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A different training model in providing effective medical waste management in the operating room: peer education

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ABSTRACT

Objectives: Objectives: This study aims to investigate the effectiveness of peer education methods in reducing medical waste in operating room settings.

Methods: A quasi-experimental design was utilized, involving 217 operating room staff who received training in medical waste management through a peer education program. Changes in knowledge, attitudes, behaviors, and the amount of medical waste generated before and after the intervention were evaluated.

Results: Following peer education, there was a significant increase in participants' knowledge levels regarding proper medical waste segregation. Positive shifts in attitudes and behaviors related to medical waste management were observed post-training. Additionally, the ratio of medical waste to general waste decreased, while the proportion of recyclable waste increased after the intervention.

Conclusions: Peer education emerges as an effective method for enhancing awareness and promoting proper medical waste management practices among operating room staff. However, achieving significant waste reduction requires comprehensive approaches beyond education alone. Clear regulations, improved infrastructure, and the adoption of reusable products are crucial for sustainable waste reduction efforts in healthcare settings.

Keywords: Medical waste management, peer education, operating room staff, waste reduction, behavior modification

Medical waste is defined by the World Health Organisation (WHO) as: "Waste generated in the processes of diagnosis, treatment or immunisation of humans or animals". Medical waste has a negative impact on the economies of countries and organisations as well as potential risks to human health. Problems in the proper disposal of these wastes increase the risk of infection and injury for healthcare personnel. In addition, it threatens public health by causing the spread of microorganisms from healthcare facilities to the environment [1-4].

An increase in the amount of medical waste is observed in connection with the increase in modern medical practices and easier access to healthcare services [5]. The use of disposable materials, which have the advantage of reducing the risk of infection between patients and healthcare personnel, further increases the production of medical waste, especially in developed

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countries. This leads to a rapid increase in the amount of medical waste that needs to be disposed of safely [6].

It is generally accepted that the best way to prevent non-infectious waste from entering the infectious waste stream is for staff working in healthcare facilities to segregate waste into infectious and non-infectious waste as soon as it is generated [7]. Health concerns and lack of knowledge lead to more medical waste generation. It has been found that most of the medical waste in the hazardous medical waste branch should not be thrown into the medical waste bag and cost savings of more than 30% can be achieved in this case with waste separation and correct definition of waste branches [8, 9].

Establishment of training programs to increase the awareness of perioperative staff members about medical waste may contribute to making positive behaviors about waste separation more widespread in the institutional culture and thus reducing the amount of medical waste [5, 10, 11].

Peer education is an active learning process in which it is aimed to change the knowledge, attitudes, beliefs and skills of individuals in a similar social group about a specific subject through educational activities by willing, volunteer and trained peers [12]. Peer education has a long history and has been used for different purposes to help the development of professional behaviors for groups of different ages and environments [13-15]. Nowadays, in the curricula of most medical schools, many departments and institutes adopt peer education method as a part of their daily teaching as well as problem-based learning [16, 17]. The aim of this study was to investigate the effect of peer education method on the reduction in the amount of medical waste.

METHODS

Study Design

Ethics committee permission was obtained from SBU Hamidiye Medical Faculty Ethics Committee with the decision dated 17.06.2022 and numbered 16/4 and local permission was obtained from Konya City Hospital Education Planning Board with the decision dated 02.12.2021 and numbered 12-16. The research conducted between 01.08.2022-02.12.2022 was descriptive and quasi-experimental. The population of the study consisted of 320 people consisting of anesthesia specialist and assistant doctors, anesthesia technicians, surgical nurses and table technicians working in the operating room. The sample consisted of 217 people who volunteered for the study.

A questionnaire form was prepared by the researchers after reviewing the relevant literature. This questionnaire aimed to evaluate the socio-demographic characteristics of the participants (8 questions) and their level of knowledge, thoughts and attitudes (12 questions) about medical waste generation, medical waste management. The questionnaire form created with Google Forms web application was delivered to the participants via social media (Whatsapp).

The amount of waste generated in our hospital is weighed separately for each clinic under the management of the environmental management department, separately as medical waste, domestic waste and recycling waste to be given to the company in charge of receiving medical waste every day. The amount of waste generated during the 35 days before the study started was obtained from the hospital environmental management department data. The team measuring the amount of waste did not know about this study.

Identification and Training of Peers

Inclusion criteria included working in our institution and operating room as anesthesiologists, assistant physicians, technicians, nurses, or housekeeping staff and having no language barriers in communication. Exclusion criteria included incomplete or inconsistent survey forms, unwillingness to participate, and not working during the study period due to reasons such as leave or medical report.

A standard medical waste training should include definitions related to the topic, scope, legal regulations, waste management processes, and health and safety issues. While planning the training with the employees working in the environmental management unit, they were asked to prioritize management processes and waste reduction topics. Additionally, fundamental issues related to medical waste management were also covered.

A pre-test on medical waste was first administered to the target group who volunteered to be included in the study. After this test, a peer trainer group was identified within the target group on a voluntary basis. Considering that each peer trainer could reach an av-

erage of 6-7 people, a group of 35 people was formed.

A peer trainer group consisting of 35 individuals received training twice. This training was provided by the same team from the environmental management unit, coordinated by the lead researchers. There was a 15-day interval between the two training sessions, and each session lasted 90 minutes.

The peer educator group was selected from people who were willing, had strong interpersonal communication, were respected by the target group and had non-judgmental attitudes (18,19). This group was ensured to be homogeneous in terms of profession and distribution to the operating rooms. The training included waste types, waste symbols, waste color coding, separation of medical waste at source. In addition, the contribution of this issue to the economy, waste disposal methods, the use of sharps boxes, injuries caused by medical waste, transmitted diseases, and the damage of waste on environmental health were explained. In addition to slides containing theoretical information, visual training methods such as short films were also used in the training.

A part of the training presentation was dedicated to the content and format of the training to be implemented by the peer trainers to ensure an effective and efficient learning experience. It was explained that during the training process, questions with missing information may be encountered, and in this case, accepting and expressing their deficiencies will increase the credibility and respectability of the learning environment, and that this attitude will help the group to develop a positive attitude towards learning and to establish a better interaction with the peer trainers. In this process, it was stated that it would be effective not only to transfer information to teammates but also to take on a supportive and motivating role in implementation. For two weeks after the training, peer trainers continued to work in the field in the form of sharing information, experience, reminders, and demonstrating exemplary behavior. Peer trainers did not use any standardized training materials while sharing their knowledge with other employees in the work environment. However, if needed, they used materials from their own existing trainings.

After the completion of the second part of the peer training, the amount of waste measured by the waste control unit was recorded again for 35 days. At the end of this 35-day period, a post-test with the same question content was administered to the entire target group. Pre-training and post-training tests were administered to all participants.

As the primary outcome of the study, the measurement of the amount of operating room medical waste before and 35 days after the peer education was evaluated. As a secondary outcome, the knowledge levels of the all participants after peer education were measured with five questions in the post-test and evaluated by comparing with the pre-test results. In addition, the behavior-attitude levels of the participants after peer education were measured with seven questions prepared according to the five-point Likert scale in the post-test and evaluated by comparing with the pre-test results.

Statistical Analysis

IBM SPSS Statistics (Version 24.0. Armonk, NY: IBM Corp.) program was used to evaluate the findings of the study. In our study, for sample size analysis, a 5% reduction after medical waste training was considered to be significant based on previous studies. In our 8-day pilot study conducted before the study, the mean medical waste in the group before the training was 403.51±22.89. In the independent groups t-test model created using the data of our pilot study, the partial Cohen's D effect size of 0.882 was used to calculate that 35 days of measurements should be performed in both groups for 95% power and maximum 5% type 1 error. Descriptive analyses such as percentage, mean and standard deviation were used for measurement values. Significance was evaluated at $P<0.05$ level.

RESULTS

The study included 217 operating room staff. Of the 217 participants, 115 (53%) were female, 108 (50%) had been practicing their profession for 1-5 years, and 146 (67%) had received previous training on the subject. The distribution of socio-demographic characteristics of the participants is given in Table 1.

The correct response rate to the question "In which waste bin should serum bags that do not come into contact with the patient be disposed of ?" increased from 90 to 125 (40% to 57.6%). However, the correct response rate to the question "In which waste bin should medication vials and serum bottles be disposed

Table 1. Socio-demographic characteristics of the participants

Characterisitics		n (%)
Gender	Female	115 (53)
	Male	102 (47)
Age (years)	18-25	88 (41)
	26-35	69 (32)
	36-45	40 (18)
	46-55	18 (8)
	55 ≥	2 (19)
Occupation	Surgical technician	35 (16)
	Nurse	64 (29)
	Anesthesia technician	71 (33)
	Anesthesiology resident	28 (13)
	Anesthesiologist	19 (9)
Gradution	High school	17 (8)
	Associate degree	72 (33)
	Bachelor degree	76 (35)
	Master's degree, medical faculty	36 (17)
	PhD, Specialist	16 (7)
Experience Period	<1	23 (11)
	1-5 years	108 (50)
	6-10 years	22 (10)
	11-15 years	28 (13)
	>15	36 (17)
Have you been trained on medical waste?	No	71 (33)
	Yes	146 (67)
Hepatitis vaccine history?	No	13 (6)
	Yes	193 (89)
	No answer	11 (5)
Have you had a tetanus vaccination in the last 5 years?	No	23 (11)
	Yes	176 (81)
	No answer	18 (8)

of?" was 15% before the training and increased to 27.6% after the training. A detailed analysis of the participants' answers to the knowledge questions about medical waste is given in Table 2.

"Do you consider your knowledge on medical waste sufficient?" The rate of respondents who considered their knowledge sufficient before the training decreased after the training (4.26 and 4, respectively). This difference is significant (P<0.01). Additionally, the rate of respondents who believed that the issue in medical waste segregation was due to a lack of knowledge was 3.71 before the training and decreased to 3.56 after the training. This difference is also significant (P<0.01). The comparison of the answers given to the 5-point Likert scale regarding the attitudes and behaviors of the participants with the paired t test is given in Table 3.

The change in the amount of weight before and after the training is given in Fig. 1. It was observed that the ratio of medical waste to all waste decreased from 8892,07 to 9569,41 (70% to 68%) in the post-training period, while this ratio increased from 1301,2 to 1485,48 (19% to 21%) in recycling waste, and there was no change in the ratio of household waste.

DISCUSSION

In our study, we investigated the effect of training given to operating room staff on medical waste management using the peer education method on the reduction in the amount of medical waste. We observed that the peer education method is an effective method in reducing the amount of medical waste.

Medical waste poses a risk of infection, contamination of soil and water resources, threats to ecosystems and disruption of the environmental balance, as well as negatively affecting the cost of institutions and countries. Waste generation rates vary according to the intensity of healthcare services, location (rural or urban), type of healthcare facility and clinic, size of use of disposable products, waste classification policies and regulations, segregation and reduction practices, procurement policies and development levels of countries [20]. Failure to segregate waste at its source and mixing it with domestic waste increases medical waste generation [21-23].

Reduction of waste generation is achieved through

Table 2. Pre-test and post-test results evaluating the participants' knowledge about medical waste

		Pre-test (n=217)	Post-test (n=217)
What is the biohazard symbol?			
	True	159 (73.3%)	161 (74.2%)
	False	49 (22.6%)	51(23.5%)
	No answer	9 (4.1%)	5 (2.3%)
In which waste bin should serum bags that do not come into contact with the patient be disposed of?			
	True	90 (40%)	125 (57.6%)
	False	126 (58.1%)	90 (41.5%)
	No answer	1 (18%)	2 (0.9%)
In which waste bin should medication vials and serum bottles be disposed of?			
	True	33 (15%)	60 (27.6%)
	False	181 (83.6%)	155 (71.4%)
	No answer	3 (1.4%)	2 (0.9%)
What is the most commonly used method for disposing of medical waste?			
	True	49 (22.6%)	76 (35%)
	False	68 (31.3%)	82 (37.8%)
	No answer	100 (46.1%)	59 (27.2%)
What color symbolizes medical waste?			
	True	209 (96.3%)	216 (99.5%)
	False	7 (3.2%)	1 (0.5%)
	No answer	1 (0.5%)	0 (0%)

Data are shown as n (%).

Table 3. Pre-test and post-test results evaluating the attitudes and opinions of the participants about medical waste

	Pre-test	Post-test	P value
Do the waste separation behaviours of the operating room team affect your attitudes?	3.45±1.09	3.65±1.34	0.10
Do you consider your knowledge on medical waste sufficient?	4.26±0.82	4.00±0.97	**<0.01**
Does peer education increase sensitivity to medical waste?	3.45±1.09	3.26±1.00	0.07
Do you think that information will have an effect on waste sorting?	4.42±0.92	4.11±0.95	**<0.01**
Is attention paid to the use of protective equipment?	3.71±1.12	3.56±1.09	0.15
Do you think that separating medical waste will have a cost impact?	4.42±0.84	4.48±0.86	0.47
Do you think there is a lack of information about medical waste segregation?	4.11±1.07	3.53±1.37	**<0.01**

Data are shown as mean±standard deviation. The answers are given on a 5-point Likert scale with 1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly agree, and 5: Strongly agree.

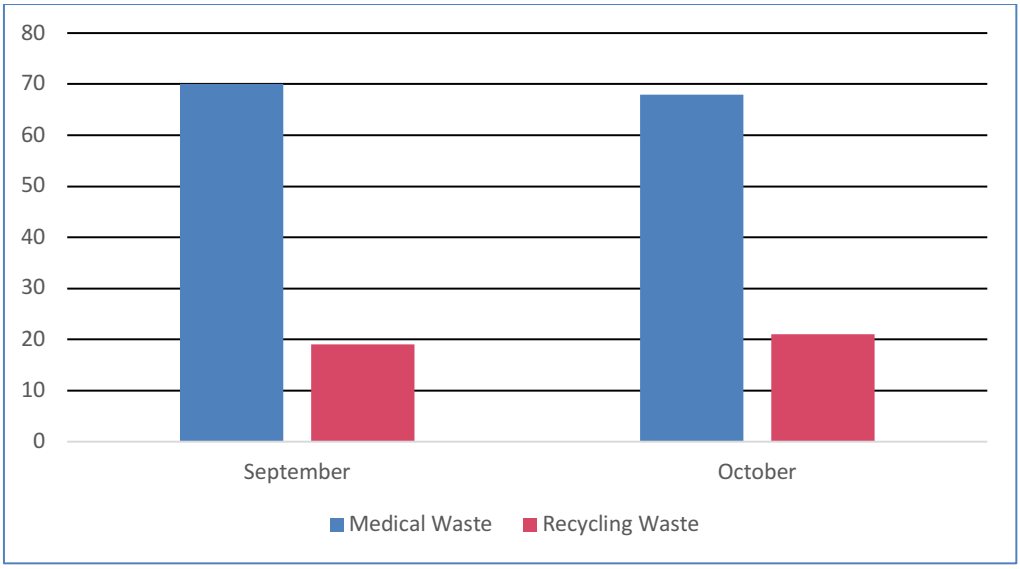

Fig. 1. The decrease in the ratio of medical and recycling waste to total waste before (September) and after (October) training.

three types of activities: absolute avoidance of waste generation, reduction at source and reuse of the product [24]. Effective personnel training is very important to reduce the amount of medical waste by segregation at the source [10]. In studies conducted with healthcare workers in our country, the rate of receiving training on medical waste varies between 43.5% and 70.7% [25-27]. In our study, the rate of receiving training on medical waste was found to be 67% and this result is consistent with the values previously reported in the literature.

Peer education programs offered as an alternative to traditional methods are used for different purposes and for groups of different ages and environments [13]. Studies have shown that the use of peer education method is effective in the skills/clinical training of nurse/medical students, teaching rational drug use, stoma care, breast self-examination, teaching physical examination in medical school, and organizing the perspective of mental illnesses [28-30]. In a study in which Chen and colleagues compared medical school students trained with traditional and peer education, it was found that the physical examination, written exam and peer evaluation scores of the students in the peer group were significantly higher [30].

In a study conducted by Öztürk *et al*. [31], five basic nursing skills that students learned for the first time were compared with peer education method and current teaching methods, and the rate of complete application of the skills within the scope of the research was found to be higher in the peer group compared to the control group.

There is no literature on the implementation of a peer education program on medical waste management and measuring the effects of this program. In our study, the results presented in Table 2 show that there was a significant increase in the knowledge level of the participants on how to properly separate medical waste after peer education. In particular, there was an increase in correct answers from 40% to 57% in the question of identifying the waste bin for serum bags that do not come into contact with the patient, and from 15% to 26.7% in the question of identifying the waste bins for drug vials and serum bottles. The peer education we conducted within the scope of this study shows that there is a significant increase in the knowledge level of the participants on how to correctly distinguish and properly dispose of medical waste materials. This shows that peer education can be used as an effective method to increase awareness on medical waste management and to enable healthcare personnel to play a more effective role in this field.

The pretest-posttest analysis of our study reveals that statistically significant differences were observed in the questions measuring attitude, behavior and thought (Table 3). These findings point to the potential of the training program to create a positive change in the participants' thoughts, attitudes and behaviors. In

particular, the fact that there were decreases in the positive answers given to the topics of considering their own knowledge sufficient, the effect of information on reducing medical waste generation and thinking that the problem in reducing medical waste is lack of information shows that the training increased the awareness of the participants on these issues. Our findings are in line with studies indicating that awareness rather than knowledge is weak in medical waste reduction.Hassan *et al*. revealed that medical waste problems arise due to lack of awareness and reluctance of healthcare workers and unclear policies and laws [32].

During the 35 days following the end of the training, the ratio of medical waste to general waste decreased from 70% to 68%, while the ratio of recyclable waste increased from 19% to 21% (Fig. 1).

Dönmez and Keskin [11] found that while the amount of medical waste decreased after training, there was a statistically significant increase in the amount of recycling waste and piercing-cutting waste. In the study of Almuneef and Memish [9], a 50 percent decrease was observed in the amount of medical waste after the implementation of a medical waste management plan and this rate is considerably higher compared to our study. The implemented medical waste management plan included mandatory in-service training, placement of color-coded waste bags in relevant areas, and waste type control. The fact that segregation was implemented for the first time in the hospital increased the rate. In our hospital, color-coded sorting was already in place, and there were 2 boxes each for medical waste, recycling, household waste, sharps, hazardous waste in each operating room. This may be effective in our medical waste reduction rate being lower.

In a study of Conrardy *et al*. [33], they conducted between two large medical centers in Bethesda, Maryland and Washington DC, medical waste produced in the operating room decreased by an average of 65% after reusable materials were preferred in surgical applications. By choosing reusable products, a significant reduction in the amount of waste caused by disposable products is achieved. This project emphasizes the importance of using reusable products as a way to reduce environmental impacts and lower costs in surgical practices. This suggests that factors other than education and awareness are effective in reducing medical waste.

Windfeld and Brooks [34] found that while many developed countries have legislation, there is often little guidance on what objects can be defined as infectious, and this lack of clarity leads to increased volumes of medical waste. Most studies in the literature have found that most of the waste generated by hospitals is not infectious and can therefore be disposed of in municipal landfills and recycling programs [35].

Lack of sufficient knowledge, awareness and clarity in medical waste legislation may lead to more medical waste generation due to health concerns and safety. It is important to clearly define the scope of legal regulations and the definition of infectious waste in medical waste reduction. In hospitals that have not been previously trained in medical waste management and whose rules are not clear, making these arrangements together with training can lead to serious reductions in the amount of waste, while in hospitals that have established this system, the contribution of training to waste reduction may be less.

Limitations

The most important limitation of our study was the small number of participants and the fact that the study area included only one hospital. The second limitation is that medical waste education with peer education method was not evaluated comparatively with a control group. However, the fact that all operating room personnel worked in circulation in a common area did not allow the formation of separate groups. Our third limitation was the exclusion of surgical physicians and cleaning staff who collect and carry the waste bins. The reason for not including them was that cleaning personnel are regularly trained by the environmental management unit, while the high circulation of surgical physicians would prevent effective training. In addition, being in the same environment during the activities of volunteer peer trainers has the potential to provide training and awareness for the whole team.

CONCLUSION

In conclusion, although peer education is an effective method for segregation of medical waste at source, more than knowledge is required for knowledge to lead to behavioral change to a great extent. In order to achieve a significant reduction in the rate of medical

waste, multifaceted regulations are needed in addition to peer education.

Authors' Contribution

Study Conception: NAE; Study Design: NAE; Supervision: MAY; Funding: MAY; Materials: BK; Data Collection and/or Processing: BK; Statistical Analysis and/or Data Interpretation: SU; Literature Review: SU; Manuscript Preparation: NAE and Critical Review: NAE.

Conflict of interest

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