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The Conformance to Standards of the Medical Waste Practices at a University Hospital



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ABSTRACT

Aim: The purpose of this descriptive-type study is to investigate the medical waste management at one of the largest university hospitals in Turkey. It is stated that when medical waste management is carried out in an effective and determined manner, it would provide great gains for the hospital economy and environmental health.

Methods: The study was carried out between January- June 2006 in a total of 51 units. The research data was collected by examining the "Hospital Waste Management Program" and by making face-to-face talks with the nurses, the personnel in the Environmental Health Service Unit, the officials and personnel of the janitorial company and by making the necessary observations.

Results: It was determined that the medical waste practices at the hospital where the study was conducted were in conformance with 70.65% of the 2005 Regulations of the Ministry of the Environment and Forestry, 47.7% of the standards of the Turkish Institute of Standards and 89.0% of the guidelines of the Center for Disease Control.

Conclusion: The following is proposed: To hold short-term meetings for informing the personnel on the regulation of medical wastes in order to eliminate the deficiencies in the medical waste practices.

Key words: Standard, medical waste practices, waste management, regulated medical waste.

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INTRODUCTION

The wastes from diagnosis and treatment, the medical and pharmaceutical research wastes and the wastes in the production of medicine are considered to be medical wastes. It is possible to classify them as hazardous hospital waste materials, such as infectious, pathological, wastes having the attribute of sharp instruments, toxigenic, pharmaceutical, chemical, heavy metal wastes, pressurized containers and radioactive wastes. The wastes should be separated according to their types for decontamination and disposal processes. Thus, the professional risk of exposure and hazard to the environment of each kind of waste can be reduced to a minimum (1-3). The most important objective of medical waste management is to prevent the spread of infectious diseases (4).

Medical institutions also produce water, food and domestic wastes, as well as medical wastes. Different collection containers and different colored bags should be used in the collection of all of these wastes. Red bags should be used for medical wastes, blue bags for domestic wastes and black bags for recyclable (serum, medicine bottles, etc.) wastes (1,2,5,6). In a study made, it was determined that there was a 21% decrease in the monthly amount of wastes, thanks to the good training of the hospital personnel in medical waste management (7).

Another subject, which is as important as the separation of wastes, is the preservation of the health of the personnel transporting the wastes and the provision of environmental safety during the transportation of wastes. Consequently, putting the wastes into waste containers, collecting, transporting and storing of wastes should be carried out with safe practices (3,4,8).

It is stated that nurses have a great responsibility in waste management for preserving the natural environment and global health and for setting forth the negative effects of medical wastes on the environment (9). The International Council of Nurses (ICN) states that nurses have great responsibilities as follows:

- To show the greatest care possible for the separation of wastes and recycling of materials;
- To prefer companies selling products produced with low toxicity polyvinyl chloride, latex and mercury;

- To purchase materials, which decrease the volume of packaging materials and which decrease the toxicity of the products used;
- To decrease the waste destruction to a minimum by choosing the materials used from among those, which are less wasteful; and
- To educate patients for reducing environmental pollution to a minimum (10).

The Centers for Disease Control and Prevention (CDC) and the Healthcare Infection Control Practices Advisory Committee (HICPAC) published the "Environmental Infection Control Guidelines at Healthcare Institutions" related to the organization and transport of separated medical wastes at hospitals (2).

It is stated that when medical waste management is carried out in an effective and determined manner, then it would provide great benefits for the hospital economy (7). An effective waste management includes the training of the personnel, the separation of the wastes, the calculation of the amount of wastes for each clinic and the determination in writing of the policies related to waste management. Thus, it is possible to reduce the costs. Almuneef et al. made a study on the subject of an effective medical waste management between 1999 and 2000. In this study, the amount of waste was 2000 kg per day. After an effective medical waste management (in-service training, feedback, separation of the waste type and variety and development of the written policies about waste management), this amount fell to 850 kg per day and the hospital budget was provided with a gain of 50% (7).

Every country should determine its own unique standards for an effective waste management by taking into account the recommendations of committees, such as the CDC and the HICPAC (7). In Turkey, The Ministry of Environment and Forestry (MEF) published "The Regulation for the Control of Medical Wastes" in 1993 with the objective of providing for its application by determining the administrative, technical and legal policies and programs aimed at the separate collection of medical wastes without harming public health and the environment, the temporary storage, recycling, transport and the destruction of medical wastes (10). This regulation was rewritten in 2005 and adopted some sanctions for the hospitals and the previous regulation was abrogated (5). The Turkish Institute of Standards (TSI) defined the

rules and terms on the subject of "The Collection and Transport of Medical Wastes" in the TS 12129 Standard (6).

The purpose of this descriptive-type study is to investigate the medical waste management at the one of the largest university hospitals in Turkey.

MATERIALS and METHODS

This is a descriptive study planned with the objective of examining the conformance to the national and international standards of the waste management at a university hospital. The study was carried out between 2 January 2006 and 30 June 2006 in a total of 51 units at a university hospital. Of these, 30 were in the internal and surgical medical sciences services and 21 were in the intensive care units. The laboratories and operating rooms were not included within the scope of the study. The conformance to standards of the medical waste practices at the hospital was determined by comparing with the MEF, TSI and CDC. The data was collected with the data collection form, which was prepared by the researchers based on the literature, the national and international regulations, standards and guidelines. The proposals in the literature related to waste management and the expressions in the standards, regulations and guidelines mentioned above were made into a table by adding a "yes" and "no" section. There are 3 parts and 82 items on the data collection form with 25 items for the collection of medical wastes, 36 items for the transport of medical wastes and 21 items for the characteristics of the temporary storage area. The research data was collected by examining the "Hospital Waste Management Program" and by making face-to-face talks with the clinical nurses, personnel in the Environmental Health Service Unit and the officials and personnel of the janitorial company and by making the necessary observations. Furthermore, data, such as the nurse/patient ratio, the patient/waste container and container for sharp instruments ratio, which could influence waste management, were also calculated.

The data was calculated as number and percentage by using the Statistical Program for Social Sciences (SPSS) 11.0 program. The necessary permissions were obtained from the Ethics Board of the Ege University, Nursing School, the Chief Physician's Office at the Hospital and the Directorate of Nursing Services at the Hospital.

DISCUSSION

The medical waste practices of a total of 51 units were investigated. Of these, 14 were in the surgical medical sciences service units, 16 were in the internal medical sciences service units, 13 were in the surgical medical sciences intensive care units and 8 were in the internal medical sciences intensive care units.

It is stated in the literature that the average daily waste amount per bed varies between 4.1-8.7 kg at the university hospitals, 2.1-4.2 kg at the general hospitals, 0.5-1.8 kg at the regional hospitals and 0.05-0.2 kg at the primary health care centers (11). Bdour et al. stated that in general, the daily waste per patient was 6-10 kg (12). It is proposed in the literature that the capacities of the waste containers should be a minimum of 10 liters and a maximum of 60 liters (1,5). According to this information, it could be considered that 1 waste collection container and 1 container for sharp instruments (with a volume of 20 cm³) would be suitable for use at 5 patients' beds at the university hospital where the study was carried out (3,6). Whereas, in the intensive care units where the patient care procedures and interventions are a lot more, the use of 1 waste container and 1 container for sharp instruments for each patient's bed would be more suitable. The waste collection containers, such as plastic bags, cardboard boxes, etc. hung on the edge of the dressing and treatment carts, which do not conform to the standards, were not evaluated in this study. Consequently, it shows the insufficiency in numbers of the waste containers, as there was one waste container and container for sharp instruments per approximately 26 patients in the service units and there was one waste container per approximately 10 patients and one container for sharp instruments per approximately 5 patients in the intensive care units.

The Separation of Wastes

The most important practice in the medical waste management is the separation of the wastes prior to collection and disposal. The separation of medical wastes is a practice, which both protects the professional health of the health care personnel and a practice, which decreases the cost in the disposal process of the wastes (4). The conformance to standards of waste management contributes to the hospital budget and also provides contributions to the

economy of the country (7, 13). It is necessary to implement special processes for the control of medical wastes and to be able to make them harmless. It is stated that this process brings an additional cost of US \$ 0.60-US \$ 2.00 per kilogram (14). It is stated that the separation of wastes decreases the amount of wastes by 20-30% and that it also decreases the costs by approximately 25-30% (15). Consequently, the separation of wastes is of great importance.

In this study, it was determined that in a great majority of the units (88.2%) there were wastes (domestic and recyclable), which were not medical wastes, inside the medical waste containers. It is stated in the literature that only 5-10% of the hospital wastes are medical wastes and in contrast to this, due to the fact that suitable procedures have not been specified for separation and that the required care is not shown for separation, more than 15% of the wastes are qualified as medical wastes (16).

A study by Birpinar et al. (2009) was found in the literature on a topic similar to our study. It was determined in Birpinar's study that 99% of the medical wastes and 100% of the sharp instrument wastes were separated. The results were found to be similar or even better than the ratios in our study. The reason for this may be that the healthcare staff was educated on the disposal of wastes at the hospitals. However, another study was not found in the literature where a comparison was made with the national and international standards (17).

The fact that there is no brochure close to the waste containers that states which container is for which waste in 19.6% of the units can be considered as a reason paving the way for this situation (Table 1). Furthermore, it was determined in this study that the patient/nurse ratio was 5.05 in the services and that the patient/nurse ratio was 2.52 in the intensive care units. It can also be considered that as the number of patients per nurse increases, it would also negatively affect the waste management.

Characteristics of the Waste Containers and Containers for Sharp Instruments

The red bags that are used for medical wastes are important compared to the other bags. The MEF and TSI have specified the characteristics of these bags. Accordingly, they should be red plastic bags that are resistant to tearing, sharp instruments, bursting

and transport, produced from medium-density polyethylene raw materials, that are leakproof and have double stitching and are without folds, with a double thickness and a minimum capacity of 10 kg and should have the "International Biohazard Emblem" and the statement "ATTENTION! MEDICAL WASTE" written on them (5,6). In our study, it was determined that the waste bags used in a majority of the units (76.5%) did not conform to the proposed characteristics. In our study, it was observed that over half (54.9%) of the units had containers with a foot-pedal, in over half (54.9%) of the units there was no lids on the medical waste containers and that there were no medical waste emblems on close to half (41.2%) of them (Table 1). In the literature it is proposed that the waste collection containers should be covered or preferably with a lid and they should be with a foot-pedal in order to prevent contamination by touching with hands (4,6,18). Accordingly, it was determined that the waste collection containers were not qualitatively suitable for use.

Infections generally emerge as the result of contact with skin, splattering and generally with wounds penetrated with sharp instruments. It is known that the persons are infected with viruses (HIV, Hepatitis B, Hepatitis C) through blood and enteral infections (16).

Contaminated sharp instruments, which are not separated correctly and not thrown out in proper containers, are the source of major infections (12). Medical wastes should not be mixed with chemical, radioactive, pathological and chemotherapy wastes and sharp instruments should definitely be separated from medical wastes (1). The characteristics of the waste containers for sharp instruments have been determined by the MEF, TSI and CDC. It is proposed that these containers should be made of plastic or boxes or containers made of laminated cardboard having the same characteristics, that they should withstand sharp instruments, tearing, breaking and bursting, that they should be waterproof and leak-proof, that it should not be possible to open and mix their contents and that they should have the "International Biohazard Emblem" and the statement "ATTENTION! SHARP WASTES" written on them. The waste containers for sharp instruments in the work area should be kept upright, changed before they are $\frac{3}{4}$ full, their tops should be tightly closed and they should be put into medical waste bags, tied up and transported (2,5,6,19).

Table 1. Characteristics of the Waste Containers and Containers for Sharp Instruments.

	Standards	Yes		No		Total	
		Number	%	Number	%	Number	%
Characteristics of the Waste Containers							
Are there separate waste containers according to the type of waste?	MEF, TSI, CDC	45	88.2	6	11.8	51	100
Are there wastes other than medical wastes in the medical waste containers?	MEF, TSI, CDC	45	88.2	6	11.8	51	100
Is there a brochure showing which container is for which waste?	Literature	41	80.4	10	19.6	51	100
Does the medical waste container have a foot pedal?	Literature	28	54.9	23	45.1	51	100
Does the foot pedal of the medical waste container work?*	Literature	21	75.0	7	25.0	28	100
Does the medical waste container have a lid?	Literature	23	45.1	28	54.9	51	100
Is there a medical waste emblem on the waste collection container?	MEF, TSI, Literature	30	58.8	21	41.2	51	100
Does the medical waste bag conform to the proposed characteristics?	MEF, TSI	39	76.5	12	23.5	51	100
Characteristics of the Containers for Sharp Instruments							
Are the containers made of plastic or laminated cardboard having the same characteristics?	MEF, TSI, CDC	50	98.0	1	2.0	51	100
Do the containers have the characteristics of being water- proof, leakproof and impossible to open and mix up the contents?	MEF, TSI, CDC	45	88.2	6	11.8	51	100
Is there the "International Biohazard Emblem" on the waste container for sharp instruments?	MEF, TSI	48	94.1	3	5.9	51	100
Is there the statement "ATTENTION! SHARP WASTE" on the waste container for sharp instruments?	MEF, TSI	9	17.6	42	82.4	51	100
Are the containers changed when they are ¾ full?	MEF	17	33.3	34	66.7	51	100
Are the tops of the containers closed when they are ¾ full and put into red plastic bags?	MEF	16	31.4	35	68.6	51	100
Are the containers in a place that can be easily accessed by the personnel?	Literature	49	96.1	2	3.9	51	100

In our study, it was determined that the containers of close to all of the units (98.0%) were made of plastic or laminated cardboard having the same characteristics and that a great majority (88.2%) of the containers were waterproof, leakproof and had the characteristics of being impossible to open and mix their contents. Also, it was determined that close to all of the units (94.1%) had the "International Biohazard Emblem" on the waste container. However, it was determined that in a great majority of the units (82.4%) there was not the statement "ATTENTION! SHARP WASTE" written on the containers for sharp instru-

ments. It was determined that the existing containers for sharp instruments in the units generally conformed to the standards. It was determined during the observations made that in over one half (66.7%) of the units that the containers for sharp instruments were not changed despite the fact that they were ¾ full (Table 1). It is thought that this situation could lead to contamination and injuries. In a study by Birpinar et al. (2009), 77.5% of the hospitals have appropriate containers for medical wastes and 75% of these containers satisfy the MEF standards.

Transport of Medical Wastes

One of the important subjects related to medical wastes is the health of the hospital/municipality workers, who are in contact with the wastes during transport (4). A risk for the waste collection personnel is constituted by not separating the medical wastes properly, not selecting suitable waste containers and suitable collection vehicles and not using suitable personnel clothing and auxiliary tools and instruments. This risk can be decreased by selecting the proper tools and instruments and by the health personnel throwing the wastes into the correct container according to the type of wastes (20-22).

In the MEF standard, it is stated that the personnel on duty should be trained periodically and that it is necessary to document that this training has been given and the institutions are responsible for providing special clothing and work equipment for the personnel on duty (4,5). In this study, the fact that the medical wastes in all of the units are continuously transported by the same persons and that the personnel have in-service training certificates is a positive

result. However, it is thought that a risk for the spread of infections is constituted in all of the units by not using protective goggles by those assigned to carry wastes, not using masks in a large majority of the units (90.2%) and not using rubber gloves in a small percentage of the units (7.8%) (Table 2).

Medical Waste Transport Vehicles

The characteristics of the waste collection vehicles, which are used with the objective of transporting the medical wastes without contaminating the environment, are specified by the MEF, TSI and CDC. It is proposed that medical and domestic wastes should be transported separately with vehicles specifically allocated for this job, that the medical waste transport vehicles have wheels and lids and should be made of rustproof metal, plastic or similar materials. It is proposed that there are vehicles allocated only for this job, which do not have sharp corners that could lead to harming or piercing the bags during loading and unloading and that they are easy to load, unload, clean and disinfect. It is proposed that the color of these vehicles should be orange and that

Table 2. Characteristics Related to the Transport of Medical Wastes.

Transport of Medical Wastes	Standards	Yes		Total
		n	%	
Do the same persons work for the transport of medical wastes?	Literature	51	100	51 100
Is there an in-service training certificate for medical waste control?	MEF	51	100	51 100
Do the waste transport workers know what to do in emergency situations, such as the tearing of a waste bag?	Literature	41	80.4	10 19.6 51 100
Is the training given by the company training official?	Literature	47	92.2	4 7.8 51 100
Does the medical waste porter use a mask?	MEF	5	9.8	46 90.2 51 100
Does the medical waste porter use rubber gloves?	MEF	47	92.2	4 7.8 51 100
Does the medical waste porter use protective goggles?	MEF	-	-	51 100 51 100
Does the medical waste porter wear boots?	MEF	38	74.5	13 25.5 51 100
Does the medical waste porter wear special orange-colored protective clothing?	MEF	40	78.4	11 21.6 51 100
Does the medical waste porter change his/her clothing every morning?	Literature	34	66.7	17 33.3 51 100
Do the personnel collecting medical waste change their gloves daily?	Literature	23	45.1	28 54.9 51 100

MEF: Turkish Ministry of the Environment and Forestry, TSI: Turkish Institute of Standards, CDC: Centers for Disease Control and Prevention.

they have the "International Biohazard Emblem" and the statement "ATTENTION! MEDICAL WASTES" written on them (2,5,6,19,23).

When the characteristics of the medical waste transport vehicles are examined, the following have been determined: Almost all of the units (80.4%) use medical waste transport vehicles and these vehicles have lids (86.3%) as specified in the regulation. It was determined that they are made from rustproof metal or plastic material (86.3%), they do not have sharp corners, which could cause the bags to tear during loading and unloading, that they are easy to clean and disinfect (78.4%) and that half of the units (51.0%) have the statement "ATTENTION! MEDICAL WASTE" written on the waste transport containers. In contrast to this, it was observed that a majority of the units (74.5%) did not have the "International Biohazard Emblem" on the waste transport vehicles, the external surfaces were not painted orange and they were also used for other jobs (Table 3). It

was determined that in general the waste collection vehicles used for the transport of medical wastes without contaminating the environment conformed to the proposals.

Temporary Waste Storage Depot

According to the MEF, health institutions having a capacity of 20 or more beds are obliged to construct a temporary waste storage depot with the objective of being able to store medical wastes in a safe manner without harming human health (5). These storage depots should have two sections for medical wastes and domestic wastes and should have the capacity to be able to store a minimum of two days of waste (10). It is also stated that the color of the door of the medical waste section should be orange and that it should have the "International Biohazard Emblem" on it and that the statement "ATTENTION! MEDICAL WASTE" should be written on it (Table 4) (5). We have determined that the temporary waste storage

Table 3. Characteristics of the Medical Waste Transport Vehicles.

Characteristics of the Medical Waste Transport Vehicles	Standards	Yes	No	Total
		Number %	Number %	Number %
Is there a medical waste transport vehicle?	MEF, TSI, CDC	41 80.4	10 19.6	51 100
Does the medical waste transport vehicle have a cover?	MEF, CDC	44 86.3	7 13.7	51 100
Is the medical waste transport vehicle made of rustproof metal or plastic materials?	MEF, CDC	44 86.3	7 13.7	51 100
Is it easy to clean and disinfect the medical waste transport vehicle?	MEF, CDC	40 78.4	11 21.6	51 100
Are the edges of the medical waste transport vehicle in a manner that would not cause the bags to tear during loading and unloading?	MEF, CDC	40 78.4	11 21.6	51 100
Is there an "International Biohazard Emblem" on the medical waste transport vehicle (TSI: with a minimum letter size of 8 cm)?	MEF, TSI	13 25.5	38 74.5	51 100
Does the medical waste vehicle have the statement "ATTENTION! MEDICAL WASTE" (TSI: on both sides and with 20 cm black letters)?	MEF, TSI	26 51.0	25 49.0	51 100
Are the external surfaces of the medical waste transport vehicle painted orange?	MEF, TSI	2 3.9	49 96.1	51 100
Is the medical waste transport vehicle used for another job?	Literature	9 17.6	42 82.4	51 100

MEF: Turkish Ministry of the Environment and Forestry, TSI: Turkish Institute of Standards, CDC: Centers for Disease Control and Prevention.

Table 4. Characteristics of the Temporary Waste Storage Depot of the Hospital.

<i>Characteristics of the Temporary Waste Storage Depot</i>	<i>Standards</i>	<i>Yes</i>	<i>No</i>
<i>Does the hospital have a temporary medical waste storage depot?</i>	<i>MEF</i>	<i>X</i>	
<i>Does the temporary medical waste storage depot have two sections for medical waste and domestic waste?</i>	<i>MEF</i>	<i>X</i>	
<i>Does the temporary medical waste storage depot have a capacity for a minimum of two days of waste?</i>	<i>MEF</i>	<i>X</i>	
<i>Is the temporary medical waste storage depot protected against water, rain and wind?</i>	<i>MEF</i>	<i>X</i>	
<i>Is there a lock on the temporary medical waste depot to restrict the entrance of unauthorized persons?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is there a drainage mechanism in the temporary medical waste storage depot?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is the liquid drained in the temporary medical waste storage depot released into the sewer after being disinfected?</i>	<i>MEF, TSI</i>		<i>X</i>
<i>Does the door of the temporary medical waste storage depot open to the outside?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is the door of the temporary medical waste storage depot bolted?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is the door of the temporary medical waste storage depot painted orange?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is there the "International Biohazard Emblem" and statement "ATTENTION! MEDICAL WASTE" on the door of the temporary medical waste storage depot?</i>	<i>MEF, TSI</i>	<i>X</i>	
<i>Is information given to the Governor's Office at the end of the year about the amount of medical waste?</i>	<i>MEF</i>	<i>X</i>	

MEF: Turkish Ministry of the Environment and Forestry, TSI Turkish Institute of Standards, CDC: Centers for Disease Control and Prevention.

depot at the hospital where we conducted our study conforms to the standards. In a study by Birpınar et al.(2009), 63% of the hospitals have a temporary storage depot and 94% of these depots satisfy the MEF standards.

Furthermore, the conformances of the medical waste practices according to each standard (CDC, MEF, TSI,) were examined separately. It was determined that the medical waste practices conformed 70.65% to the MEF, 47.4% to the TSI and 89.0% to the CDC standards.

CONCLUSION

The practices not in conformance with the standards (waste bags not conforming to the standards, the personnel handling waste transports do not use masks and protective goggles and the deficiencies of warning messages, etc.) are actually determined to be correctable practices.

In our study, it was determined that there were separate waste collection containers in the majority of the units. However, there were wastes other than medical wastes within the majority of the containers. Over half of the waste containers were in conformance with the standards. A majority of the waste bags and waste containers for sharp instruments were in conformance with the standards. It was determined that the personnel handling waste transports conformed to most of the proposals on the subject of transporting medical wastes. It was determined that a majority of the units used waste collection vehicles for the transports of wastes and that the waste collection vehicles conformed to the proposals in general, except for the color of the vehicles and the written warnings. It was also determined that the hospital conformed to the proposals for the temporary storage depot area characteristics.

The following is recommended at the conclusion of this study:

1. To select waste collection containers having more functional characteristics and to eliminate deficiencies, such as the medical waste emblem,
2. To put warning labels stating "ATTENTION! SHARP WASTE", which are missing on the waste containers for sharp instruments or to take this subject into consideration for new purchases,
3. To eliminate the deficiencies on the subjects of the paint color and the warning message of the waste collection vehicles and to make reminders to the personnel on the subject of using them covered,
4. To make the waste instructions used with the objective of providing information for the separation of the wastes more noticeable and for them to have the characteristic of being more visible, and
5. To hold short-term meetings for providing information related to the separation of wastes and to provide for the participation at these meetings of all of the personnel working at the hospital and the students (medical, nursing, laboratory, etc.) engaged in practices at the hospital.

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