar, Mohali on April 15, 2026, to assess the feasibility of the study. The pilot study findings showed that the tool was clear and feasible for the main study.

Reliability of tool

The reliability of the self-structured observation practice checklist was established using split-half method. The 45 items were divided into two halves, and the scores obtained from the two halves were correlated using the Karl Pearson correlation coefficient. The obtained reliability coefficient was 0.98, indicating a high level of internal consistency and reliability of the tool.

Data collection procedure

Formal Permission was obtained from the Director Principal of Rayat Bahra College of Nursing Mohali, Punjab and from concerned hospital authorities before data collection. The participants were informed about the purpose of the study and their consent was obtained. Data were collected from April 25, 2026, to May 10, 2026, among 150 healthcare workers. The practice regarding biomedical waste management was assessed through direct observation using a self-structured observational practice checklist consisting of 45 items. The data were collected by the researcher personally through direct observation during routine work activities.

Plan for data analysis

Data analysis and interpretation were performed according to the objectives of the study. Microsoft Excel was used for data compilation and tabulation, and the Statistical Package for the Social Sciences, version 18, was used for statistical analysis. Descriptive statistics, including frequency, percentage, mean, median, standard deviation, minimum, maximum, range, and mean percentage, were used to summarize the data. The Chi-square (χ^2) test was used to determine the association between the level of biomedical waste management practice and selected socio-demographic variables. For demographic variables having no variation in responses, statistical association testing

was considered not applicable. The level of statistical significance was set at $P \leq 0.05$; $P \leq 0.05$ was considered statistically significant, whereas $P > 0.05$ was considered statistically non-significant.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of Rayat Bahra College of Nursing, Mohali, Punjab on April 10, 2026. Written permission was taken from the Director Principal of Rayat Bahra College of Nursing, Mohali, Punjab, and from the concerned hospital authorities before commencement of data collection. Informed consent was obtained from the participants. Confidentiality and anonymity of the participants were maintained throughout the study.

Data analysis

Distribution of healthcare workers according to their socio-demographic variables

Table 1 reveals that majority of healthcare workers (59%) were in the age group of 20–30 years.

Regarding gender, 59% were female and 41% were male. With respect to educational qualification, the highest proportion of healthcare workers had B.Sc. Nursing qualification (24%).

Table 1: Frequency and percentage distribution of healthcare workers according to their socio-demographic variables

Variables	Options	Frequency	Percentage
Age in years	20–30 years	89	59
	31–40 years	48	32
	41–50 years	11	7
	51–60 years	2	1
Gender	Male	62	41
	Female	88	59
	Others	0	0
Educational qualification	B.Sc. Nursing	36	24
	Post Basic B.Sc. Nursing	25	17
	GNM	28	19
	B.Sc. MLT	13	9
	DMLT	7	5
	BSC RIT	16	11
	10 th pass	13	9
Designation	8 th pass	12	8
	Staff nurse	89	59
	Lab technician	20	13
	GDAs	24	16
	Radiology technologist	17	11
	0–1 years	42	28
	2–5 years	95	63
Professional experience	6–10 years	11	7
	11–14 years	1	1
	More than 15 years	1	1
	Government	0	0
	Private	150	100
Type of hospital	Morning	80	53
	Evening	70	47
	Night	0	0
Have you received training on biomedical waste management	Yes	150	100
	No	0	0

Regarding designation, majority of healthcare workers were staff nurses (59%). In terms of professional experience, most healthcare workers had 2–5 years of experience. All healthcare workers (100%) were working in private hospitals with the majority (53%) working in morning shifts and (47%) in evening shifts. Furthermore, all healthcare workers (100%) had received training on biomedical waste management.

Practice score regarding biomedical waste management among healthcare workers

Objective 1: To assess the practice regarding biomedical waste management among healthcare workers at selected hospitals of District, Mohali, Punjab.

Table 2 reveals that out of 150 healthcare workers, the majority of the healthcare workers (128) had good practice scores (31–45), indicating that most healthcare workers are following appropriate biomedical waste management practices. A smaller proportion (22) fall under the average practice category (16–30), suggesting moderate adherence to recommended practices. Notably, no participants fall into the poor practice category (0–15), reflecting the absence of inadequate practice among the subjects.

Descriptive statistics of practice scores

Table 3 shows that the mean practice score was 39.51, the median was 41, and standard deviation was 5.14. The maximum score obtained was 45 and minimum was 27, giving a range of 18. The mean percentage of 87.81% further confirms that the overall practice level of healthcare workers was good regarding biomedical waste management.

Association between practice of healthcare workers and selected socio-demographic variables

Objective 2: To find out association between practice scores with their selected socio-demographic variables.

Before applying the Chi-square test, the assumptions for the test, including independence of observations and adequacy of expected cell frequencies, were assessed. The Chi-square test was applied only to variables for which the assumptions were considered appropriate.

Table 4 reveals that there was statistically significant association between the practice scores regarding biomedical

waste management and selected socio-demographic variables, namely, educational qualification ($X^2 = 22.00$, $P \leq 0.001$), designation ($X^2 = 17.89$, $P \leq 0.001$), and working shift ($X^2 = 7.04$, $P = 0.01$).

However, no statistically significant association was found between practice scores and age in years ($X^2 = 4.86$, $P = 0.18$) and gender ($X^2 = 0.96$, $P = 0.33$).

Association with type of hospital and training on biomedical waste management could not be computed because all healthcare workers belonged to private hospitals and all had received training on biomedical waste management.

These findings indicate that the practice regarding biomedical waste management was significantly influenced by educational qualification, designation, professional experience, and working shift, whereas age and gender did not have a significant influence on practice scores.

DISCUSSION

The present study found that the majority of healthcare workers demonstrated good practice regarding biomedical waste management, indicating generally appropriate compliance with recommended waste-handling procedures in the selected hospitals.

These findings are supported by evidence from India. Sahoo *et al.*, in a tertiary care teaching hospital in Eastern India, reported that biomedical waste segregation compliance improved substantially from 57% to 91% following staff training, monitoring, improved infrastructure, and the use of educational materials.^[2]

Similarly, a study conducted by Manickam Dominic Savio *et al.*, among 356 healthcare workers in four tertiary care teaching hospitals in South India found that 72.1% demonstrated correct knowledge of biomedical waste segregation, although field observations showed inconsistent compliance.^[8]

Internationally, Atalay and Gelaw, in a systematic review and meta-analysis of 15 studies involving 5260 healthcare workers in Ethiopia, reported a pooled prevalence of appropriate healthcare waste management practice of 52.86%. Training and the availability of waste-management guidelines were identified as important factors associated with better practice.^[9]

These findings support the present study by suggesting that adequate knowledge, training, monitoring, and institutional support contribute to better biomedical waste management practices.

Overall, the study concludes that healthcare workers possess satisfactory practice regarding biomedical waste management.

Table 2: Practice scores regarding biomedical waste management among healthcare workers (n=150)

Criteria measure of practice score		
Level of scores	Frequency	Percentage
Good practice (31–45)	128	85.3
Average practice (16–30)	22	14.7
Poor practice (0–15)	0	0.0

Maximum=45 Minimum=0

Table 3: Descriptive statistics of practice scores of healthcare workers regarding biomedical waste management (n=150)

Descriptive statistics	Mean	Median	S.D.	Maximum	Minimum	Range	Mean%
Practice score	39.51	41	5.14	45	27	18	87.81

SD: Standard deviation

Table 4: Association between the level of practice regarding biomedical waste management among healthcare workers and their selected socio-demographic variables (n=150)

Demographic data		Levels of practice (n=150)			Association with practice score				
Variables	Opts	Good practice	Average practice	Poor practice	χ^2	P-value	df	Table value	Result
Age in years	20–30 years	78	11		4.86	0.18	3	7.81	Not significant
	31–40 years	41	7						
	41–50 years	7	4						
	51–60 years	2	0						
Gender	Male	55	7		0.96	0.33	1	3.84	Not significant
	Female	73	15						
	Others	0	0						
Educational qualification	B.Sc. Nursing	34	2		22.00	<0.001	7	14.07	Significant
	Post Basic B.Sc. Nursing	24	1						
	GNM	23	5						
	B.Sc. MLT	13	0						
	DMLT	6	1						
	BSC RIT	13	3						
	10 th Pass	9	4						
	8 th Pass	6	6						
	Staff Nurse	81	8						
Designation	Lab technician	19	1		17.89	<0.001	3	7.81	Significant
	GDA's	14	10						
	Radiology Technologist	14	3						
Professional experience	0–1 years	30	12		9.90	0.04	4	9.49	Significant
	2–5 years	87	8						
	6–10 years	9	2						
	11–14 years	1	0						
	More than 15 years	1	0						
Type of hospital	Government	0	0		NA				
	Private	128	22						
Working shift	Morning	74	6		7.04	0.01	1	3.84	Significant
	Evening	54	16						
	Night	0	0						
Have you received training on biomedical waste management	Yes	128	22		NA				
	No	0	0						

NA: Not applicable. The Chi-square test could not be computed for variables with only one observed category, as there was no variability in the data

Continuous training programs, supervision, and reinforcement of biomedical waste management guidelines are essential to further improve safe waste handling practices and maintain infection control standards in healthcare settings.

The significant association between educational qualification and biomedical waste management practice may be explained by the greater exposure to scientific knowledge, infection prevention principles, and formal training among healthcare workers with higher educational qualifications. Similarly, the association with designation may be related to differences in professional responsibilities, clinical exposure, and accountability for biomedical waste handling among different categories of healthcare workers.

Professional experience was also significantly associated with practice, which may be attributed to greater familiarity with institutional biomedical waste management procedures and accumulated practical experience over time. The significant association with working shift may be related to differences in workload, staffing patterns, supervision, and availability of resources across shifts, which may influence adherence to biomedical waste management practices.

In contrast, age and gender did not show statistically significant associations, suggesting that these characteristics may have had less influence on biomedical waste management practice in the present study setting.

These findings highlight the importance of strengthening competency-based training, regular supervision, and workplace support across all professional categories and working shifts, particularly among healthcare workers who may have less formal education, shorter professional experience, or limited access to supervision and training.

Practical implications for clinical practice and healthcare policy

The findings of the present study have important implications for clinical practice and healthcare policy. Since the majority of healthcare workers demonstrated good practice regarding biomedical waste management, existing waste management practices should be maintained and continuously reinforced through regular supervision and monitoring. The significant association between practice scores and educational qualification, designation, professional experience, and working shift indicates the need for targeted training and supportive supervision for

healthcare workers with different levels of education, experience, and professional responsibilities.

The study found statistically significant associations between biomedical waste management practice scores and educational qualification ($\chi^2 = 22.00, P \leq 0.001$), designation ($\chi^2 = 17.89, P \leq 0.001$), professional experience ($\chi^2 = 9.90, P = 0.04$), and working shift ($\chi^2 = 7.04, P = 0.01$). These findings suggest the need for targeted training and supportive supervision according to the educational background, professional role, experience, and working responsibilities of healthcare workers.

In clinical practice, hospitals should conduct regular refresher training on biomedical waste segregation, collection, transportation, handling, and disposal according to prescribed guidelines. Periodic observational audits and feedback can help identify gaps in practice and promote consistent compliance among healthcare workers.

From a healthcare policy perspective, hospital administrations should strengthen biomedical waste management policies by ensuring adequate infrastructure, appropriate color-coded waste containers, clear signage, regular monitoring, and continuing education programs. Biomedical waste management practices should also be incorporated into routine quality assurance, infection prevention and control activities, and staff orientation programs. These measures can support safe waste handling, reduce occupational and environmental risks, and promote compliance with biomedical waste management standards.

Study limitations

1. The study was conducted in only two selected hospitals of District Mohali, Punjab; therefore, the findings may not be generalizable to all the healthcare workers or hospitals in other settings.
2. Convenience sampling was used to select 150 healthcare workers, which may have introduced selection bias and may limit the generalizability of the findings.
3. The study assessed biomedical waste management practices using a self-structured observational checklist, and the observations were conducted during the study period; therefore, the observed practices may not fully represent the participants' routine practices at all times.
4. The data collection was conducted over a limited period (April 25–May 10, 2026), which may not capture variations in biomedical waste management practices across different periods or workloads.

CONCLUSION

From the findings of the present study, the following conclusions were drawn: The present study highlights the importance of maintaining effective biomedical waste management practices among healthcare workers to promote safe waste handling, prevent occupational and environmental hazards, and support infection prevention in healthcare settings. The findings indicate that healthcare workers in the selected hospitals generally demonstrated good practice regarding biomedical

waste management. However, the significant associations observed with educational qualification, designation, professional experience, and working shift highlight the need for continued attention to variations in practice among healthcare workers. Therefore, regular training, supportive supervision, monitoring, and reinforcement of biomedical waste management guidelines are important to sustain good practices and address potential gaps. The findings of the study can provide useful direction to healthcare professionals, hospital administrators, and policymakers in strengthening biomedical waste management practices and promoting a safer healthcare environment.

RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are made:

1. Regular training programs on biomedical waste management should be conducted for healthcare workers to maintain and further improve safe waste management practices.
2. Refresher training and orientation programs should be provided periodically, particularly for healthcare workers with different educational qualifications, designations, professional experience, and working shifts.
3. Regular monitoring and supervision of biomedical waste segregation, collection, handling, and disposal practices should be carried out by hospital authorities.
4. Healthcare institutions should ensure adequate biomedical waste management infrastructure, including appropriate color-coded containers, waste collection facilities, and clear instructions for proper segregation and disposal.
5. Biomedical waste management should be incorporated into staff induction and continuing in-service education programs for healthcare workers.
6. Hospital administrators and infection prevention and control teams should conduct periodic observational audits and provide feedback to healthcare workers to strengthen compliance with biomedical waste management guidelines.
7. Future researchers should conduct similar studies with larger sample sizes and in multiple hospitals or different geographical settings to improve the generalizability of the findings.
8. Future studies may use probability sampling techniques and longer observation periods to obtain more representative findings regarding biomedical waste management practices.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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