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Original Article

Knowledge, Attitude, and Practices About Biomedical Waste Management Among Emergency Department Healthcare Personnel in A Tertiary Care Hospital, India

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ABSTRACT

Background: Biomedical waste (BMW) poses significant risks to healthcare workers, patients, and the environment. Although India's Biomedical Waste Management Rules (1998; amended 2016) mandate safe handling, compliance in high-pressure areas like emergency departments (EDs) remains challenging. This study assessed knowledge, attitudes, and practices (KAP) regarding BMW management among ED healthcare personnel in a tertiary care hospital.

Methods: A cross-sectional study was conducted from October–December 2024 among ED staff with ≥6 months of experience. Of 210 eligible, 175 participated. Data were collected via a pretested Google Forms questionnaire assessing socio-demographics, BMW knowledge (20 items), practices (10 items), and attitudes (10 Likert-scale items). Associations between knowledge and demographics were tested using chi-square ($p \leq 0.05$).

Results: Most participants were aged 26–30 years (40.6%) and nursing officers (54.3%); 49.7% had BMW training in the past year. Knowledge was excellent in 76%, good in 21%, and poor in 3%, with higher scores linked to education, occupation, experience, and training ($p < 0.05$). While 73.1% always segregated BMW by color coding, only 33.1% consistently used PPE and 41.7% performed hand hygiene. Needle cutter use was low (7.4%). Attitudes were largely positive, supporting safety and regular updates.

Conclusion: Despite high knowledge and favorable attitudes, ED staff showed gaps in safe BMW practices, highlighting the need for regular hands-on training, adequate resources, and behavioral reinforcement.

Keywords: *Biomedical waste, Knowledge, Attitude, Practices, Emergency Department, India.*

INTRODUCTION

Biomedical waste (BMW) generated in healthcare facilities contains infectious and hazardous materials that pose risks to healthcare workers, patients, and the environment. Improper segregation, handling, or disposal can lead to occupational injuries, disease transmission, and environmental contamination. The World Health Organization estimates that around 15% of healthcare waste is hazardous, underscoring the need for strict management [1].In India, the Biomedical Waste Management Rules (1998; amended 2016) mandate systematic segregation, collection, transport, and disposal. Despite these regulations, compliance varies, particularly in high-stress clinical areas such as emergency departments (EDs), where heavy patient loads and urgent care demands may compromise best practices [2,3].Evaluating the knowledge, attitudes, and practices (KAP) of ED healthcare personnel is essential for identifying gaps and strengthening compliance. This study assesses the KAP related to BMW management among ED staff in a tertiary care hospital in India, aiming to inform targeted training, improve safety, and enhance adherence to national waste management protocols.

METHODOLOGY

A cross-sectional observational study was conducted over three months (October–December 2024) in the Emergency Department (ED) of a tertiary care hospital in India. The study included healthcare personnel (HCPs) with more than six months of ED experience, excluding temporary staff. Ethical clearance was obtained from the Institutional Ethics Committee (Ref. no: AIIMS/IEC/24/569). Of the 210 ED staff members, 197 met the eligibility criteria. The required sample size was calculated using the formula for finite populations with N = 210, Z = 1.96 (99% confidence), p = 0.41 (from a previous study), and e = 0.05, resulting in 159 participants; adjusting for a 10% non-response rate, the target sample size was 175. Participants were categorized as ED doctors, nursing officers, emergency lab technicians, and supporting staff, and written informed consent was obtained.

Data were collected via a pretested, self-administered Google Forms questionnaire comprising five sections: (1) socio-demographic details (age, gender, education, occupation, and ED experience); (2) knowledge of biomedical waste (BMW) management, assessed through 20 multiple-choice questions scored 0–20 and categorized as excellent (15–20), good (10–14), or poor (<10); (3) observed BMW management practices, assessed through 10 items with "always," "sometimes," or "never" options; (4) attitudes toward BMW management, measured on a 10-item five-point Likert scale, with negatively worded items reverse-coded and scores dichotomized into favorable/unfavorable based on the mean; and (5) knowledge of needle stick injuries, assessed through 10 Yes/No questions.

STATISTICAL ANALYSIS

Data was analyzed using Statistical Package for Social Sciences (SPSS), Version 21.0 (IBM Corp. Released 2012. Armonk, NY, USA: IBM Corp.). Numbers and percentages were tabulated using frequency distribution. Mean and standard deviation were calculated using descriptive statistics. Chi-square analysis was employed to test the association between the knowledge of healthcare personnel on BMW management and their demographic characteristics, with a p-value of 0.05 or less considered statistically significant.

RESULTS

Of the 175 participants, the majority of participants were aged 26–30 years (40.6%), with females constituting 54.3% of the sample. Nursing officers formed the largest professional group (54.3%), and most participants had 1–5 years of emergency department experience (67%). Nearly half of the participants (49.7%) had received biomedical waste management training in the previous year. The detailed socio-demographic characteristics of the study population are presented in table 1.

Table 1: Demographic details of the Emergency department health care personal

Demographic details	Frequency (n=175) (%)
Age categories	
21-25 yrs	42 (24)
26-30 yrs	71 (40.6)
31-40 yrs	42 (24)
41-50 yrs	17 (9.7)
51-60 yrs	3 (1.7)
Gender	
Female	95 (54.3)
Male	80 (45.7)
Educational qualifications	
BSC MLT	8 (4.6)
BSC Nursing	83 (47.4)
GNM	12 (6.9)
Matriculation	17 (9.7)
MBBS	24 (13.7)
MD	12 (6.9)
Pre matriculation	19 (10.9)
Occupation	
Emergency Physician (Doctor)	36 (20.6)
Emergency lab technician	8 (4.6)
Nursing officer	95 (54.3)
Support staff	36 (20.6)
ED work experience	
< 1 year	37 (21)
1-5 years	117 (67)
6-10 years	20 (11.5)
>10 years	1 (0.5)
BMW management training in last year	

Attended	87 (49.7)
Not attended	88 (50.3)

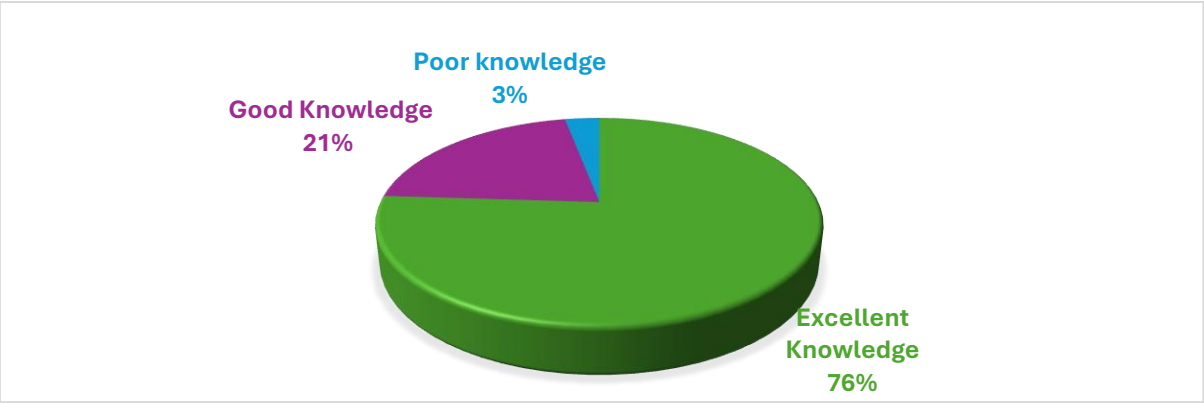

Figure 1 shows that a majority of ED staff demonstrated good to excellent knowledge regarding biomedical waste (BMW) management.

Figure 1 BMW Management Knowledge among ED staff

Self-reported practices revealed variation despite high knowledge levels (Table 2). While 73.1% of participants always segregated BMW according to color coding, only 33.1% always wore PPE during procedures, and 41.7% consistently performed handwashing before and after procedures. Use of needle cutters was infrequent, with only 7.4% always using them. Over half (51.4%) reported always discarding BMW themselves after a procedure, whereas 44% admitted to delegating disposal to colleagues. Regular checking of segregation bins at the start and end of duty was less consistent, with only about one-quarter doing so always.

Table 2: Self-Reported Biomedical Waste Management Practices Among ED Staff

	Always	sometimes	Never
1.Do you wear Personal protective equipment PPE while doing a Procedure?	58 (33.1%)	107 (61.1%)	10(5.7%)
2.Do you perform handwashing before and after a medical procedure?	73(41.7%)	102(58.3%)	0
3.Do you recap the syringe needless safely after use?	89(50.9%)	82(46.9%)	4(2.3%)
4.Do you check Biomedical waste segregation bins at your duty starting?	41(23.4%)	97(55.4%)	37(21.2%)
5.Do you check Biomedical waste segregation bins at your duty ending?	44(25.1%)	92(52.6%)	39(22.4%)
6.Do you use needle cutter?	13(7.4%)	107(61.2%)	55(31.4%)
7.Do you discard BMW by yourself after procedure?	90(51.4%)	85(48.6%)	0
8.Do you order to discard BMW by your colleague staff after a procedure?	16(9.1%)	82(46.9%)	77(44%)
9.Do you segregate the Biomedical waste as per color coding?	128(73.1%)	46(26.3%)	1(0.6%)
10.Do you inform authority about untoward incidents in BMW disposal?	98(56%)	65(37.1%)	12(6.9%)

Attitudes toward BMW management were predominantly favorable (Table 3). Nearly all participants agreed or strongly agreed that safe disposal is necessary in the ED (98.2%) and that BMW management is a team effort (100%). Most disagreed with negative statements regarding BMW being an extra burden (60.6%), a major infection risk (65.7%), or excessively time-consuming (61.2%). A large majority supported the use of PPE (77.7%), color-coded segregation (93.2%), and regular knowledge updates (98.3%). Most also recognized BMW management's role in infection prevention (99.4%) and quality assurance (100%).

Table 3: Attitude About BMW Management Among ED Staff

	Agree	**Neutral**	**Strongly agree**	**Disagree**	**Strongly disagree**
1.Safe disposal of BMW is necessary in ED	44(25.1%)	3(1.7%)	128(73.1%)	0	0
2.BMW management is a teamwork	49(28%)	0	126(72%)	0	0
3.BMW management creates extra	31(17.7%)	18(10.3%)	20(11.4%)	36(20.6%)	70(40%)

burden on my work*					
4.BMW management is risk to transmit any infectious diseases*	23(13.1%)	10(5.7%)	27(15.4%)	39(22.3%)	76(43.4%)
5.Segregating biomedical waste into different category is time consuming*	31(17.7%)	23(13.1%)	14(8%)	33(18.9%)	74(42.3%)
6.PPE is must while handling biomedical waste in Emergency department	50(28.6%)	37((21.1%)	36(20.6%)	49(28%)	3(1.7%)
7.Use of colour code for segregation of BMW is must	71(40.6)	35(20%)	57(32.6%)	12(6.9%)	0
8.Proper handling of Biomedical waste reduces the infection and hazard	46(26.3%)	0	128(73.1%)	1(06%)	0
9.Proper BMW management enhance the quality assurance of health care sectors.	47(26.9%)	0	128(73.1%)	0	0
10.Regular Upgrade of knowledge on BMW management is mandatory	40(22.9%)	3(1.7%)	132(75.4%)	0	0

Table 4 shows knowledge levels with frequency and percentage across groups. Significant associations were observed for age (p=0.009), experience (p=0.024), occupation (p=0.000), attitude (p=0.010), and training (p=0.000). Younger participants, physicians, nurses, favorable attitudes, and training showed higher excellent knowledge, while older and supporting staff reported poorer knowledge.

Table 4: Association with level of knowledge onBMW Management Among ED Staff

Age Group	ExcellentKnowledge	GoodKnowledge	PoorKnowledge	Total	P-value
21–25 years	40 (85.1%)	2 (4.3%)	0 (0.0%)	47	0.009
26–30 years	59 (83.1%)	11 (15.5%)	1 (1.4%)	71	
31–40 years	28 (66.7%)	12 (28.6%)	2 (4.8%)	42	
41–50 years	6 (35.3%)	10 (58.8%)	1 (5.9%)	17	
51–60 years	0 (0.0%)	2 (66.7%)	1 (33.3%)	3	
Experience Category					
>10 years	1 (100.0%)	0 (0.0%)	0 (0.0%)	1	0.024
6–10 years	17 (85.0%)	3 (15.0%)	0 (0.0%)	20	
1–5 years	82 (70.1%)	30 (25.6%)	5 (4.3%)	117	
<1 year	33 (89.2%)	4 (10.8%)	0 (0.0%)	37	
Occupation					
Emergency Lab Technician	5 (62.5%)	3 (37.5%)	0 (0.0%)	8	0.00
Emergency Physician	36 (100.0%)	0 (0.0%)	0 (0.0%)	36	
Nursing Officer	91 (95.8%)	4 (4.2%)	0 (0.0%)	95	
Supporting Staff	1 (2.8%)	30 (83.3%)	5 (13.9%)	36	
Attitude Type					
Favourable Attitude	87 (91.6%)	16 (16.8%)	1 (1.1%)	95	0.010
Unfavourable Attitude	46 (57.5%)	21 (26.3%)	4 (5.0%)	80	
Training in Last Year					
No	53 (60.2%)	30 (34.1%)	5 (5.7%)	88	0.000
Yes	80 (92.0%)	7 (8.0%)	0 (0.0%)	87	

DISCUSSSION

This study examined the knowledge, attitudes, and practices related to biomedical waste (BMW) management among healthcare personnel working in the Emergency Department (ED) of a tertiary care hospital. The ED presents unique challenges for BMW management due to high patient turnover, rapid clinical decision-making, stressful working conditions, and frequent exposure to infectious materials and sharps.

The participant profile reflected a predominantly young workforce, with the largest age group being 26–30 years (40.6%). Females formed a slight majority (54.3%), and nursing officers constituted the largest occupational group (54.3%), followed by emergency physicians and support staff (20.6% each). Most participants (67%) had 1–5 years of ED experience, and only about half (49.7%) had attended BMW management training in the past year, indicating a need to expand training coverage, particularly for support staff.

Overall, knowledge levels regarding BMW management were high, with 76% of participants demonstrating excellent knowledge, 21% good knowledge, and only 3% poor knowledge. These findings compare favorably to the work of Mathur et al. (2011) [3], who reported adequate knowledge among only 58% of healthcare workers, and are more closely aligned with Akkajit et al. (2020) [4] in Thailand, who found that 89.5% of trained healthcare workers possessed high levels of knowledge. In the present study, knowledge was significantly associated with educational qualification ($p < 0.001$), occupation ($p < 0.001$), and years of experience ($p < 0.05$), with higher scores among more educated staff and those in clinical roles. Training status was also a strong predictor, with trained participants showing significantly better knowledge ($p = 0.000$). These results echo findings from Lavanya et al. (2018) [5] and Gupta et al. (2016) [6], both of whom reported lower knowledge among support staff and less-educated participants.

Despite the strong knowledge base, BMW management practices were inconsistent. Only 33.1% consistently wore PPE during procedures, and 41.7% always performed hand hygiene before and after medical procedures. Half of the participants (50.9%) reported always recapping syringes safely, despite evidence from Jalal et al. (2019) [7] that recapping increases the risk of needle stick injuries. Routine checks of BMW segregation bins were infrequent, with only 23.4% doing so at the start of duty and 25.1% at the end. The most consistently followed practice was color-coded segregation (73.1%). A majority (51.4%) always discarded BMW themselves after procedures, while 44% never delegated disposal to colleagues. Needle cutter usage was particularly low, with only 7.4% always using them—similar to the observations of Patil and Shekdar (2001) [8], who reported that fewer than 30% of staff followed correct needle disposal protocols. These findings are in line with the observations of Jalal et al. (2019) [7], who found that high knowledge does not guarantee compliance, with only 28.1% consistently using PPE and 34.4% following hand hygiene guidelines.

Attitudes toward BMW management were generally positive, with an overall mean score of 4.19 ± 0.50. Most participants strongly agreed that safe disposal in the ED is necessary (73.1%), that BMW management is a team effort (72%), and that proper handling reduces infection and hazards (73.1%). A similar proportion strongly agreed that BMW management enhances quality assurance (73.1%) and that regular knowledge updates are essential (75.4%). Negative perceptions were minimal, with 43.4% strongly disagreeing that BMW management is a burden and 42.3% strongly disagreeing that segregation is time-consuming. This overall favorable attitude mirrors earlier findings by Rao et al. (2004) [9], who also observed strong agreement among healthcare workers on the importance of BMW management despite workload pressures.

The findings indicate that while ED staff have high knowledge and favorable attitudes, significant practice gaps remain. This supports the conclusion of Jalal et al. (2019) [7] and Gupta et al. (2016) [6] that educational interventions alone are insufficient to ensure compliance. To bridge these gaps, a comprehensive strategy is needed—incorporating hands-on training, regular monitoring, and behavior change communication. Targeted programs for support staff, consistent provision of PPE and sharps disposal equipment, and fostering a culture of non-punitive incident reporting could further enhance compliance. Addressing these operational and behavioral barriers is essential to translating knowledge into consistent, safe BMW management practices in high-pressure environments like the ED.

CONCLUSION

The study revealed that most ED staff (76%) possessed excellent knowledge of biomedical waste management. While attitudes were generally positive (mean score 4.19 ± 0.50), reflecting strong support for safety and continuous learning, significant gaps were identified in self-reported practices. Key areas needing improvement include consistent PPE usage (33.1%), hand hygiene (41.7%), and the proper use of safety devices like needle cutters (7.4%). Color-coded segregation showed the highest adherence (73.1%). These findings highlight that knowledge, while high, does not consistently translate into practice, necessitating multi-faceted interventions.

Declaration:
Conflicts of interests: The authors declare no conflicts of interest.
Author contribution: All authors have contributed in the manuscript.
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REFERENCES

1. World Health Organization. Health-care waste [Internet]. Geneva: World Health Organization; 2018 [cited 2025 Apr 24]. Available from: https://www.who.int/news-room/fact-sheets/detail/health-care-waste
2. Central Pollution Control Board. Bio-Medical Waste Management Rules, 2016. New Delhi: Ministry of Environment, Forest and Climate Change; 2016.
3. Mathur V, Dwivedi S, Hassan M, Misra R. Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. Indian J Community Med. 2011 Apr;36(2):143-5. Doi: 10.4103/0970-0218.84135. PMID: 21976801; PMCID: PMC3180941.
4. Akkajit, Pensiri, Romin, Husna, Assawadithalerd, Mongkolchai, Assessment of Knowledge, Attitude, and Practice in respect of Medical Waste Management among Healthcare Workers in Clinics, *Journal of Environmental and Public Health*, 2020, 8745472, 12 pages, 2020. https://doi.org/10.1155/2020/8745472

5. Lavanya KM, Majhi P. Knowledge, Attitude and Practices (KAP) about biomedical waste management among hospital staff– A cross-sectional study in a tertiary care hospital, Andhra Pradesh, India. *J Community Health Manag*. 2018;5(1):32–6. doi:10.18231/2394-2738.2018.0008.
6. Gupta NK, Shukla M, Tyagi S. Knowledge, attitude and practices of biomedical waste management among health care personnel in selected primary health care centres in Lucknow. Int J Community Med Public Health 2016; 3:309-13.
7. Jalal, S.M.; Akhter, F.; Abdelhafez, A.I.; Alrajeh, A.M. Assessment of Knowledge, Practice and Attitude about Biomedical Waste Management among Healthcare Professionals during COVID-19 Crises in Al-Ahsa. Healthcare 2021, 9, 747. https://doi.org/10.3390/healthcare9060747
8. Patil AD, Shekdar AV. Health-care waste management in India. J Environ Manage. 2001 Oct;63(2):211-20. doi: 10.1006/jema.2001.0453. PMID: 11721600.
9. Rao S, Ranyal RK, Bhatia SS, Sharma VR. Biomedical Waste Management: An Infrastructural Survey of Hospitals. Med J Armed Forces India. 2004 Oct;60(4):379-82. doi: 10.1016/S0377-1237(04)80016-9. Epub 2011 Jul 21. PMID: 27407678; PMCID: PMC4923431.