

## Research Article

# Nurses' Knowledge of Hospital Medical Waste Management: Areas to Improve

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### Abstract

**Objectives:** Despite the recognized importance of medical waste management, reports are presenting significant shortcomings. Our aim in this study was to evaluate the knowledge of hospital nurse on medical waste management.

**Methods:** All 540 nurses in a tertiary hospital in Eastern Turkey were invited to take part in a 20-item knowledge test on hospital waste.

**Results:** Of the 467 participants, 387 (82.9%) were females, and 416 (89.1%) had some training on medical wastes. Mean age was  $28.8 \pm 7.0$ . The majority (89.1%;  $n=416$ ) had some training on medical wastes. Mean medical waste knowledge scores were  $17.6 \pm 2.1$  from a scale of 0 to 20. Of the participants, 355 (62.1%) reported being injured with possibly contaminated cutting tools. 132 (34%) did not know that papers used for the packaging of medicinal materials should be discarded into blue bins.

**Conclusion:** This study demonstrated competent knowledge of hospital nurses on medical waste. However, there are still areas to improve about self-protection and separation of recyclable medical waste.

**Keywords:** Medical waste management, nurses, self-injury

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Wastes, in the shortest sense, can be described as objects with no further value or direct use<sup>[1]</sup>. It involves specific training activities and associated risk management as well as legal liability issues<sup>[2]</sup>. Health-care waste includes all the wastes generated by medical activities. It embraces activities of diagnosis as well as preventive, curative and palliative treatments in the field of human and veterinary medicine. In other words, are considered as health-care waste all the wastes produced by a medical institution, a medical research facility or a laboratory<sup>[3]</sup>. Whereas hospital waste is "Any waste which is generated in the diagnosis, treatment or immunization of human beings or animals or research" in a hospital<sup>[4]</sup>. It is possible to classify hospital wastes as domestic waste, medical waste, chemical waste and radioactive waste. These wastes pose risks to hospital staff, patients and community health<sup>[5]</sup>. Worldwide awareness has grown regarding the need to impose stricter controls on the handling and disposal of wastes generated by healthcare facilities.

However, the attention of Asian developing countries towards safe disposal of healthcare wastes is mostly diluted<sup>[6,7]</sup>. It was noted that the current system of healthcare waste management was underdeveloped and was in dire need of immediate attention and improvement in some countries<sup>[8]</sup>. In Turkey, legislative initiatives regarding medical waste started in 1983 with the law number 2872 on the habitat<sup>[9]</sup>. This regulation aimed to prevent medical wastes arising from the health institutions from harming the environment and human health. It was decided that medical waste shall be collected separately at the source.

According to studies from Turkey, 70-80% of the health professionals have some training activities about medical waste<sup>[10,11]</sup>. Akbolat et al.<sup>[11]</sup> have studied the issue in state hospitals in Western Turkey and stated that 19.4% of the medical staff was not aware that color codes were used to separate medical waste from other types of waste. More-

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over, 37.4% of the participants didn't know that there is personnel specifically assigned to the task of collecting medical garbage.

## Objectives

Despite the essential importance of the issue, it is emerging that the awareness of health personnel on hospital waste is not satisfactory. Hence, we hypothesized that the Atatürk University Hospital, a significant health center in Eastern Turkey would demonstrate similar deficiencies in hospital waste knowledge. Our primary aim in this study was to evaluate the knowledge of hospital staff on medical waste management and check for associations with participant characteristics.

## Methods

### Study Design

The study was conducted in a descriptive, cross-sectional plan, between February and March 2016. Study reporting was done in accordance with the STROBE guidelines<sup>[12]</sup>. The study protocol was approved by the Local Ethics Committee of Atatürk University (No: B.30.2.ATA.0.01.00/03 -Date: 01.28.2016).

### Setting

Atatürk University Medical Faculty was established in 1957 as a regional hospital in Eastern Anatolia, Turkey. The hospital has a capacity of 1418 inpatients and employs 588 doctors and 540 nurses. Every department in the hospital has trash cans marked with different colors collecting medical waste. In 2017 the hospital produced 415 thousand tons of medical waste.

### Participants

Participants in the study were all nurses working in the Atatürk University Hospital.

### Variables

The study variables were: Age (year), gender (male/female), education (college/associate degree/license/masters), marital status (single/married), employed unit (inpatient/outpatient/other), department (surgical sciences/medical sciences/basic sciences), having received education on medical waste (yes/no), and being injured with a cutting tool (yes/no).

Injury with a cutting tool and behavior in case of cutting as well as participants' knowledge on medical waste were queried with multiple choice questions. There were eight knowledge questions measuring the correct separation of serum sets, blood and blood products, foley catheters,

used dressing materials, food waste, nasogastric catheters, serum and medication bottles, and packing of medical products. The responses were coded as Red, Blue, Black, and Do not know. Besides, there were 12 True/False type knowledge questions, making up a total of 20 test questions. The knowledge questions were prepared by the authors after a literature search and asking for expert opinions.

An open-ended question was asked about the diseases possibly transmitted from medical waste, and responses were grouped. A self-administered questionnaire was prepared for data collection.

### Bias

In the questionnaire, there was brief information about the research to ensure that the research data were obtained correctly, and participants were asked not to put their identities on the questionnaire form.

### Study Size

All nurses working in the hospital (n=540) were targeted for the study. Response rate was 86.5% (n=467).

### Quantitative Variables

Participants' levels of medical waste knowledge were measured by scoring the knowledge questions. Total correct scores were calculated by marking "1" for correct and "0" for wrong answers, giving a maximum total score of 20 points.

### Statistical Methods

Data was entered into the computer and analyzed using the SPSS 20.0 software. The results were presented as frequencies, percentages, means, and standard deviations (SD). The medical waste knowledge score was set as the dependent variable; its normal distribution was examined by the Kolmogorov Smirnov test. Gender comparisons were done with the Mann-Whitney U Test, education and working groups comparisons with the Kruskal-Wallis Test, marital status and medical waste education were compared with the Student t test, and working unit with the one-way ANOVA using post hoc LSD. A p value of <0.05 was considered statistically significant.

## Results

### Participants

The mean age of the subjects was 28.87±7.06 years (min. 19, max. 55). Of the participants, 82.9% (n=387) were females, 37.0%, (n=173) had license education, 52.7% (n=246) were married, 48.6% (n=227) were working in surgical departments, 76.7% (n=358) were dealing with inpatients, and

89.1% (n=416) had some training on medical wastes. The type of medical waste training were in-service training in 88.7% (n=369), seminar participation in 9.6% (n=40), and other educations in 1.7% (n=7). Basic characteristics of the participants are given in Table 1.

## Descriptive Data

Of the participants, 95.9% (n=448) said that some disease could spread from medical waste. The mentioned possible diseases spread via medical waste were grouped and presented in Table 2. The highest three responses were hepatitis (63.0%; n=294), HIV (37.5%; n=175), and blood-borne

diseases (23.8%; n=111).

Of the participants, 62.1% (n=355) reported being injured with cutting tools in contact with patient materials.

The distribution of answers given by participants to the question of which color waste bags are to be discarded for different types of waste is presented in Table 3. In general, the correct answer rate is high. The percentage of knowing that blood and blood products had to be dispensed into red-colored bins was the largest (98.7%, n=461). The least known was that paper packaging of medicinal materials should be discarded into blue containers (76.0%; n=335).

Participant responses to True/False knowledge questions are presented in Table 4. The proportion of correct answers was ranging from 79.7 to 97.4%.

The reliability of the knowledge questions was assessed by calculating the Cronbach alpha coefficient, which revealed 0.81.

**Table 1.** Participant characteristics (n=467)

Variable	n	%
Gender		
Male	80	17.1
Female	387	82.9
Education		
College	112	24
Associate Degree	165	35.3
License	173	37
Master's degree	17	3.6
Marital Status		
Married	246	52.7
Single	221	47.3
Working section		
Internal	208	44.5
Surgical	227	48.6
Basic sciences	32	6.9
Working Unit	7	1.5
Policlinics		
Clinics	358	76.7
Other	102	21.8
Training on Medical Waste		
Yes	416	89.1
No	51	10.9

**Table 2.** Possible diseases spread by medical waste mentioned by the participants

Disease	n	%
Hepatitis	294	63.0
HIV	175	37.5
Blood-borne diseases	111	23.8
Tuberculosis	22	4.7
Crimean Congo Hemorrhagic Fever	15	3.2
Other infectious diseases	21	4.5
Syphilis	9	1.9
Acinetobacter	7	1.5
H1N1	6	1.3
Brucella	6	1.3
VRE	5	1.1
Other*	13	2.8
Don't know	20	4.3

\*gas gangrene, cholera, diseases spread by body fluids, salmonella, hospital infections, hydatid cyst, VRE= Vancomycin-Resistant Enterococcus.

**Table 3.** Distribution of participant responses on which waste should go into which type of bin

Waste type	Red		Blue		Black		Don't know	
	n	%	n	%	n	%	n	%
Serum set	434	92.9	24	5.1	8	1.7	1	0.2
Blood and blood products	461	98.7	3	0.6	2	0.4	1	0.2
Foley catheter	458	98.3	0	0.0	4	0.9	4	0.9
Disposed dressing materials	449	96.1	8	1.7	9	1.9	1	0.2
Food waste	8	1.7	29	6.2	423	90.6	7	1.5
Nasogastric catheter	446	95.5	11	2.4	10	2.1	0	0.0
Serum and medication bottles	20	4.3	421	90.1	24	5.1	2	0.4
Paper used for packing medical supply	36	7.7	355	76.0	76	16.3	0	0.0

\*Correct answer percentages are marked as bold.

**Table 4.** Distributions of participant responses to knowledge questions

Question	True		False		Don't know	
	n	%	n	%	n	%
Medical waste must be collected in distinctive red-colored bags	404	<b>86.5</b>	2	0.4	61	13.1
Attire for medical waste handling should be different from those used in other cleaning tasks in the hospital	448	<b>95.9</b>	5	1.1	14	3.0
Hands must be washed after collecting medical waste	458	<b>98.1</b>	0	0.0	9	1.9
The container used for medical waste must always be kept closed	457	<b>97.9</b>	2	0.4	8	1.7
Containers should be washed regularly every day following the evacuation of medical waste	444	<b>95.1</b>	0	0.0	23	4.9
Personnel involved in stacking of medical waste storage should wear appropriate footwear	417	<b>89.5</b>	10	2.1	39	8.4
Medical and domestic wastes should be transported separately	455	<b>97.4</b>	0	0.0	12	2.6
Medical wastes and household wastes should be stacked in separate reservoirs	441	<b>94.4</b>	0	0.0	26	5.6
Medical waste bags must be filled at most up to three quarters	411	<b>88.0</b>	15	3.2	41	8.8
Medical waste bags must be compacted to occupy less space.	41	8.8	372	<b>79.7</b>	54	11.6
Medical waste bags should not be completely closed	22	4.7	420	<b>89.9</b>	25	5.4
Household waste mixed with medical waste should be separated and placed in a domestic waste bag	62	13.3	388	<b>83.1</b>	17	3.6

\*Correct answer percentages are marked as bold.

## Outcome Data

Participants' mean medical waste knowledge scores were  $17.64 \pm 2.16$ . Medical waste knowledge scores according to participant characteristics are given in Table 5. There were no statistically significant differences ( $p > 0.05$ ) between medical waste knowledge scores in subgroup comparisons of educational status, marital status, employing department, and medical waste education. However, there was a statistically significant difference between the medical waste knowledge scores concerning the employing unit (inpatient/outpatient/other) ( $F = 3.21$ ,  $p = 0.04$ ). Post-Hoc LSD analysis demonstrated that the difference was between those working in outpatients ( $18.43 \pm 0.53$ ) and other units ( $17.19 \pm 1.9$ ) ( $p = 0.02$ ).

## Discussion

### Key Results

According to our results, the study sample had adequate knowledge on medical waste; mean scores of  $17.64/20$  would mean 88.2%. Although from this perspective, there seems to be no need for critical education, there are still areas to improve concerning employee safety in dealing with infected medical materials and recycling of uninfected paper waste.

### Limitations

The reliability of the study instrument, as well as the relatively high sample size, are some strengths of this study. On

**Table 5.** Distribution of medical waste knowledge scores according to participant characteristics

	Mean±SD	Test statistics	p
Gender			
Male	18.08±1.50	Z*=1.77	0.07
Female	17.55±2.26		
Education			
College	17.20±3.21	$\chi^2_{**} = 3.79$	0.29
Associate Degree	17.94±1.31		
License	17.69±1.92		
Master's degree	17.06±2.08		
Marital Status			
Married	17.50±2.64	t***=1.63	0.16
Single	17.78±1.44		
Working section			
Internal	17.80±1.69	$\chi^2_{**} = 0.80$	0.67
Surgical	17.44±2.57		
Basic science	17.97±1.43		
Working Unit			
Policlinic	18.43±0.53	F****=3.21	0.04
Clinic	17.75±2.23		
Other units	17.19±1.90		
Training on Medical Wastes			
Yes	17.69±2.22	t***=1.41	0.16
No	17.24±1.54		

SD: Standard Deviation; \* Mann-Whitney U Test; \*\*: Kruskal-Wallis Test; \*\*\*: Student t-test; \*\*\*\*: One way ANOVA.

the other hand, the investigation focused on knowledge; inclusion of participant behaviors on medical waste could yield more interesting results. Nurses are only one of the professions in the hospital dealing with medical waste. The

status of other hospital professionals, especially the managers, who are more directly involved with policymaking could be included in the sample.

## Interpretation

Although 75-95% of bio-medical wastes are non-hazardous, reports in the literature show 80% of all medical trash are mixed with general waste, making domestic waste more dangerous for human health [8]. One study from Turkey reported 621 kg medical waste per patient's bed in 2007 [13]. Hospitals in Istanbul, the metropolitan city of Turkey, generate 22 tons of medical waste per day with an average generation rate of 0.63 kg/bed/day [14].

Medical waste generation rates of 0.28 to 0.82 kg/bed/day have been reported in another study [15]. Healthcare waste management is a neglected issue in developing countries [16, 17]. Although Turkey has taken significant steps for improvement, there are still shortcomings [15-18]. As an example, despite agreeing with the European Union (EU) waste directives, most of the hospital waste is still treated in autoclave plants [19]. Akbolat et al.'s [11] study in 2011 reported that 69.9% of health employees received training on medical waste management. Our results indicate much higher knowledge levels. In the study conducted by Ozder et al. [18] in 2013, male and female participants scored 81.4% and 87.5% respectively from a 37-items knowledge test. Studies from Bangladesh (7.7/12=64.1%) [16] and Indiana (69.2%) [20] revealed much lower knowledge scores.

Despite the high knowledge of our participants regarding medical waste, there seem to be some problems with the injury prevention precautions. 62.1% of our sample reported having injured themselves with possibly contaminated sharp objects. The highest two occupations among hospital workers experiencing this kind of injuries are house-keeping staff and nurses, and injuries usually occur during contact with medical waste bags (28%) or while replacing full sharp-boxes (14%). [21] Whereas, one out of five participants in our study indicated that medical waste bags must be compacted to occupy less space. Thus, we should emphasize that hospital staff must be more vigorously trained for self-protection measures related to medical waste. Due to its relatively higher prevalence, hepatitis is a major threat to people dealing with possibly infected waste. One study from Greece has shown a significantly higher prevalence of hepatitis B virus infection among waste collectors compared with white-collar employees (15% vs. 2.5%, respectively) [22]. Our study group has put hepatitis on the top of possible diseases spread by medical waste. The reason why HIV is lower on the list may be due to the relatively low prevalence of this condition in our region. Recyclable

paper forms approximately 30% of the solid hospital waste [23]. Mixing this waste with infected trash leads to multiple undesirable outcomes. First of all, there will be financial losses for the hospital paying for the collection of medical waste. There will also be general economic losses by hindering recycling. Additionally, the number of infected material increases, leading to a higher possibility of human and environmental hazard. The fact that our participants' weakest area was the knowledge on discarding packaging materials indicates a need for stressing the use of blue bins in hospital waste management educations. In conclusion, our study demonstrated competent knowledge of hospital nurses on medical waste. However, there are still areas to improve concerning self-protection and separation of recyclable medical waste.

Future studies should concentrate on interventions to reduce risky health behaviors in dealing with cutting tools contaminated with patient material as well as to initiatives to reduce hospital waste.

## Disclosures

**Ethics Committee Approval:** The study was approved by the Local Ethics Committee.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

**Authorship Contributions:** Concept – E.O.C.; Design – A.A.; Supervision – E.O.C.; Materials – A.A.; Data collection &/or processing – E.O.C.; Analysis and/or interpretation – A.A.; Literature search – E.O.C.; Writing – A.A.; Critical review – A.A.

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