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Original Research Article

Impact of multi-modal learning workshop on awareness and knowledge of health care providers about waste management in India

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ABSTRACT

Background: Hospital waste management is crucial in preventing needle stick injuries and exposure to hazards. Adequate knowledge, appropriate safety measure, and methods of handling the wastes are more important in waste management.
Aim and Objective: The objective of this project is to study the impact of multi-modal training workshops in improving the knowledge and awareness on biomedical waste management among healthcare workers.
Materials and Methods: An eight-hour onsite training workshop was conducted in Ahmedabad, Kolkata, Indore, and Hyderabad from July to September 2023. A validated pre and post-test questionnaire was used to assess the impact of the workshop. At the end of each workshop, responses were analyzed to study the effectiveness of the workshop and to do a gap analysis on the areas that require strategic learning. Analysis was conducted on data aggregated using the Chi-square test.
Results: In the above analysis, the pre-test scoring of these participants was 66%. After the workshop, the post-test scoring was 83% with a significant improvement ($p < 0.0001$). The pre-test and post-test scores in individual regions were 63% and 78% at Ahmedabad, 71% and 86% at Kolkata, 60% and 86% at Indore, and 68% and 83% at Hyderabad respectively.
Conclusion: In healthcare facilities, training plays a key role in preventing health hazards for both employees and patients. Training must involve different types of learning methods tailored to the needs and capability of understanding of the participants. The effectiveness of training must be measured using appropriate tools to study the impact of the learning methods.

1. Introduction

Hospital waste management is crucial as it has hazardous and infectious wastes. In hospital, segregation of general (solid) wastes and biomedical waste is of paramount importance in preventing injuries, fatal harms, and exposure to hazards thereby preserving the ecosystem. To make stringent rules in this area of concern, the Ministry of Environment, Forest, and Climate Change of India has revised the guidelines for waste management in the year 2016 with subsequent amendments in 2018, and 2019 and COVID-specific guidelines in 2020.[1] In addition

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to biomedical waste (BMW) management, the Central Pollution Control Board of India has written guidelines on general (solid) wastes, e-waste, and battery waste.[1] Even though guidelines and legal regulations exist, some practical hinges and challenges lead to partial compliance or non-compliance in waste management. Mismanagement of hospital waste is not limited to the hospital environment; it is a community and a global health problem.[2]

Although there are regular training programmes conducted among healthcare professionals in their hospitals, the level of awareness in India is found to be unsatisfactory in many survey.[3,4] A study conducted in 2007 at Agra, India has shown that most of the hospital wastes generated by Government sectors are disposed in their neighborhood due to a lack of awareness, inadequate facilities/infrastructure and operational inefficiencies.[5] Adequate knowledge, appropriate techniques and methods of handling the wastes, and regular practice of safety measures can go a long way towards the safe disposal of biomedical wastes and protect the environment.[6]

With this background, we have aimed to conduct regional workshops across various parts of India on waste management among healthcare professionals. The objective of this project is to study the impact of multi-modal learning programmes in improving the knowledge and awareness of waste management in healthcare facilities.

2. Materials and Methods

An eight-hour onsite training workshop was conducted in five regions of India namely Mohali, Ahmedabad, Kolkata, Indore, and Hyderabad during the month of July to September 2023 which is supported by the World Health Organization, India. The training module was created by a team of experts in the field of infection control, waste management and environmental engineering. The module was created in consensus with the existing national and state-wise guidelines. The training material included PowerPoint presentations, published guidelines and a literature review. The training material was reviewed by experts from the World Health Organization, India before being used as a resource material.

The training programme was attended by doctors, nurses, quality professionals, engineers, housekeeping managers, and administrators from various hospitals. There were 138, 116, 110, and 146 participants in Ahmedabad, Kolkata, Indore, and Hyderabad respectively. The total number of people trained were 510. The responses from Mohali were not documented here due to less sample size.

The training programme was conducted by three experts in waste management. The learning methodology used were didactic lectures, simulation-based learning, case studies and using digital tools. In addition, a real-time audit was also conducted through group exercises. The programme was scheduled for a period of 8 hours with the following sessions: Basics of biomedical waste & hazards, Regulatory frameworks and guidelines governing waste management in India, Biomedical waste colour coded categories & segregation, Safe Handling, Transportation & Storage of BMW waste, Case studies, Group exercises, BMW treatment methods, BMW committee responsibilities, General waste & Miscellaneous waste management and focus group discussions.

Before initiating the training programme, a learning environment was created by a round table seating arrangement, an ice-breaking session for the participants and a few games were conducted to help participants to feel free and comfortable to ask questions during the sessions. The participants were requested to fill out a pre-test questionnaire before and a post-test questionnaire after the completion of the session through Google Forms. The questionnaire had 25 questions about the waste management guidelines that were validated by experts with the same set of questions for both pre and post-test. The questions had two different sections: one section of 10 questions that covered the biomedical waste management rules and regulations, and another set of 15 questions covering the practices.

In our workshop, we used PowerPoint presentations with the 3W concept: What, Where and Why in waste management. What stands for what is the material made up of: is it plastic, non-plastic, metal or sharp? Where stands for which colour code does the material go? Why stands for why the material was discarded in that colour? This was followed by a live simulation-based skill station workshop with real wastes (Figure 1). All the participants were asked to segregate the products in different colour-coded bins during the workshop. There were active interactions during the segregation and the queries raised were cleared by the experts. In addition, a group exercise was done at the end to audit the compliance with the segregation. One group was assigned as the segregation team and another group was assigned as the auditing team through which the waste segregation audit was performed.

Figure 1: Skill station based learning on waste management

At the end of each workshop, responses were analyzed to study the effectiveness of the workshop and to do a gap analysis on the areas that require vigorous training or strategic learning. The analysis was shared with the

resource persons immediately which helped them to find the grey areas in the waste management. Based on the previous workshop responses, more focus was given to fill those gaps in subsequent workshops. Overall data was compiled and used for statistical analysis. Analysis was conducted on the data aggregated using the Chi-square test; the difference between pre-and post-tests was examined for statistical significance. The ethical approval and/or institutional review board (IRB) was not applicable for this study.

3. Results

The pre and post-test results were collected from the participants. Table 1 shows the region-wise overall responses to the assessment. When compared to the pre-test, there was a significant improvement in the post-test after the workshop ($p < 0.0001$). Overall, it was found that the scoring for correct responses were 63% vs 78% at Ahmedabad, 71% Vs 86% at Kolkata, 60% Vs 86% at Indore and 68% Vs 83% at Hyderabad in the pre-test Vs post-test analysis.

The analysis of responses to 10 set of questions that covered BMW rules and regulations were compared between each region. Table 2 shows the responses to BMW regulatory questionnaire. There was significant improvement in post-test for all the questions which was statistically proven. When individual questions were analyzed for a less than 70% score in the pre-test, participants were not aware of legal actions for violation, CPCB ministry name, waste accident management, waste record keeping and purpose of barcoding. In post-test, overall responses were more than 70% scoring except for the purpose of barcoding.

Table 3 shows the responses to each question under the section BMW practices. Overall, 14 questions were answered correctly after the workshop with a statistical significance when compared to the pre-test, except one question on the size of the burial pit. When individual questions were analysed for a score of less than 70% in the pre-test, participants were not aware of final treatment method of metallic implants, measurement of deep burial pit, colour coding for Orthopaedic K nail, legal requirement for e-waste, colour coding for insulin syringe discarding, food waste and battery wastes.

In post-test, there has been improvement in above underscored questions except final treatment method of metallic implants, measurement of deep burial pit and colour coding of K nail.

4. Discussion

This analysis was conducted to study the effect of using different types of learning methods in improving the knowledge of health care workers on waste management

Table 1: Overall awareness of waste management before and after the workshop

S. No	Regional workshop location	Type of assessment	Number of participants	Correct response (%)	Incorrect response (%)	P value
1	Ahmedabad	Pre-test	146	63	37	<0.0001
		Post-test	135	78	22	
2	Kolkata	Pre-test	110	71	29	<0.0001
		Post-test	99	86	14	
3	Indore	Pre-test	116	60	40	<0.0001
		Post-test	97	86	14	
4	Hyderabad	Pre-test	138	68	32	<0.0001
		Post-test	110	83	17	

Table 2: Awareness of biomedical waste management regulations before and after the workshop

S. No	Question	Type of assessment	Correct response (%)	Incorrect response (%)	P value
1	Identify the year of release of the current bio medical waste management rules	Pre-test	77	23	<0.0001
		Post-test	93	7	
2	What does CPCB stand for in the context of biomedical waste management?	Pre-test	91	9	0.001
		Post-test	96	4	
3	Records of biomedical waste management annual report should be submitted to	Pre-test	60	40	<0.0001
		Post-test	77	23	
4	Which of the following does not belong to the major accidents?	Pre-test	59	41	<0.0001
		Post-test	78	22	
5	Legal Actions for violation of the provisions under Section 15 of 'The Environment (P) Act, 1986' includes	Pre-test	55	45	<0.0001
		Post-test	93	7	
6	Accident Report is needed to be forwarded in written to the respective SPCB/PCC within	Pre-test	58	42	<0.0001
		Post-test	81	19	
7	Which ministry in India is responsible for formulating rules and guidelines for biomedical waste management?	Pre-test	56	44	<0.0001
		Post-test	82	18	
8	According to the MOHFW rules, which of the following healthcare facilities are required to obtain authorization from the State Pollution Control Board for biomedical waste management?	Pre-test	81	19	<0.0001
		Post-test	95	5	
9	Which of the following is a mandatory document that needs to be maintained by healthcare facilities for the transportation of biomedical waste?	Pre-test	83	17	<0.0001
		Post-test	93	7	
10	According to the CPCB guidelines, what is the purpose of barcoding in biomedical waste management?	Pre-test	47	53	<0.0001
		Post-test	67	33	
11	Which among the following waste category does not comes under BMW CPCB rules 2016?	Pre-test	54	46	<0.0001
		Post-test	82	18	
12	As per the CPCB rules, how long should the records of biomedical waste management be maintained by healthcare facilities?	Pre-test	50	50	<0.0001
		Post-test	89	11	
13	According to the CPCB guidelines, how often should training on biomedical waste management be provided to healthcare facility personnel?	Pre-test	78	22	<0.0001
		Post-test	91	9	
14	According to the CPCB guidelines, which vaccination is mandatory for biomedical waste handlers?	Pre-test	95	5	0.001
		Post-test	99	1	

Table 3: Responses to each question under the section BMW practices

S. No.	Question	Type of assessment	Correct response	Incorrect response	P value
1	Urobag should be discarded into	Pre-test	81	19	0.001
		Post-test	89	11	
2	Placenta should be finally treated by	Pre-test	72	28	<0.0001
		Post-test	86	14	
3	What is the final disposal treatment method of metallic implants?	Pre-test	39	61	<0.0001
		Post-test	60	40	
4	What is the standard of measurement for deep burial pit height?	Pre-test	53	47	0.340
		Post-test	55	45	
5	Orthopedic K nail should be discarded into which of the following color coded bins?	Pre-test	39	61	<0.0001
		Post-test	60	40	
6	Which category of biomedical waste should be segregated and collected in red-colored containers or bags?	Pre-test	82	18	<0.0001
		Post-test	94	6	
7	What is the prescribed color for the container used for the disposal of discarded medicines or cytotoxic drugs waste?	Pre-test	76	24	<0.0001
		Post-test	96	4	
8	According to the CPCB rules, what is the legal requirement for the management of e-waste generated by healthcare facilities?	Pre-test	63	37	<0.0001
		Post-test	78	22	
9	As per the CPCB rules, which treatment method is commonly used for the sterilization of laboratory wastes?	Pre-test	83	17	<0.0001
		Post-test	95	5	
10	Identify the appropriate colour coding for discarding the insulin syringe	Pre-test	60	40	<0.0001
		Post-test	77	23	
11	Identify the appropriate colour coding for discarding the blood bag	Pre-test	73	27	<0.0001
		Post-test	88	12	
12	Identify the appropriate coloured bins for disposal of plastic apron?	Pre-test	74	26	<0.0001
		Post-test	92	8	
13	Where will you discard the Chemotherapy drug	Pre-test	72	28	<0.0001
		Post-test	93	7	
14	Identify the colour coding to discard food waste?	Pre-test	54	46	0.024
		Post-test	61	39	
15	Which of the colour coding is ideal for discarding the battery waste?	Pre-test	54	46	<0.0001
		Post-test	83	17	

process. Even though waste management is routinely taught in medical curriculum, employee induction and annual training program, there is lack of awareness and discrepancies in the practices. Various studies conducted in India have shown that the knowledge and awareness on waste management is around 60-70%.[7–10] This is mainly due to the lack of standardized training programs, lack of evaluation during training and not giving importance to the feedback of the employees. A structured training program can help improve the knowledge among healthcare professionals.[11] The routine didactic PowerPoint based training program on topics like waste management will be difficult to understand fully, as there are plenty of medical products been used in routine practice which goes for disposal. In routine training, only few of the products like masks, gloves, syringes, catheters, and needles are shown in the images; hence the health care workers may not be able to learn the colour of segregation for the remaining products during their routine clinical rounds. This leads to improper segregation in waste management process.

All the participants who attended the regional workshop in our project had already undergone some form of training program in their hospitals. In most of the places, there was no annual training programme in waste management. After the induction programme, there is a tendency to forget the guidelines as these practices are habitual and this needs to be reiterated through repeated training programmes. In the above analysis, the pre-test scoring of these participants was 66%. After the workshop, the post-test scoring of these participants was found to be 83%. It has been proven by other studies that training plays a significant role in improvement of knowledge on BMW.[11,12] This finding highlights the importance of simulating the real-world scenario in training methodologies. This study has shown the need for a structured and validated training programme developed by experts through different learning methods that makes an impact among the audience. The participants were able to address all the queries and their knowledge were significantly improved after the workshop. Similar findings has been shown by Kumar et al., (2016) that the effect of training as an intervention is sustainable and has a positive impact on health care professionals and should be included within the healthcare policies.[13]

Waste management interventions are often hampered by lack of awareness and limited knowledge on resource recovery technologies, poly tools and financial mechanisms.[14] The ability to appropriately and sustainably manage biomedical and other waste rests on well-developed and well-built capacity for health care practitioners, as well as environmentally conscious citizens. There is a high percentage of attrition rate especially post COVID pandemic that leads to difficulty to training repeatedly.[15] Due to staff shortage in various hospitals, especially nurses, the time for induction programme has been shortened and importance to waste management is not highlighted in the training. The main reason for limited awareness about proper waste segregation and disposal practices is due to inadequate and insufficient training programs for healthcare professionals.

The findings of the above study suggest that the guidelines can be implemented through training academy targeted only for waste management which can be initiated and funded by the central Government. These academic initiatives can involve volunteers from various health care set ups through national level medical and nursing networks and environmental friendly non-governmental organisations as done for solid waste management.[16] An online educational platform in CPCB website with pre-recorded videos and pre/post-test scoring can be implemented which is an education and awareness strategy to promote behavioural change at national level and transform habits and perceptions about waste as a resource. This program can be made compulsory for all employees and can be documented in employee file. A toolkit to do self-assessment can be developed and can be used for assessment by the pollution control board on a regular basis. The goal is to foster behavioural change at the national level to achieve sustainable resource and waste management.

5. Conclusion

In healthcare facilities, training plays a key role in preventing health hazards for both employees and patients. Training must involve different types of learning methods tailored to the needs and capability of understanding of the participants. The effectiveness of training must be measured using appropriate tools to study the impact of the learning methods. Gaps in waste segregation can be bridged by multi-modal learning methods during training.

6. Ethical Approval

The ethical approval and/or institutional review board (IRB) was not applicable for this study.

7. Source of Funding

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8. Conflict of Interest

The author does not have any competing interests to declare in this study.

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