

## Original Article

# Medical Waste Management in Patients with Diabetic Foot Ulcers: A Pilot Study in Turkey

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### Abstract

**Aims and objectives:** The aim of our study was to assess the management of the medical waste of patients with diabetic foot being monitored/treated at home.

**Background:** The proper collection and disposal of medical waste accumulated through the treatment at home of chronic illnesses such as diabetes and diabetic foot will contribute to safeguarding human health and the environment, as well as to development.

**Method:** A cross-sectional and descriptive study was conducted with 40 patients with diabetic foot ulcers in Istanbul.

**Results:** 90% of the patients were being treated with insulin and 86.1% of them were receiving insulin injections two or more times a day. 80.6% of the diabetics indicated they discarded insulin pen needles into the household waste along with non-hazardous waste, and 86.1% of them reported that they disposed of this waste by throwing it into street trash receptacles. Similarly, they said that they tossed the lancets used in measuring blood glucose levels (%87.5) and empty pens/vials (%86.1) into street trash receptacles. 86.8% reported that they discarded used dressing into the household waste and 84.2% said that they threw them into street trash receptacles. 80% of the patients had not received education on household medical waste disposal.

**Conclusion:** It was found that diabetics were uninformed about household medical waste disposal and that they discarded the vast majority of household waste by throwing it into the household trash, along with non-hazardous waste, a practice that poses a major risk to the environment and public health.

**Relevance to clinical practice:** Our research has demonstrated the disposal of used injection devices into the household garbage by diabetic patients is very common. Sharps discarded in an unsafe manner in the community cause concern as they potentially place people at risk of injury and infection from blood-borne pathogens such as HIV and viral hepatitis.

**Keywords:** diabetes mellitus, diabetic foot, medical waste, disposal practices, insulin pen needle

### Introduction

The entire world currently faces a Type 2 diabetes pandemic. There were 425 million patients with diabetes in the world in 2017 and this figure is expected to rise to 629 million in 2045 (IDF Diabetes Atlas 2017). This translates into one out of ten adults being diabetic in 2045. The prevalence of diabetes in Turkey is extensive and well above international rates. According to TURDEP-II's Turkish Diabetes, Hypertension, Obesity and Endocrine Disorders Study, in 2010, the incidence of diabetes in the adult Turkish population had reached 13.7%, while that of prediabetes was 23.7%. In other words, there are

6.5 million adults with diabetes in Turkey (Satman et al. 2013). Therefore, diabetes has become the most serious public health problem in the country. The treatment of diabetic foot problems, which have increased along with the rising incidence of diabetes, is a protracted and difficult health problem (Yılmaz 2005). The escalation of poorly controlled glycaemia has greatly contributed to the development of diabetic foot ulcers (Porselvi et al. 2017).

### Background

Diabetic foot ulcers demand long-term care and sound metabolic monitoring. The role of

debridement and dressing in their treatment is crucial. Part of this involves keeping blood glucose levels under control. However, it also requires appropriate care and dressing, which depends on the ulcer's characteristics (Moura et al. 2013; Owayolu et al., 2014, 1Saltoglu et al. 2015).

Self-care is very important for keeping blood glucose levels at target values, thereby controlling diabetes and preventing complications (Konstantikaki 2008). This involves self-administration of insulin and/or self-monitoring of blood glucose (SMBG) (Majumdar et al. 2015). The management of diabetes requires regular blood glucose testing, oral medications and insulin injections (Atukorala et al. 2016), and insulin is indispensable to it (Frid et al. 2016; Poudel et al. 2017).

These practices employed in the long-term treatment of chronic medical problems such as diabetes and diabetic foot generate household medical waste (Atukorala et al. 2016). Appropriately discarding and destroying it is critical for the protection of human health and the environment. Improperly disposed of medical wastes have the potential to cause public health problems, including needle puncture wounds and blood-borne infections Gold 2011; (Atukorala et al. 2016).

Diabetes-related technologies, such as disposable insulin pens and lancets, have made it much more convenient for individuals to manage their diabetes. However, these conveniences brought by technology have given rise to the problem of disposing household medical waste. Each day, diabetics receive four insulin injections, test their blood glucose levels 1-10 times and change diabetic foot wound dressings (Kır Bicer and Olgun 2007; Hones, Muler&Surrige 2008; Perfetti 2010; Gold 2011).

Incorrect sharps disposal practices among patients with diabetes result in their being mixed in with household trash, and it is known that improper disposal has the potential to cause public health problems such as personal injury and propagation of blood-borne infections via needle stick injuries (Atukorala et al. 2016). The lancets used for SMBG are often loosely recapped and are susceptible to breakage/detachment when subjected to even

minimal force. Similarly, not using puncture-proof receptacles for disposed lancets and insulin syringes is equally hazardous. Needle stick injuries can lead to epidemics of blood-borne infections such as HIV/AIDS, hepatitis B and hepatitis C (Gold K 2011; Majumdar et al. 2015).

Accordingly, this research was done as a pilot study to assess how diabetics with foot ulcers in Turkey dispose of the household medical waste they produce.

**Methodology:** This study was designed as a pilot study to assess how diabetics with foot ulcers dispose of their household medical waste. The study uses a descriptive and cross-sectional research method.

### *Study Questions*

- 1 What is the disposal practice of patients with diabetic foot about medical waste at home ?
- 2 How is the patient with diabetic foot removal their medical waste from home ?

**Setting and sample:** The population of the study consisted of patients (n=40) at the diabetic foot polyclinic of a major university hospital in Istanbul, Turkey between February 1, 2016 and March 1, 2016. It reached the entire population.

**Inclusion Criteria of Study:** Patients with diabetic foot ulcers who could properly communicate and were free of any psychiatric diagnoses were included in the study.

**Location and Characteristics:** The diabetic foot polyclinic is a one-day-a-week polyclinic operating under the auspices of the plastic surgery polyclinic. Patients receive an appointment to have their foot ulcers assessed and treated. After the patients are assessed, depending on their medical condition, they are given a follow-up appointment at a later date.

**Measurements/Instruments:** A patient intake form designed by the researcher as a data collection instrument was used to gather data on patient demographic characteristics (e.g., age, sex, and educational level), their diabetes status (e.g., diabetes duration and treatment plan) and their knowledge of medical waste management (e.g., disposal of insulin pen needles, lancet, and wound dressing).

**Data analysis:** Descriptive statistics (e.g., number and per cent distributions, means, SD)

were used to evaluate the data. SPSS 22.0 was used to perform the analyses.

**Ethical Considerations:** The study protocol received written approval from the IU CTF ethics committee (Approval number: 83045809/604.01), and the study itself complied with the criteria stipulated in the Declaration of Helsinki.

## Results

**Sociodemographic characteristics:** The mean age of the diabetics participating in the study was  $61.6 \pm 10.4$  (65% men; 72.5% married). The mean number of years since the patients' diagnosis of diabetes was  $11.5 \pm 7.2$  dir. The majority of the patients had a primary school education (82.5%) (Table 1).

**Table 1. Baseline characteristics of participants (n=40)**

Variables		(Mean $\pm$ SD)	
Age (years)		$61.6 \pm 10.4$	
Diabetes duration (years)		$11.5 \pm 7.2$	
	<b>Category</b>	<b>n</b>	<b>%</b>
Gender	Female	14	35.0
	Male	26	65.0
Marital status	Married	29	72.5
	Single	11	27.5
Education level	Primary school -Literacy	35	87.5
	Secondary school	5	12.5
Diabetes Type	Type 1	4	10.0
	Type 2	36	90.0
Treatment type	Oral medications	4	10.0
	Insulin + oral medications	36	90.0
Number of insulin injections/day	Only one	5	13.9
	$\geq$ Two times	31	86.1
Re-use of disposable needle (n=36*)	Yes (only one)	18	50.0
	No (more than one)	18	50.0
Blood glucose measurement	Regularly	32	80.0
	Not measure	2	5.0
	Not regularly (rarely)	6	15.5
Medical waste disposal training	Received	8	20.0
	Not received	32	80.0
Waste sorting status	Not sorted	30	75.0
	Only medical waste/sharp disposal	7	17.5
	Only batteries	2	5.0
	Only recycles	1	2.5

\*patients using insulin

**Table 2. Disposal practices of used needle, lancet and pen (n=40)**

	n	%
<b>Disposal of pen needles at home (n=36*)</b>		
Household waste	29	80.6
Closed box / bottle	4	11.1
Medical Waste Receptacle	1	2.8
Burn	2	5.6
<b>Removal of pen needles from the home (n=36*)</b>		
Street trash receptacles	31	86.1
Municipal waste collection receptacle	2	5.6
Hospital waste collection receptacle	1	2.8
Burn	2	5.6
<b>Disposal of lancets at home</b>		
Household waste	34	85.0
Closed box/bottle	5	12.5
Burn	1	2.5
<b>Removal of lancet from the home</b>		
Street trash receptacle	35	87.5
Municipal waste collection receptacle	2	5.0
Hospital waste collection receptacle	1	2.5
Burn	2	5.0
<b>Disposal of empty insulin pen and vials after use at home (n=36*)</b>		
Household waste	29	80.6
Closed box/bottle	5	13.9
Burn	2	5.6
<b>Removal of used insulin pen device and vial from the home (n=36*)</b>		
Street trash receptacle	31	86.1
Municipal waste collection receptacle	2	5.6
Hospital waste collection receptacle	1	2.8
Burn	2	5.6
<b>Disposal of reagent strips after use at home</b>		
Household waste	34	85.0
Closed Box/bottle	5	12.5
Burn	1	2.5
<b>Removing used blood glucose strips from the home</b>		
Street trash receptacle	36	90.0
Municipal waste collection receptacle	2	5.0
Hospital waste collection receptacle	1	2.5
Burn	1	2.5
<b>Recycling of glucometer batteries</b>		
Household waste	35	87.5
Street trash receptacle	3	7.5
Battery recycling point	1	2.5
Medical waste collection receptacle	1	2.5
<b>Total</b>	<b>40</b>	<b>100.0</b>

\*patients using insulin

**Table 3. Situation of wound dressing waste (n=40)**

Variables	n	%
<b>Frequency of wound dressing changes</b>		
No dressing	3	7.5
Once daily	15	37.5
Twice daily	22	55.0
<b>Person changing wound dressing</b>		
Self/family member	28	73.7
Home care personnel/health professional	5	13.2
Hospital/medical clinic	5	13.2
<b>Disinfectant/medication used for dressing</b>		
Yes	22	55.0
No	18	45.0
<b>Current wound fluid or exudate</b>		
Yes	20	50.0
No	16	40.0
Not aware of	4	10.0
<b>Disposal of wound dressing waste after use</b>		
Household waste	33	86.8
Closed box/bottle	2	5.3
Medical waste collection receptacle	2	5.3
Burn	1	2.6
<b>Removing wound dressing waste from the home</b>		
Street trash receptacle	32	84.2
Municipal waste collection receptacle	2	5.3
Hospital waste collection receptacle	2	5.3
Burn	2	5.3
<b>Cooperation with municipalities on medical waste</b>		
Providing medical waste receptacle	4	10.0
Medical waste bag	1	2.5
No cooperation	35	87.5
<b>Total</b>	<b>40</b>	<b>100.0</b>

**Insulin and Insulin Pen Needles Use**→ 90% of the patients were using insulin injections as the form of treatment for their diabetes. Of these insulin-using patients, 86.1% received insulin injections 2 or more times daily. Half (50%) of the diabetics using insulin used their insulin needles only once, while the other half reused them more than once (Table 1). 80% of the patients reported monitoring their blood glucose levels on a daily basis. 80.6% of the patients in the study reported throwing their insulin pen needles into the household trash. 86.1% said that they discarded their household waste into street trash receptacles. Similarly, 87.5% and 86.1%,

respectively, reported getting rid of the lancets used in measuring blood glucose levels and empty pens/vials by tossing them into street trash receptacles. 85.1% of the patients indicated that they discarded their blood glucose test strips into the household waste and 90% said that they threw the household waste into street trash receptacles. 87.5% of them disposed of the batteries used in glucometers into the household waste (Table 2).

**Diabetic Foot Ulcer Dressing** : The frequency at which foot ulcer dressings were changed varied from once a day (37.5%) to twice a day (55%). 50% of the patients reported discharge from their

ulcers. 73.7% indicated that they or one of their family members changed the dressings. 86.8% said that they discarded the used dressings into the household waste while 84.2% said that they threw this household waste into street trash receptacles.

**Medical Waste Education:** Only 10% of the diabetics reported obtaining medical waste receptacles from their municipalities (Table 3); 75% said that they did not separate their medical waste from ordinary waste in the household waste and 80% reported not having received any education regarding household medical waste (Table 1).

## Discussion

Due to improved technology and expanding healthcare systems, the volume of medical waste has reached enormous proportions. Among the factors contributing to the growth of medical waste are single-use devices and materials (Kocak et al. 2016).

According to the Coalition for Safe Community Needle Disposal, households use more than 7.5 billion syringes, and this number is rapidly rising. Diabetic individuals make up the largest group of these syringe users; this figure does not include the number of lancets used by 25 million diabetics (Gold, 2011).

The TURDEP-2 study determined that 13.7% of diabetics in Turkey (6,095,579) are afflicted with Type 2 diabetes and of these people, 14% use insulin. 1.3% of diabetics in the country (1,017,043) suffer from Type 1 diabetes (Satman et al. 2013). Ilkova et al. (2016) report that 72% of diabetics in Turkey are unable to reach target HbA1c values.

They also maintain that in order to attain target values, patients must resort not only to insulin but also to more intensive treatment methods (Ilkova et al. 2016). And this means the creation of even more medical waste. Medical waste that is not appropriately separated, collected and destroyed poses serious risks to public health and the environment.

### **Insulin and Insulin Pen Needles Use**

Our research found that nearly all of the patients monitored for diabetic foot ulcers used insulin pens and blood glucose testing devices. Moreover, they were uninformed about the need to dispose of the medical waste (insulin needles,

blood glucose test strips) safely. The vast majority (80%) of the patients discarded this waste in the household waste and 86.1% then threw this trash into street trash receptacles. Only 2.8% of them threw used needles into a medical waste container and 5.6% incinerated the medical waste they generated.

Only one study has been done in Turkey specifically on diabetics and the management of household medical waste. A few other studies have been done on how medicines (e.g., empty containers/instruments used to administer them/left over amounts) used in the home are discarded and the efforts made by local municipalities to dispose of medical waste. Therefore, our research findings are a substantial contribution to this area of research.

In a study done on children with Type 1 diabetes aged  $12.5 \pm 3.9$  in Turkey, Zuhur et al. found that 73.8% discarded their insulin pen needles into the household waste and that 71.9% then threw this waste into street trash receptacles. The results of our study are comparable (Zuhur Yanik et al. 2014).

In a study they did on public awareness of how to dispose of medicines and devices associated with administering them found in the home, Kose et al. observed that the most common means of disposal was throwing them into the trash, pouring them down the drain or flushing them down the toilet (Kose et al. 2013).

Udofia et al. (2017) found that 89% of waste consisting of sharps capable of perforating the skin was thrown into the garbage can while 9.3% was incinerated. 42.2% of blood-contaminated objects were tossed into the trash and 40.6% was either incinerated or buried (Udofia, Gulis & Fobil 2017).

Regarding empty medicine containers such as used insulin pens and vials, 13.9% of the patients reported that they collected them in closed boxes or bottles. Of these collected items, 5.6% were disposed of in medical waste collection receptacles and 2.8% in hospital medical waste collection receptacles. While there are very few publications on the disposal of household medical waste in Turkey, Zuhur et al. found in their study that three-quarters of patients discarded the insulin pens, needles and blood glucose measurement strips used to monitor and/or treat diabetes into trash cans and then

improperly threw this trash into street trash receptacles (Zuhur Yanik et al. 2014).

Comparing the situation found in Turkey with other countries, a study done in South Africa by Govender and Ross determined that more than 97% of patients improperly discarded needles (Govender and Ross 2012). A study done in Pakistan showed that disposing injection-related waste into household trash by diabetics was extremely widespread (syringes 92%, pens 75% and lancets 91%) (Ishtiaq et al. 2012).

In a study they conducted at the Primary Care Unit in Brazil, Cunha et al. found that 57% of diabetics discarded their used syringes, needles and lancets and 66.1% of them threw empty insulin vials into the household trash. 86% of them tossed used cotton into the household trash. Similar to our study, 63.8% threw household medical waste into ordinary trash receptacles without separating it from the non-medical waste (Cunha et al. 2017).

In multi-location study they carried out in the U.S. on the risk of sharps injuries among home care aides, Brouillette et al. (2017) found that those caring for diabetics were more than twice as likely to be injured than those not caring for diabetics (Brouillette et al. 2017). In a study they did in Nepal, Poudel et al. determined that roughly half of the participants threw used needles into the trash. Less common practices were discarding them in isolated places and burn (Poudel et al. 2017). Similarly, the majority of the Indian patients were known to throw the needle and syringes directly into the garbage and public drainage system (Patil et al. 2016). Other studies also reported improper disposal of used needles (Satterfield and Kling 1991; Frid et al. 2016; Kalra et al. 2017). Markkanen et al. (2015), in their qualitative study, *Understanding sharps injuries in home healthcare*, based on interviews and a questionnaire, found that participants improperly disposed of medical waste and that this posed a serious public health risk. 86% of the 44 participants completing the questionnaire indicated that they inappropriately disposed of medical waste (Costello and Parikh 2013; Markkanen et al. 2015)

### ***Diabetic Foot Wound Dressing***

In the “Regulation on Control of Hazardous Waste” that went into effect with its publication in the Official Gazette (*Resmi Gazete*) in 2005

in Turkey, medical waste is defined as waste that has the potential to spread disease/infection and includes items that can cut or otherwise perforate the skin. First and foremost among infectious, disease-causing waste is any materials that have come into contact with body fluids, especially blood and blood products. These regulations require medical waste to be separated from other non-medical waste. The used dressing discarded by diabetics participating in this study constitute infectious waste (Regulation on Control of Hazardous Waste 2005) 86.8% of the patients in our study threw their dressing waste into the household waste and 84.2% of them improperly threw this trash into street trash receptacles.

### ***Medical Waste Education***

More than three-quarters of the patients in our study had not received education about how household medical waste should be discarded. This was the main reason for their incautious practices. Research has shown that even in developed countries diabetics do not appropriately discard their insulin pen needles and lancets (Costello and Parikh 2013). In a study conducted in New Delhi, only 14.1% of diabetic patients had received sharps disposal education (Singh and Chapman 2011).

Studies have shown that health personnels are not sufficiently informed about waste production and management (Akbolat et al. 2011). Other studies, however, emphasize the importance of education in medical waste management (Olowokure, Duggal & Armitage 2003; Ikeda 2014;).

In order to raise public awareness of the importance of this issue, the awareness of workers handling medical waste also needs to be improved. Therefore, medical waste management education is crucial.

### ***Conclusion***

In conclusion, studies show that diabetic patients in many countries, including Turkey, do not dispose of sharps and other medical waste properly. Despite the paucity of literature related to the subject in Turkey, given the large number of diabetics in the country and the, potentially disease-causing, medical waste they produce, people responsible for handling it and the public as a whole are at great risk of contracting blood-borne diseases.

The findings of our study are consistent with those of other studies done since the 1990s and call attention to the fact that the disposal of needles/sharps, in particular, and medical waste, in general, is a global problem, in both the developed and developing world. The best way to eliminate the risks associated with inappropriate medical waste disposal is to educate healthcare workers as well as patients and their relatives.

**Relevance to clinical practice:** Our research has demonstrated the disposal of used injection devices into the household garbage by diabetic patients is very common. Sharps discarded in an unsafe manner in the community cause concern as they potentially place people at risk of injury and infection from blood-borne pathogens such as HIV and viral hepatitis.

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