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Original Research Article

A longitudinal follow-up study on sustained behavioural change and compliance post BMW management training among healthcare workers

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ABSTRACT

Background: While training interventions on bio-medical waste (BMW) management have shown immediate improvements in knowledge and practices among healthcare workers, there is limited evidence on the sustainability of such outcomes. This study follows up with the same cohort from the 2022 intervention at three hospitals in Rajasthan to assess long-term behavioural retention and operational compliance six months post-training.
Methods: This observational follow-up study included 124 of the original 156 participants. A structured survey and observational audit were conducted to measure retention of knowledge and adherence to BMW segregation protocols, PPE usage, and reporting mechanisms for needle-stick injuries. Spot-checks and supervisor feedback were also recorded.
Results: The average knowledge score declined slightly from 16.4 (post-training) to 14.8 after six months but remained significantly higher than the pre-training baseline (9.2, $p<0.001$). Sustained compliance was observed in 85% for colour-coded segregation, 89% for PPE use, and 82% for hand hygiene. Reporting of needle-stick injuries, however, dropped from 89% to 63%. Class 4 and housekeeping staff showed the most retained improvement, suggesting lasting value in training lower-cadre employees.
Conclusions: While slight declines were observed, most key behaviours related to BMW management remained significantly better than baseline. This underscores the value of refresher modules and continuous monitoring to sustain impact. Structured interventions, when coupled with audits and reinforcement, can yield lasting operational changes even in low-resource hospital settings.

Keywords: Biomedical waste, Health workforce behaviour, Longitudinal study, Infection control, Sustainability

INTRODUCTION

BMW is inherently hazardous and requires systematic handling, segregation, and disposal to prevent occupational exposure, healthcare-associated infections, and environmental contamination.[1] Improper biomedical waste management has been associated with needle-stick injuries, transmission of blood-borne infections, and downstream public health risks.[2] Healthcare facilities generate large volumes of waste, a significant proportion of which is infectious or hazardous in nature.[3] Effective biomedical waste management depends on regulatory frameworks, infrastructure, and, critically, sustained behavioural compliance among healthcare workers.[4]

In India, the bio-medical waste management rules, 2016 provide a comprehensive legal framework; however, implementation gaps persist due to inadequate training, inconsistent supervision, and lack of periodic reinforcement.[5] Training interventions have been shown to improve short-term knowledge and self-reported

compliance among healthcare workers.[6,7] However, evidence on the long-term sustainability of these improvements in real-world clinical settings remains limited.[8]

Frontline workers, particularly housekeeping and class 4 staff, often receive minimal follow-up training despite being directly involved in waste handling.[9]

This study follows up on a structured BMW management training intervention conducted in 2022 across three hospitals in Rajasthan to evaluate whether observed improvements in knowledge and behaviour were sustained six months post-training.[10]

The study also explores areas of behavioural decay and identifies opportunities for reinforcement in low-resource hospital settings.

Objectives

To assess knowledge retention on BMW rules six months post-training. To measure sustained compliance with waste handling protocols. To evaluate gaps in implementation and potential strategies for reinforcement.

METHODS

Study design

This study adopted an observational cross-sectional follow-up design conducted on the same cohort that participated in the 2022 pre- and post-training BMW intervention. The follow-up assessed knowledge retention and sustained behavioural compliance six months after the initial training.

Study place

The study was conducted in three hospitals in Rajasthan: a General Hospital, Janana Hospital, and a Covid-designated Hospital.

Study duration

The study was conducted from July 2022 to January 2023, covering six months post-training.

Study population

The original intervention included 156 healthcare workers, out of which 124 participants were available during follow-up.

Sampling technique

Sampling was done using a complete enumeration approach, including all workers reachable at the time of follow-up. Attrition reasons included transfers, resignations, and maternity leave.

Inclusion criteria

Participants who completed both pre- and post-training assessments in 2022. Healthcare workers present in the hospital during the follow-up period. Individuals giving informed consent.

Exclusion criteria

Participants who were unavailable during follow-up due to transfer or leave. Individuals declining participation. Incomplete records in baseline datasets.

Sample size consideration

Since this was a follow-up of an established cohort, the sample size was predetermined by the number of available participants. No fresh calculation was required. Sampling followed total enumerative sampling of all accessible members of the original cohort.

Data collection procedure

Two categories of tools were used, adapted from the original study revised 20-item knowledge questionnaire assessing recall of BMW rules. Observational audit checklist evaluating correct bin colour segregation. Use of PPE during waste handling. Reporting of needle-stick injuries. Hand hygiene practices post waste handling additionally spot-checks were conducted across wards. Interviews with 12 nursing supervisors and housekeeping leads provided contextual insights and validation.

Ethical approval

Ethical clearance was obtained from the Institutional Ethics Committee prior to data collection.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.

Knowledge scores were expressed as mean±standard deviation. Behavioural compliance indicators were expressed as numbers and percentages. Paired t-test was used to compare pre-training, post-training, and follow-up knowledge scores. A p value <0.05 was considered statistically significant.

RESULTS

Knowledge retention six months post-training

There was a statistically significant decline from post-training to follow-up, $p=0.012$, though scores remained

significantly higher than baseline (p<0.001). Knowledge scores showed a statistically significant decline at six months compared to immediate post-training levels (p=0.012), but remained significantly higher than pre-training baseline values (p<0.001).

Sustained improvements were observed in segregation, PPE use, and hand hygiene, each retaining over 80 percent compliance at follow-up. Needle-stick injury reporting showed the largest decline over time. Sustained compliance was highest for PPE use and waste segregation; while reporting of needle- stick injuries showed the most pronounced decline over time.

Table 1: Professional profile of participants.

Variable	Number
Staff Nurse	55 (35.3%)
Laboratory technicians	22 (14.1%)
Housekeeping staff	46 (29.5%)
Class 4/ Ward boys	33 (21.2%)

Table 2: Comparison of knowledge scores over time.

Time point	Mean score±SD
Pre-training	9.2±SD
Immediately post training	16.4±2.1
Six-month follow-up	14.8±2.4

Table 3: Compliance rates at baseline, post-training, and six-month follow-up.

Compliance indicator	Pre-training (%)	Post-training (%)	Six-month follow-up (%)
Colour-coded segregation	62	94	85
PPE use during waste handling	69	96	89
Hand hygiene post handling	72	93	82
Needle-stick injury reporting	48	89	63

Subgroup observations

Housekeeping staff and class 4 workers showed the highest behavioural retention. Covid Hospital workers had the best compliance, influenced by existing SOP-driven supervision. Nurses and lab technicians showed comparatively higher regression in compliance behaviours.

DISCUSSION

This longitudinal assessment indicates that structured BMW training leads to meaningful and sustainable behavioural improvements among healthcare workers, even six months after the intervention. Despite minor regression, most compliance indicators remained substantially higher than baseline. This aligns with previous research showing that while knowledge may decline without reinforcement, trained behaviour tends to persist where institutional norms are strong.[1]

The findings demonstrate that structured BMW management training can result in sustained behavioural change six months post-intervention, particularly when reinforced through institutional norms and supervisory oversight.[1] Although a modest decline in knowledge scores was observed, compliance with critical practices such as segregation and PPE use remained above 80 percent.[2]

The decline in needle-stick injury reporting highlights a gap in sustaining procedural behaviours that lack immediate perceived benefit, underscoring the need for targeted reinforcement strategies.[3] Similar longitudinal studies have reported partial regression in the absence of refresher training, supporting the importance of continuous audit and feedback mechanisms.[4-6]

Consistent with prior research, this study reinforces that policy awareness, supervision, and systemic support are key determinants of long-term compliance.[7-9] The stronger retention among housekeeping and Class 4 staff suggests that focused, task-specific training may yield durable behavioural outcomes.[10]

Limitations

The study showed attrition in follow-up limits representativeness. Observational audit may still have an observer effect (Hawthorne bias). No biochemical markers or actual infection incidence were measured.

CONCLUSION

Structured BMW training programs yield long-term benefits, but some behaviour decay is natural. BMW training demonstrates clear long-term benefits, with most behaviours sustaining over six months. Integrating refresher training, supervisory monitoring, and systemic reinforcement mechanisms such as audit loops can help institutionalize safe waste management practices across healthcare settings. This follow-up study advances the field by highlighting the importance of longitudinal tracking in public health intervention evaluation.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Mathur V, Dwivedi S, Hassan MA, Misra RP. Knowledge, attitude and practices about biomedical waste management among healthcare personnel: a cross-sectional study. Indian J Community Med. 2011;36(3):143-5.
2. Kini BS, Kumar S, Reddy M, Nabar AS, Kamath VG. Knowledge, attitudes and practices regarding biomedical waste management among staff of a tertiary healthcare centre in coastal Karnataka. J Public Health Med Res. 2014;2(1):20-4.
3. Verma LK, Mani S, Sinha N, Rana S. Biomedical waste management in nursing homes and smaller hospitals around Delhi. Waste Manag. 2008;28(12):2723-34.
4. Kumar S, Bhattacharyya JK, Vaidya AN, Chakrabarti T, Devotta S, Akolkar AB. Assessment of the status of solid waste management in metro cities, state capitals, class I cities, and class II towns in India: an insight. Waste Manag. 2009;29(2):883-95.
5. Radha R. Assessment of existing knowledge, attitude and practices regarding biomedical waste management among the health care workers in a tertiary care rural hospital. Int J Health Sci Res. 2012;2(7):14-9.
6. Sharma AK. Biomedical Waste (Management and Handling) Rules. Bhopal: Suvidha Law House; 2012.
7. Misra V, Pandey SD. Hazardous waste: impact on health and environment for development of better waste management strategies in future in India. Environ Int. 2005;31(3):417-31.
8. Patil AD, Shekdar AV. Healthcare waste management in India. J Environ Manage. 2001;63(2):211-20.
9. Nath P, Prashanthini V, Visvanathan C. Healthcare waste management in Asia. Waste Manag. 2010;30(1):154-61.
10. Lakshmikantha H. Report on waste dump sites near Bangalore. Waste Manag. 2006;26(6):640-50.

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