Original Article

Knowledge Attitude Practices Regarding Biomedical Waste Management Among Healthcare Worker at Primary Health Care Facility: A Cross-Sectional Study

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Abstract

Background: BMW management is necessary to protect the environment and human lives. Biomedical waste mishandling is very dangerous, as it can lead to the spread of infections and environmental contamination. Although regulations do exist in India, adherence to BMWM practices is not uniform even within the primary healthcare setting. The goal of the research was to assess the knowledge, attitudes, and practices (KAP) of healthcare workers (HCWs) regarding BMWM in primary healthcare facilities in the Kashmir Valley, and to identify barriers to compliance. **Material and Methods:** In 2024, a cross-sectional study was conducted among 250 HCWs, of whom 22% were Doctors, 52% Nurses, and 26% Paramedics. Data were gathered through a structured questionnaire and semi-structured interviews. Quantitative data were analysed in SPSS 25, and qualitative data from interviews were analysed using thematic analysis. The statistical significance was set at p= <0.05. **Results:** Most HCWs were aware of BMWM rules (96-98%), whereas colour-coded segregation and the need to choose the right bag for disposing of infected waste were less well known amongst Paramedics (60-67% each) than amongst Nurses and Doctors (p=0.02, p=0.03). There was a positive attitude among 92 percent of the Doctors, 88 percent of the nurses, and 85 percent of the paramedics, who indicated that BMWM was important. Nevertheless, there was a variation in compliance with colour-coding segregation, with doctors (66%) showing less compliance than Paramedics (69%) but more than Nurses (87%) (p=0.03). Needle-stick injuries were reported low in all groups (2035, p=0.001). **Conclusion:** Although awareness is high, there are practice and training gaps that negatively affect BMWM. Resource limitations, regular training programs, and enhanced enforcement of policies are very important for improving compliance.

Keywords: Biomedical waste, healthcare worker, waste segregation, infection control, thematic analysis.

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Introduction

Biomedical waste (BMW) encompasses all waste produced throughout healthcare processes, and 15% of it is considered hazardous because it is either infectious, toxic, or radioactive. BMW is vital for effective risk management to protect healthcare workers (HCWs), patients, and the environment.[1] The mishandling of BMW has been linked to the transmission of contagious illnesses and environmental pollution worldwide, which is why it has become a very urgent, socially considered problem.[2,3]

The Bio-Medical Waste (Management & Handling) Rules were initially enacted in India in 1998 and subsequently revised in accordance with international standards. These regulations require the separate treatment and disposal of BMW at the source, so that safe handling can be ensured. Even though these regulations have been put in place, adherence is not mandatory, especially in primary healthcare facilities.[4] Research has also noted gaps in knowledge, attitude, and behavior of HCWs, and it is known that frequent training and surveillance are required to address them.[5]

Studies undertaken in Delhi and other rural locations have found that, despite high knowledge levels among HCWs, the actual practice of some of these recommendations, e.g., colour-coded segregation and proper disposal of sharps, is not always the case.[6] Poor compliance is caused by a lack of resources, training, and perceived extra work, among other factors.

This research aims to assess the KAP of HCWs regarding BMWM in primary healthcare centres in the Kashmir Valley. The study aims to identify gaps and barriers, followed by recommendations for specific interventions to support compliance with and safer healthcare waste management practices.

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Materials and Methods

In 2024, a cross-sectional study was conducted in a primary healthcare centre across 62 hospitals in the Kashmir Valley. The study participants were 250 healthcare workers (HCWs), including Doctors (22 percent), Nurses (52 percent), and Paramedics (26 percent). Paramedics covered the laboratory technicians and Class IV employees. Convenience sampling was used to select participants, who were HCWs involved in biomedical waste management (BMWM). The structured, pre-tested questionnaire and semi-structured interviews were employed to gather this data. The questionnaire consisted of four parts: demographic and professional information (age, gender, position, and experience); knowledge, about the level of awareness of BMWM rules, segregation principles, and colour coding; attitudes toward BMWM, including importance of the given practice, training requirements, and difficulties; practices, including adherence to the segregation rules, needle-stick injuries reporting, and vaccination. A subgroup of participants participated in semi-structured interviews in which barriers to compliance were discussed, and suggestions for addressing current issues were provided. Interview themes were triangulated with quantitative data to give more information.

The pilot study was conducted on 30 HCWs from comparable facilities (the subjects were not included in the core study). The pilot study was used to revise the questionnaire to make it comprehensible and relevant. The quantitative data were entered into Microsoft Excel and analysed using SPSS version 25. Response and demographic data were summarised using descriptive statistics. With chi-square tests, the relationships between variables were assessed, and p-values of less than 0.05 were deemed significant. Semi-structured interviews provided qualitative data that were subjected to thematic analysis to identify barriers and enablers and were triangulated with quantitative data. The institution's research ethics committee approved the study. Informed consent was obtained from all participants, and their confidentiality was preserved throughout the study.

Results

Socio-Demographic Characteristics: The participants of the study included 250 healthcare workers (HCWs) and were divided into doctors (n=55), Nurses (n=130), and Paramedics (n=65). The mean age of participants was 30.3 years (±5.6 SD). Among the participants, 46% were male, and 54% were female.

- The majority of HCWs (49%) were aged 26–30 years, followed by 23.2% in the 31–35 age group and 15.4% in the 21–25 age group.
- Nurses represented the largest group (52%), followed by doctors (22%) and Paramedics (26%).

Table 1: Socio-Demographic Characteristics of HCWs

Characteristic	Doctors	Nurses	Paramedics
Male (%)	46	54	49
Female (%)	54	46	51
Aged 21–25 (%)	15.4	18.4	12.5
Aged 26–30 (%)	49.0	52.3	48.5
Aged 31–35 (%)	23.2	19.2	26.1

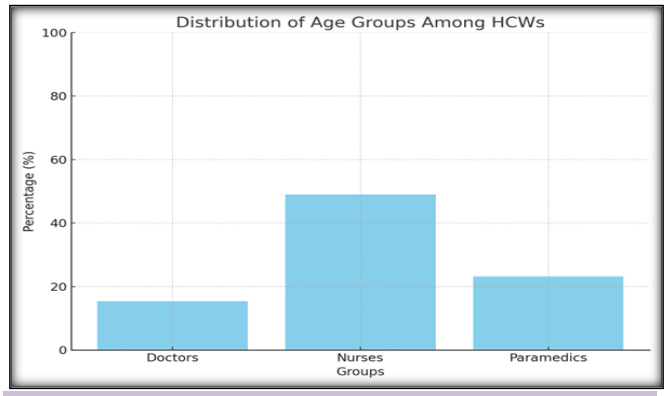


Figure 1: Distribution of Age Groups Among HCWs (Bar chart showing age distribution among Doctors, Nurses, and Paramedics)

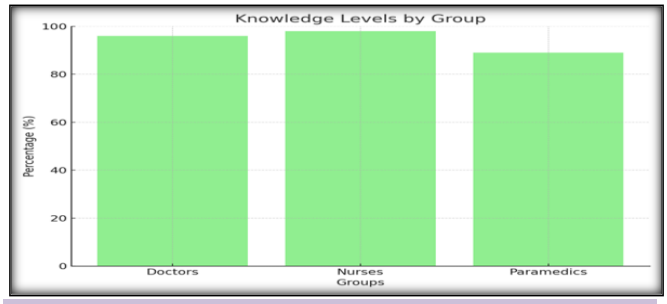
Knowledge of Biomedical Waste Management

The analysis of knowledge among HCWs showed significant differences across groups:

1. Awareness of BMW Management Rules:
   - 98% of Nurses, 96% of doctors, and 89% of Paramedics reported awareness.
   - Statistical significance: Fisher's Exact Test, p=0.28.
2. Knowledge of Color-Coding Segregation:
   - Knowledge was highest among Nurses (85%), followed by doctors (80%) and Paramedics (60%).
   - Statistical significance: Chi-square Test, p=0.02.
3. Recognizing the Correct Bag for Infected Waste:
   - 88% of Nurses, 83% of doctors, and 67% of Paramedics correctly identified the bag.
   - Statistical significance: Chi-square Test, p=0.03.

Table 2: Knowledge of BMWM

Knowledge	Doctors (%)	Nurses (%)	Paramedics (%)	Statistical Test	P-Value
Awareness of BMWM Rules	96	98	89	Fisher's Exact Test	0.28
Knowledge of Color Coding	80	85	60	Chi-square Test	0.02
Recognizing Correct Bag for Waste	83	88	67	Chi-square Test	0.03



[Figure 2] Knowledge Levels by Group (Bar chart illustrating comparative knowledge levels among Doctors, Nurses, and Paramedics)

Attitudes Toward Biomedical Waste Management

Positive attitudes were prevalent, but differences were observed among groups:

1. Perceived Importance of BMW Management:
- 92% of doctors, 88% of Nurses, and 85% of Paramedics believed BMWM reduces health risks.
- Statistical significance: Chi-square Test, p=0.12.
2. Need for Training:
- 89% of doctors, 86% of Nurses, and 78% of Paramedics supported regular training sessions.
- Statistical significance: Chi-square Test, p=0.01.

Table 3: Attitudes Toward BMWM

Attitudes	Doctors (%)	Nurses (%)	Paramedics (%)	Statistical Test	P-Value
Perceived Importance of BMWM	92	88	85	Chi-square Test	0.12
Support for Regular Training	89	86	78	Chi-square Test	0.01

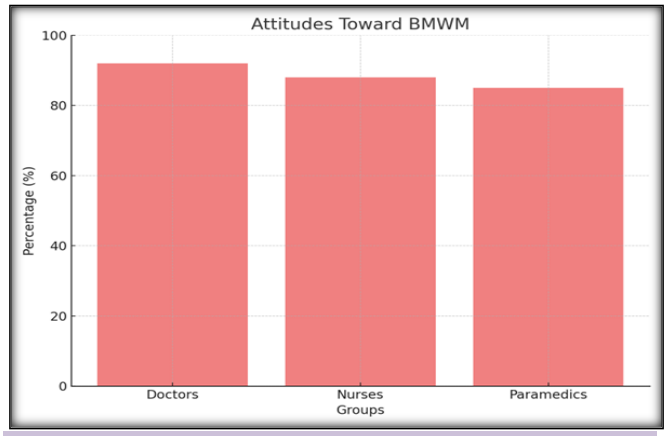


Figure 3: Attitudes Toward BMWM (Bar chart comparing the perceived importance of BMWM and support for training across groups)

Practices Related to Biomedical Waste Management

Significant gaps were observed in the practical implementation of BMWM:

1. Adherence to Color-Coding Segregation:
- 87% of Nurses, 66% of Doctors, and 69% of Paramedics adhered to segregation practices.
- Statistical significance: Chi-square Test, p=0.03.
2. Needle-Stick Injury Reporting:
- Among those who sustained needle-stick injuries, 35% of Doctors, 28% of Nurses, and 20% of Paramedics reported the event.
- Statistical significance: Chi-square Test, p=0.001.
3. Hepatitis B Vaccination:
- Vaccination rates were 92% among doctors, 87% among Nurses, and 73% among Paramedics.
- Statistical significance: Chi-square Test, p=0.001.

Table 4: Practices Related to BMWM

Practices	Doctors (%)	Nurses (%)	Paramedics (%)	Statistical Test	P-Value
Adherence to Colour Coding	66	87	69	Chi-square Test	0.03
Needle-Stick Injury Reporting	35	28	20	Chi-square Test	0.001
Hepatitis B Vaccination	92	87	73	Chi-square Test	0.001

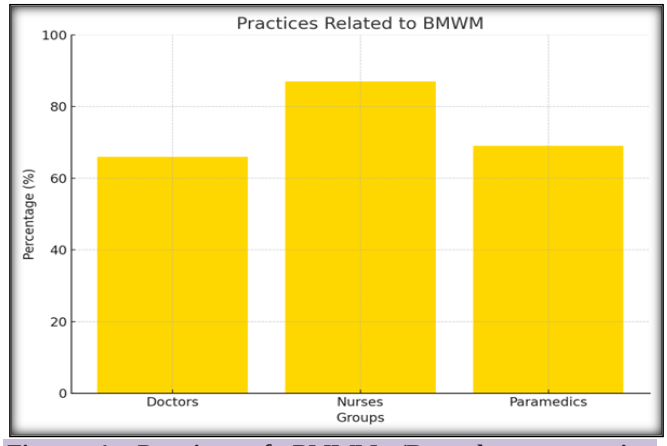


Figure 4: Practices of BMWM (Bar chart comparing adherence, injury reporting, and vaccination rates across groups)

Thematic Analysis

From semi-structured interviews, the following themes emerged:

1. Resource Constraints:
- Paramedics reported inadequate availability of bins and PPE.
- Example quote: “We often don’t have enough bins, and gloves run out quickly.”
2. Training Gaps:
- Nurses and paramedics highlighted the need for more refresher training.
- Example quote: “We need more hands-on training to improve compliance.”
3. Perceived Additional Workload:
- Paramedics viewed BMW Management as an added burden.
- Example quote: “We are already overloaded with work; this adds more responsibility.”
4. Positive Attitudes:

- Participants recognized the importance of BMW Management for infection control.
- Example quote: "Proper waste management reduces risks for everyone."

Discussion

This research paper identifies significant gaps in knowledge, attitudes, and practices regarding biomedical waste management (BMWM) among primary healthcare workers (HCWs) in the Kashmir Valley. General understanding of BMWM rules was good among nurses (98%) and doctors (96%), but not among paramedics (89%). This is in line with other related studies conducted in rural India, which indicate knowledge gaps between auxiliary and support staff, especially in following the segregation practicum. This disparity may be attributed to limited training opportunities and insufficient resources.[9]

The results show a positive attitude towards BMW Management across all groups, and most respondents have recognised its significance in mitigating health risks. Nevertheless, there was non-conformity between following the protocols of segregation and reporting, particularly in paramedicals, in which only 69% followed the colour-coded segregation policies. This is in keeping with other studies, where practical compliance tended to be lower than awareness, indicating a lack of knowledge-practice relationships.[10]

A significant problem observed was inadequate reporting of needle-stick damage, with only 20 percent of paramedics reporting the occurrence of injuries on needles as opposed to 35 percent of doctors. This low reporting rate may be due to fear of punishment or to the absence of proper reporting protocols, a problem that has been noted in other healthcare environments.[11]

Interview-based thematic analysis gave extra information. It was mentioned several times that resource constraints, including a lack of bins, personal protective equipment, and others, are barriers to successful BMW Management. That resonates with research findings highlighting the essential role of infrastructure in facilitating compliance.[12] The recurring theme was training gaps, with many participants feeling that regular training was necessary and should include hands-on training depending on position.

Conclusion

The research highlights the need for targeted interventions to overcome the knowledge-to-practice gap in BMW Management among HCWs, particularly among paramedics. To establish a culture of compliance, regular training, better resource allocation, and effective reporting procedures are required. Filling these gaps will not only improve BMW Management but also extend to broader infection control and workplace safety interventions in primary health care institutions.

Recommendations

1. Improved Training Programs: Training sessions conducted regularly to meet the requirements of various HCWs should be conducted. These sessions must be dedicated to the practical aspects of segregation, injury reporting, and infection control.
2. Better Resources: It is essential to make sure that there are sufficient colour-coded bins, personal protective equipment, and other resources needed to enhance compliance.
3. Policy and Monitoring Mechanisms: There should be clear policies on reporting needle-stick injuries, and the routine auditors and feedback should monitor this.
4. Special Interventions to Paramedics: Interventions to paramedics whose practices exhibited the greatest differences should be given priority.

Limitations: The research is limited in several ways. They could have selected participants through convenience sampling, which could have introduced selection bias, thereby reducing the applicability of the results. Self-reported data on self-generated practices, such as compliance with segregation regulations, may be subject to social desirability bias. Furthermore, the cross-sectional design does not allow for causal conclusions about knowledge, attitudes, and practices.

Interpretive interviews also led to thematic analysis regarding insights. Lack of resources, such as the theft of bins and personal protective equipment, was cited several times as an obstacle to effective BMWM. This aligns with research by scholars who have highlighted the pivotal role of infrastructure in facilitating compliance.[4] Another common theme, not to mention, was training gaps, with most participants noting the need for regular, role-specific practical training sessions.

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Conflicts of interest

There are no conflicts of interest.

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