



Knowledge And Practices Of Biomedical Waste Management Among Doctors And Nurses In A Tertiary Care Hospital

Padma Raja G^{1*}, Shiji Poulose¹, Shivamurthy M²

1; Nirwan University, Jaipur, India

2; Vaasudhara college of nursing, Hoskote, Bangalore

Abstract

Background: Biomedical waste (BMW) management is essential for hospital infection control and environmental safety, and inadequate segregation, limited awareness of legal frameworks, and poor access to policy documents increase occupational hazards and the risk of nosocomial infections. **Objectives:** To assess knowledge and practices related to biomedical waste management and associated legal frameworks among doctors and nurses in a tertiary care hospital in Mysuru, India. **Methods:** A descriptive cross-sectional study was conducted among doctors and nurses at a 250-bed tertiary care teaching hospital in Mysuru, Karnataka. Data were collected using a structured, self-administered questionnaire assessing knowledge of BMW guidelines, access to policy documents, waste handling and segregation practices, and awareness of infection risks. Data were analysed using descriptive statistics and the Chi-square test. **Results:** Of the 150 questionnaires distributed, 128 were completed (response rate: 85%). Nurses constituted 74.2% of participants and doctors 25.8%. Awareness of the WHO manual on safe management of health-care waste was limited (45.3%), with no significant difference between professional groups ($p = 0.40$). Access to BMW policy documents differed significantly, with 90.5% of nurses reporting access compared to 15.2% of doctors ($p < 0.001$). Despite limited policy awareness, more than 90% of respondents reported appropriate waste segregation, correct use of colour-coded bins, and glove use. Awareness of infection risks associated with improper BMW management was high. **Conclusion:** Although reported biomedical waste management practices were satisfactory, gaps in awareness of and access to formal guidelines and legal frameworks persist, particularly among doctors. Targeted training and improved dissemination of policy documents are required to strengthen compliance.

Keywords: Biomedical waste management; Doctors; Health-care workers; Infection control; Nurses; Waste segregation

Introduction

Health-care facilities generate a variety of wastes, a proportion of which is hazardous and poses risks to health-care workers, patients, waste handlers, and the environment if improperly managed. Biomedical waste (BMW) includes infectious materials, sharps, pathological waste, pharmaceuticals, and chemical residues generated during health-care delivery [1]. The World Health Organisation (WHO) estimates that 10–25% of health-care waste is hazardous, requiring specialised handling and disposal [1,2].

Improper biomedical waste management has been associated with occupational injuries, transmission of blood-borne infections such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV), and environmental contamination [3–5]. Segregation of waste at the point of generation is a critical step in reducing these risks and limiting unnecessary treatment of non-hazardous waste [1].

In India, biomedical waste management is regulated by the Bio-Medical Waste Management Rules, 2016, supported by implementation guidelines from the Central Pollution Control Board (CPCB) [6,7]. Although these regulations clearly outline the responsibilities of health-care institutions and professionals, their effectiveness depends on awareness, accessibility of policy documents, and adherence to routine practice.

Previous studies from India have reported gaps between knowledge and practices of biomedical waste management among health-care workers, with nurses often demonstrating better operational compliance than doctors [8–10]. Limited engagement of physicians with legal frameworks may compromise institutional compliance and sustainability of waste management practices.

This study aimed to assess knowledge and practices related to biomedical waste management and associated legal frameworks among doctors and nurses in a tertiary care hospital in Mysuru, Karnataka.

Methodology

Study design and setting

A descriptive cross-sectional study was conducted at Apollo BGS Hospital, a 250-bed tertiary care teaching hospital in Mysuru, Karnataka, India. Ethical Permission was obtained from Apollo BGS Hospital, Mysuru.

Study population and sample size

The study population included doctors and nurses employed at the hospital during the study period. Of approximately 220 eligible health-care professionals, a minimum sample size of 125 was calculated assuming 50% awareness of biomedical waste policies. To account for non-response, 150 questionnaires were distributed using proportionate random sampling. A total of 128 completed questionnaires were received (response rate: 85%).

Data collection tool and procedure

Data were collected using a structured, self-administered questionnaire developed based on WHO guidance and relevant literature [1,8]. The questionnaire assessed demographic characteristics, knowledge of biomedical waste policies and laws, access to policy documents, reported waste management practices, and awareness of infection risks. The tool was piloted for clarity and content validity before data collection. Informed consent was obtained from all participants.

Statistical analysis

Data were analysed using SPSS software. Descriptive statistics were used to summarise responses as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test, with $p < 0.05$ considered statistically significant. P-values reported in the tables correspond to those described in the Results section.

Results

A total of 128 out of 150 questionnaires were completed, yielding a response rate of 85%.

Table 1. Distribution of study participants by profession (n = 128)

Profession	Frequency (n)	Percentage (%)
Nurses	95	74.2
Doctors	33	25.8
Total	128	100.0

Table 1 shows the distribution of study participants by profession. Nurses constituted the majority of respondents (95, 74.2%), while doctors accounted for 33 (25.8%). This distribution reflects the professional composition of the hospital workforce.

Table 2. Awareness of the WHO manual on safe management of health-care waste

Profession	Aware n (%)	Not aware n (%)	Total	p-value
Nurses	45 (47.4)	50 (52.6)	95	-
Doctors	13 (39.4)	20 (60.6)	33	-
Total	58 (45.3)	70 (54.7)	128	0.40

Table 2 depicts participants' awareness of the WHO manual on safe management of health-care waste. Overall, fewer than half of the respondents (58, 45.3%) were aware of the existence of the WHO manual. Awareness was slightly higher among nurses (47.4%) compared to doctors (39.4%); however, this difference was not statistically significant (χ^2 test, $p = 0.40$), indicating a general lack of awareness across both professional groups.

Table 3. Mode of acquiring knowledge about health-care waste management policies (n = 124*)

Mode of knowledge acquisition	Nurses n (%)	Doctors n (%)	Total n (%)
Self-learning	27 (60.0)	18 (40.0)	45 (36.3)
Seminar/training	39 (97.5)	1 (2.5)	40 (32.3)
Other sources	36 (92.3)	3 (7.7)	39 (31.4)
Total	102 (82.3)	22 (17.7)	124 (100)

*Includes only respondents who reported awareness of at least one policy.

Table 3 shows the reported modes through which participants acquired knowledge about health-care waste management policies. Among respondents who reported awareness of at least one policy, self-learning was the most common method (36.3%), followed by seminars or training programs (32.3%) and other sources such as colleagues or circulars (31.4%). Attendance at seminars or training programs was reported predominantly by nurses, while doctors were more likely to report self-learning as their primary source of knowledge.

Table 4. Access to health-care waste management policy documents

Profession	Access available n (%)	No access n (%)	Total	p-value
Nurses	86 (90.5)	9 (9.5)	95	-
Doctors	5 (15.2)	28 (84.8)	33	-
Total	91 (71.1)	37 (28.9)	128	<0.001

Table 4 depicts access to biomedical waste management policy documents among doctors and nurses. Overall, 91 respondents (71.1%) reported having access to at least one policy document. Access differed significantly by profession, with 90.5% of nurses reporting access compared to only 15.2% of doctors. This difference was statistically significant (χ^2 test, $p < 0.001$), highlighting a marked disparity in access to regulatory information between the two groups.

Table 5. Reported practices related to handling and segregation of health-care waste

Practice	Yes n (%)	No n (%)
Differential treatment of risk vs general waste	115 (89.8)	13 (10.2)
Availability of separate bins in wards	124 (96.9)	4 (3.1)
Ability to distinguish colour-coded bins	123 (96.1)	5 (3.9)
Appropriate utilisation of bins	123 (96.1)	5 (3.9)
Waste segregation at the point of generation	117 (91.4)	11 (8.6)
Use of gloves when handling waste	122 (95.3)	6 (4.7)

Table 5 shows reported practices related to handling and segregation of health-care waste. The majority of participants reported appropriate practices, including differential treatment of health-care risk waste and general waste (89.8%), segregation at the point of generation (91.4%), appropriate use of colour-coded bins (96.1%), and consistent use of gloves while handling waste (95.3%). No statistically significant differences were observed between doctors and nurses for these practices, indicating broadly similar self-reported compliance across professions.

Table 6. Awareness of diseases transmitted through healthcare waste

Disease	Agree / Strongly agree n (%)	Not sure n (%)	Disagree / Strongly disagree n (%)
HIV	106 (82.8)	6 (4.7)	16 (12.5)
Hepatitis B	113 (88.3)	6 (4.7)	9 (7.0)
Hepatitis C	97 (75.8)	18 (14.1)	13 (10.1)

Table 6 depicts awareness of diseases transmitted through contact with health-care waste. Most respondents agreed or strongly agreed that HIV (82.8%), hepatitis B (88.3%), and hepatitis C (75.8%) could be transmitted through improperly managed biomedical waste. A smaller proportion of participants were unsure or disagreed, particularly with respect to hepatitis C transmission.

Table 7. Perceptions regarding transmission of nosocomial infections through health-care waste

Group at risk	Agree / Strongly agree n (%)	Not agree / Not sure n (%)
Health-care workers	127 (99.2)	1 (0.8)
Other hospital workers	124 (96.9)	4 (3.1)
Patients	124 (96.9)	4 (3.1)

Table 7 shows participants' perceptions regarding the role of health-care waste in transmitting nosocomial infections. Almost all respondents agreed or strongly agreed that improperly managed waste could transmit infections among health-care workers (99.2%), other hospital workers (96.9%), and patients (96.9%). No significant differences were observed between doctors and nurses for these perceptions.

Table 8. Knowledge related to healthcare waste generation and logistics

Indicator	Nurses aware n (%)	Doctors aware n (%)	p-value
Knowledge of the number of bins filled per ward/day	72 (75.8)	12 (36.4)	0.01
Knowledge of waste collection frequency	78 (82.1)	14 (42.4)	0.01

Table 8 depicts professional differences in operational knowledge related to health-care waste generation. Nurses were significantly more likely than doctors to report knowledge of the number of waste bins filled per ward per day and the frequency of waste collection (χ^2 test, $p = 0.01$ for both indicators).

Table 9. Availability of health-care waste storage containers in wards

Availability of containers	Frequency (n)	Percentage (%)
Always available	122	95.3
Occasionally unavailable	6	4.7
Total	128	100.0

Table 9 shows the reported availability of health-care waste storage containers in hospital wards. The vast majority of respondents (95.3%) reported that storage containers, including sharps containers, were always available. A small proportion (4.7%) reported occasional unavailability. Variation in availability was significant between wards ($p = 0.01$), rather than between professional groups.

Overall, the results indicate satisfactory self-reported biomedical waste management practices and high awareness of infection risks. However, gaps were observed in awareness of formal guidelines and access to policy documents, particularly among doctors, as well as in operational knowledge related to waste generation and logistics.

Discussion

This study assessed knowledge and practices related to biomedical waste (BMW) management and associated legal frameworks among doctors and nurses in a tertiary care hospital in Mysuru, India. The findings reveal a clear discrepancy between relatively satisfactory self-reported waste management practices and limited awareness of formal guidelines and legal documents, particularly among doctors.

Awareness of international guidance on biomedical waste management was suboptimal, with fewer than half of the respondents aware of the WHO manual on safe management of health-care waste. Similar deficiencies in awareness have been reported in earlier Indian studies, suggesting that the availability of guidelines alone does not ensure effective dissemination or uptake among health-care professionals [1,8,9]. The absence of a statistically significant difference between doctors and nurses indicates that limited exposure to international guidance is a system-level issue rather than one confined to a specific professional group.

In contrast, awareness of hospital-level biomedical waste management policies was relatively higher, especially among nurses. This finding is consistent with previous studies reporting better operational knowledge and compliance among nursing staff, likely due to their closer involvement in ward-level management and infection control activities [8,10,11]. Lower engagement among doctors has been attributed to the perception that waste management is ancillary to clinical care, a pattern observed in both Indian and international settings [4,12].

A key finding of this study was the marked difference between doctors and nurses in access to biomedical waste management documents. While most nurses reported access to policy documents, the majority of doctors did not. Similar professional disparities have been documented in earlier studies, where physicians were less likely to attend training programs or access institutional guidelines related to biomedical waste management [9,10,13]. Limited access to regulatory documents may reduce familiarity with statutory responsibilities under the Bio-Medical Waste Management Rules, 2016, thereby weakening compliance and accountability [6,7].

Despite gaps in awareness of formal guidelines, reported waste handling and segregation practices were largely satisfactory. Most respondents reported segregation at the point of generation, appropriate use of colour-coded bins, and consistent use of gloves while handling waste. Comparable findings have been reported from other tertiary care hospitals in India, where acceptable practices were observed even when knowledge of legal frameworks was incomplete [8–10,14]. These practices may be driven primarily by

infection control training and awareness of occupational risks rather than explicit knowledge of biomedical waste legislation [2,3].

Awareness of infection risks associated with improper biomedical waste management was high among both doctors and nurses. Most respondents recognised the potential transmission of HIV, hepatitis B, and hepatitis C through unsafe waste handling. This aligns with WHO guidance and earlier studies highlighting the role of risk perception in promoting safer waste handling behaviours [1–3]. Additionally, the near-universal acknowledgement of the role of biomedical waste in transmitting nosocomial infections underscores the perceived link between waste management and hospital-acquired infections [4,8,15].

Operational knowledge related to waste generation and collection was significantly higher among nurses than among doctors. This reflects the routine involvement of nurses in ward management and logistics. Similar professional differences have been reported in earlier studies, reinforcing the need to actively involve doctors in operational and managerial aspects of biomedical waste management to ensure shared responsibility and sustained compliance [9,10,13].

Limitations

This study relied on self-reported practices, which may be subject to reporting and social desirability bias. Direct observational assessment of waste management practices was not conducted. Additionally, the study was carried out in a single tertiary care hospital, which may limit the generalisability of the findings to other health-care settings, particularly primary and secondary care facilities.

Recommendations and future directions

Regular, structured training programs on biomedical waste management regulations should be implemented for all healthcare professionals, with particular emphasis on doctors. Easy access to policy documents through hospital intranet systems and visible ward-level displays is recommended. Periodic refresher training integrated with infection control programs and routine audits may further strengthen compliance. Future studies should incorporate observational or mixed-methods approaches to validate reported practices and explore barriers to physician engagement.

Conclusion

The study demonstrates that while biomedical waste management practices and awareness of infection risks among doctors and nurses were generally satisfactory, significant gaps exist in awareness of and access to formal biomedical waste management guidelines and legal frameworks, particularly among doctors. Strengthening the dissemination of policies, improving accessibility of regulatory documents, and ensuring active participation of all professional groups are essential to achieve sustained compliance, occupational safety, and environmental protection.

References

1. World Health Organization. *Safe management of wastes from health-care activities*. 2nd ed. Geneva: WHO; 2014.
2. World Health Organization. *Health-care waste*. Fact sheet. Geneva: WHO; 2017.
3. Prüss A, Giroult E, Rushbrook P, editors. *Safe management of wastes from health-care activities*. Geneva: WHO; 1999.
4. Weir E. Hospitals and the environment. *CMAJ*. 2002;166(13):354.
5. Ketlogetswe C, Oladiran MT, Foster J. Improved combustion processes in medical waste incinerators. *Afr J Sci Technol*. 2004;5(1):67–72.
6. Government of India. *Bio-Medical Waste Management Rules, 2016*. New Delhi: Ministry of Environment, Forest and Climate Change; 2016.
7. Central Pollution Control Board. *Guidelines for management of healthcare waste as per BMW Rules, 2016*. New Delhi: CPCB; 2018.
8. Mathur P, Patan S, Shobhawat AS. Need of biomedical waste management system in hospitals. *Indian J Public Health*. 2011;55(3):203–207.
9. Dey P, Das B. Knowledge, attitude and practices about biomedical waste management as per 2016 rules. *J Med Soc*. 2020;34(1):31–35.
10. Pandit NA, Tabish SA, Qadri GJ, et al. Biomedical waste management in a large teaching hospital. *JK-Practitioner*. 2007;14(1):57–59.
11. Tudor TL, Noonan CL, Jenkin LET. Healthcare waste management: a case study from the NHS in Cornwall. *Waste Manag*. 2005;25(6):606–615.
12. Kaiser B, Eagan PD, Shaner H. Solutions to health care waste: life-cycle thinking and green purchasing. *Environ Health Perspect*. 2001;109(3):205–207.
13. Patil AD, Pokhrel K. Biomedical solid waste management in an Indian hospital: a case study. *Waste Manag*. 2005;25:592–599.
14. Chandra H, Shishoo S. Sharps management: a model for implementation. *J Acad Hosp Admin*. 2001;13(1):15–19.
15. Sobotová L, Nosková T, Voleková J, et al. Practical training on prevention of nosocomial infections. *Indoor Built Environ*. 2006;15(1):73–76.