

Original Research

Received 18 June 2026

Revised 19 July 2026

Accepted 02 Aug 2026

Natural Resources for Human Health 2026, Vol. 6 (16s): 25–29

KEYWORDS:

Biomedical waste; health care workers; knowledge, attitude and practice; BMW rules; infection control

Biomedical Waste Management: A Study on Knowledge, Attitude and Practice among Health Care Workers in a Tertiary Care Hospital

¹Dr S Vidyaa Nayaki, ²Dr Sangeetha GA, ³Dr Rithvika V

^{1,2,3} Dept of Microbiology, Saveetha Medical College, affiliated to SIMATS University, Chennai, 602105, Tamil Nadu, India

ABSTRACT: Aim & Objective: To assess the knowledge, attitude and practice (KAP) of biomedical waste management (BMWM) among health care workers (HCWs) in a tertiary care hospital.

Background/Introduction: Improperly managed biomedical waste can contaminate the hospital environment and increase the risk of infection transmission; HCWs, who are constantly exposed to it, are at particular risk.

Material & Methods: 594 HCWs (teachers, postgraduates, interns, staff nurses, laboratory technicians, and housekeeping staff) participated in a cross-sectional study after Institutional Ethics Committee clearance. A structured, pre-tested questionnaire covering knowledge, attitude and practice domains was administered after informed consent. Data were analysed using SPSS version 23; cadre-wise comparisons were examined using the chi-square test of independence ($p < 0.05$)

Results: Of 594 HCWs, 308 (51.8%) were male. KAP scores were good across all cadres but consistently lower among housekeeping staff and technicians. This cadre-wise gap was statistically significant for 7 of 10 items assessed ($p < 0.05$); 3 items showed no significant cadre difference.

Conclusion: KAP regarding BMWM were satisfactory overall, with a statistically significant gap concentrated in housekeeping staff and technicians for most items. Regular, vernacular-language training targeted at these cadres is recommended.

INTRODUCTION

Any waste produced during the diagnosis, treatment, or vaccination of humans or animals, as well as in associated biological research, production, or testing, is referred to as biomedical waste (BMW).^[1] Only 15% of the trash generated during medical operations is classified as hazardous, which includes radioactive, chemical, and infectious elements; the remaining 85% is classified as general non-hazardous waste.^[2] BMW handling guidelines were first released in 1998, revised as the Bio-Medical Waste Management Rules in March 2016, and amended in 2018 and 2019. Biomedical waste management is an important part of hospital infection control; if not managed properly, it can contaminate the hospital environment and transmit infectious disease to persons exposed.^[3] Everyone who comes into contact with biomedical waste is potentially at risk if it is not managed properly.^[4] Following the COVID-19 pandemic, BMW generation rose from 500–750 g/day to 2.5–4.5 kg/day, posing a serious risk to community and environmental health.^[5] Lack of awareness of BMWM, manpower constraints and financial constraints can aggravate this situation further.^[6]

Segregation at the point of generation, which divides waste into four color-coded bags based on type, is the first step in managing biomedical waste.^[1] HCWs are responsible for ensuring appropriate segregation at the point of production; non-

compliance with BMWM increases the risk of needlestick injury and the spread of infectious disease. Therefore, educating HCWs about BMW rules and regulations, storage, disinfection, and transfer to the terminal disposal site is crucial to BMWM.^[7]

Studies from different parts of the country have shown a gap in the knowledge, attitude and practice of BMWM among HCWs.^[8] Against this background, this study was conducted to assess the knowledge, attitude and practice of BMWM among HCWs in a tertiary care hospital.

MATERIALS AND METHODS

Study design and setting

A cross-sectional study was conducted among health care workers in a tertiary care hospital after obtaining clearance from the Institutional Ethics Committee. The study population included HCWs from different sectors: faculty, postgraduates, interns, staff nurses, laboratory technicians and housekeeping staff. The research was conducted in accordance with the ethical standards.

Sample size

The entire available workforce(HCW), during the study period was enrolled.

Data collection instrument

A structured, pre-designed, pre-tested questionnaire was administered after obtaining informed consent. Part I recorded demographic data — age, sex, designation, education, qualification, experience, Hepatitis B vaccination status, and prior BMWM training. Part II consisted of questions on the Knowledge, Attitude and Practice domains of BMWM, using yes/no/not sure (Knowledge, Practice) and agree/disagree/no comment (Attitude) response formats. The questionnaire was translated into the local language by an experienced professional for housekeeping staff. The validity of the questionnaire was established by expert panel review and the vernacular translation was checked by back translation into English to confirm equivalence of meaning.

Statistical analysis

Data were entered into Excel and analysed using various statistical parameters. Descriptive statistics (frequencies, percentages) summarised responses; cadre-wise comparisons for each item were tested using the chi-square test of independence, with $p < 0.05$ considered significant.

RESULTS

A total of 594 HCWs were included: 308 (51.8%) males and 286 (48.2%) females. The study population included 87 (14.6%) faculty, 80 (13.5%) postgraduates, 115 (19.4%) interns, 174 (29.3%) staff nurses, 32 (5.4%) laboratory technicians and 106 (17.8%) housekeeping staff (Figure 1). Overall, 92.3% had seen BMWM posters, 86.6% had received Hepatitis B vaccination, and 83% had attended prior BMWM training.

Fig 1: Distribution of Study Participants by Cadre (n=594)

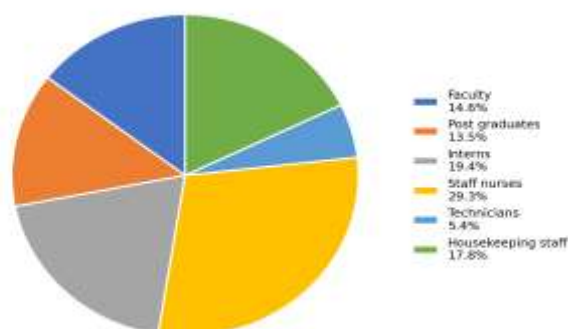


Figure 1: Distribution of study participants by cadre (n=594)

Knowledge item	Faculty (n=87)	PG (n=80)	Interns (n=115)	Nurses (n=174)	Techs (n=32)	H.Keep (n=106)	Overall (n=594)	χ^2 (df=5), P
Segregation into colour-coded bags, n (%)	78 (89.7%)	65 (81.3%)	104 (90.4%)	169 (97.1%)	28 (87.5%)	94 (88.7%)	538 (90.6%)	17.78, p=0.003
Anatomical waste in yellow bag, n (%)	80 (91.9%)	71 (88.8%)	101 (87.8%)	165 (94.8%)	27 (84.4%)	91 (85.8%)	535 (90.1%)	8.82, p=0.116
Gloves in red bag, n (%)	79 (90.8%)	69 (86.3%)	109 (94.8%)	163 (93.7%)	29 (90.6%)	89 (84.0%)	538 (90.6%)	11.53, p=0.042
Needles/sharps in white container, n (%)	77 (88.5%)	64 (80.0%)	98 (85.2%)	172 (98.9%)	23 (71.9%)	98 (92.5%)	532 (89.6%)	37.97, p<0.001
Broken glass in blue bag, n (%)	70 (80.5%)	66 (82.5%)	95 (82.6%)	159 (91.4%)	30 (93.8%)	87 (82.1%)	507 (85.4%)	10.65, p=0.059

Table 1: Cadre-wise knowledge of biomedical waste segregation, with chi-square test of association (n=594)

Attitude item	Faculty (n=87)	PG (n=80)	Interns (n=115)	Nurses (n=174)	Techs (n=32)	H.Keep (n=106)	Overall (n=594)	χ^2 (df=5), P
BMWM is beneficial to HCWs, n (%)	81 (93.1%)	74 (92.5%)	110 (95.6%)	170 (97.7%)	28 (87.5%)	96 (90.6%)	559 (94.1%)	10.00, p=0.075
BMWM should be strictly followed, n (%)	76 (87.4%)	67 (83.8%)	105 (91.3%)	169 (97.1%)	25 (78.1%)	91 (85.8%)	533 (89.7%)	20.69, p<0.001
BMWM rules enhance quality assurance, n (%)	79 (90.8%)	66 (82.5%)	101 (87.8%)	168 (96.6%)	22 (68.8%)	84 (79.2%)	520 (87.5%)	32.73, p<0.001

Table 2: Cadre-wise attitude towards biomedical waste management, with chi-square test of association (n=594)

Practice item	Faculty (n=87)	PG (n=80)	Interns (n=115)	Nurses (n=174)	Techs (n=32)	H.Keep (n=106)	Overall (n=594)	χ^2 (df=5), P
Hand hygiene followed after BMWM, n (%)	76 (87.4%)	69 (86.3%)	101 (87.8%)	166 (95.4%)	27 (84.4%)	85 (80.2%)	524 (88.2%)	16.04, p=0.007
Separation of general from biomedical waste, n (%)	78 (89.7%)	71 (88.8%)	106 (92.2%)	169 (97.1%)	29 (90.6%)	91 (85.8%)	544 (91.6%)	12.80, p=0.025

Table 3: Cadre-wise practice of biomedical waste management, with chi-square test of association (n=594)

Across all three domains, housekeeping staff and technicians showed the lowest scores, while staff nurses showed the highest. This cadre-wise difference reached statistical significance ($p<0.05$) for 7 of the 10 items tested, but not for disposal into the yellow bag, disposal into the blue bag, or the 'BMWM is beneficial' attitude item.

DISCUSSION

The aim of this study was to assess the knowledge, attitude and practice of BMW among health care workers. A key step in BMW is segregation of waste at the point of generation, which depends on adequate HCW training and awareness of waste categories, storage and transport requirements.

In this study, knowledge among faculty, postgraduates, interns and staff nurses was higher than among housekeeping staff, a difference that reached statistical significance for most individual knowledge items (Table 1). This is consistent with Aravind A et al.^[9] and Mathur et al.^[10], where knowledge of BMW was similarly higher among faculty, residents and nurses compared with housekeeping staff. Knowledge of disposal into the yellow bag was good across all cadres except housekeeping staff, though this difference did not reach statistical significance ($p=0.116$) — consistent with Malini and Eshwar,^[11] where 93.7% of participants were aware of yellow-bag disposal, but in contrast to Kishore et al.,^[12] where only 28% demonstrated this awareness.

Knowledge of disposal into the red bin was significantly higher among most cadres except housekeeping staff ($p=0.042$), consistent with Malini and Eshwar.^[11] Knowledge of sharps disposal was slightly lower than other categories and showed the strongest cadre effect (89.6% overall, $p<0.001$), similar to Malini and Eshwar,^[11] but in contrast to Aravind A et al.,^[9] where only 42.9% of participants demonstrated this awareness.

Overall, knowledge of BMW was good across all cadres except housekeeping staff. Nearly 83% of HCWs had previously received BMW training, underscoring the importance of regular training. Knowledge was slightly higher among nursing staff, consistent with Soyam et al.^[13]

Regarding attitude, most HCWs demonstrated a positive attitude towards BMW across all three items assessed (94.1%, 89.7% and 87.5% respectively), broadly consistent with Soyam et al.^[13] Attitude scores among housekeeping staff and technicians were lower for the 'strictly followed' and 'quality assurance' items (both $p<0.001$), similar to Mathur et al.,^[10] though the 'BMW is beneficial' item did not show a statistically significant cadre difference ($p=0.075$).

Regarding practice, performance was good across all cadres, with nursing staff scoring significantly higher and housekeeping staff/technicians significantly lower on both items assessed ($p=0.007$ and $p=0.025$). Around 88% reported following hand hygiene practice after BMW handling, consistent with Soyam et al.^[13] and Saini et al.^[14] Around 92% reported strict separation of general from biomedical waste, consistent with Motamed et al.^[15]

To summarise, HCWs are constantly exposed to biomedical waste, which motivated this study. Across all three KAP domains, staff nurses generally showed the highest scores and housekeeping staff and technicians the lowest — a pattern that reached statistical significance for most, though not all, items assessed. This indicates that KAP gaps concentrated in these two cadres require targeted, recurring, vernacular-language training rather than a generic hospital-wide programme.

Strengths and Limitations

The main strength of this study is that all three KAP domains were assessed at a single time point across all HCW cadres, enabling cross-cadre comparison. A limitation is that the Practice domain was assessed only by self-reported questionnaire; direct observation using a practical scenario was not performed due to time constraints.

CONCLUSION

Knowledge, attitude and practice towards biomedical waste management were good among health care workers overall, but a statistically significant gap was concentrated in housekeeping staff and laboratory technicians for most items assessed. These cadres should be specifically targeted for education on the risks of inappropriate BMW handling, with training conducted at regular intervals in the vernacular language. Periodic sensitisation and monitoring are recommended to ensure sustained compliance.

Source of Funding

Nil.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

AUTHOR ACTION NEEDED: IJFCM explicitly requires this statement (not present in earlier drafts). Fill with each author's actual role.

[Author 1] contributed to conception and study design. [Author 2] contributed to data acquisition. [All authors] contributed to analysis and interpretation of data, drafting and critical revision of the manuscript, and approved the final version. — Author to complete with real names/roles.

Data Availability Statement

AUTHOR ACTION NEEDED: IJFCM explicitly requires this statement (not present in earlier drafts). Pick the option that matches your actual plan.

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to institutional data-sharing policy / participant confidentiality. —

REFERENCES

- [1] Bio-medical Waste Management Rules 2016. Available at: https://dhr.gov.in/sites/default/files/Bio-medical_Waste_Management_Rules_2016.pdf. Accessed 12 June 2023.
- [2] Health-care waste. World Health Organization. Available at: <https://www.who.int/news-room/fact-sheets/detail/health-care-waste>. Accessed 12 June 2023.
- [3] Manekar SS, Bakal RL, Jawarkar RD, Charde MS. Challenges and measures during management of mounting biomedical waste in COVID-19 pandemic: an Indian approach. *Bull Natl Res Cent.* 2022;46(1):159.
- [4] Radha R. Assessment of existing knowledge, attitude, and practices regarding biomedical waste management among health care workers in a tertiary care rural hospital. *Int J Health Sci Res.* 2012;2(7):14-19.
- [5] Capoor MR, Parida A. Current perspectives of biomedical waste management in context of COVID-19. *Indian J Med Microbiol.* 2021;39(2):171-8.
- [6] Pandit NB, Mehta HK, Kartha GP, Choudhary SK. Management of biomedical waste: awareness and practice in a district of Gujarat. *Indian J Public Health.* 2005;49:245-7.
- [7] Kini BS, Kumar S, Reddy M, Nabar AS, Kamath VG, 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.
- [8] Pattnaik S, Reddy MV. Assessment of municipal solid waste management in Puducherry (Pondicherry), India. *Resour Conserv Recycl.* 2010;54:512-20.
- [9] Aravind A, et al. *Int J Community Med Public Health.* 2023;10(10):3655-3659.
- [10] Mathur V, Dwivedi S, Hassan MA, Misra RP. Knowledge, attitude and practices about bio-medical waste management among health care personnel: a cross-sectional study. *Indian J Community Med.* 2011;36(2):143-5.
- [11] Malini A, Eshwar B. Knowledge, attitude and practice of biomedical waste management among health care personnel in a tertiary care hospital in Puducherry. *Int J Biomed Res.* 2015;6(3):172.
- [12] Kishore J, Goel P, Sagar B, Joshi T. Awareness about biomedical waste management and infection control among dentists of a teaching hospital in New Delhi, India. *Indian J Dent Res.* 1999;11:157-61.
- [13] Soyam GC, et al. *Int J Community Med Public Health.* 2017;4(9):3332-3337.
- [14] Saini S, Nagarajan SS, Sarma RK. Knowledge, attitudes and practices of bio-medical waste management amongst staff of a tertiary level hospital in India. *J Acad Hosp Admin.* 2005;17:1-12.
- [15] Motamed N, Mahmoodi FB, Khalilian A, Peykanheirati M, Nozari M. Knowledge and practices of health care workers and medical students towards universal precautions in hospitals in Mazandaran Province. *East Mediterr Health J.* 2006;12(5):653-61.