



Green diabetes mellitus: a pilot project

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ABSTRACT

INTRODUCTION: Most of approximately 422 million people globally have diabetes mellitus use sharps for glucose monitoring. Many adults with diabetes are unaware of safe disposal methods, posing a risk of injury or potential infection to others.

AIM: To determine how adults with diabetes dispose of diabetes care-related waste and to assess changes in their disposal habits after receiving brief targeted education during medical visits.

METHODS: Ambulatory adults with diabetes (aged ≥ 18 years) were enrolled during their medical visit. After completing an initial questionnaire, a handout on safe disposal practices was discussed with them, which was followed by a second questionnaire 3 months later.

RESULTS: There were 111 participants at baseline (mean age 55 years, 50.4% had diabetes for >10 years, 52% female, 74.7% insulin users, 59.4% had home sharps containers, 53.1% had previous diabetes education). Of these, 40.5% reported disposing of sharps in their household trash. Insulin use, previous diabetes education or having a 'Red Sharps' container at home were each significantly associated with safe disposal (all $P < 0.05$). Of the 96 (86.5%) participants who completed the second questionnaire, unsafe disposal of sharps fell from 39.6% to 10.4% ($P < 0.001$). Preferred method of container disposal was the use of drop-off sites (pharmacies, doctors' offices and hospitals). Outside their homes, 18.8% of completers had used regular trash for sharps disposal. Post education, this fell to 8.7% ($P = 0.065$). Post education, reuse of sharps decreased from 38.3% to 14.9% ($P < 0.001$) and improper handling of sharps (eg bending or cutting) fell from 18.8% to 9.4% ($P = 0.004$).

CONCLUSIONS: Safe sharps disposal can be improved by providing a simple handout with a brief discussion at the time of medical visits. Disposal methods that are easy, convenient and free-of-charge are needed to further increase safety.

KEYWORDS: Sharps; diabetes mellitus; healthcare-related waste

Introduction

Approximately 422 million people globally (including 30.3 million people in the USA (9.3% of population)) have diabetes mellitus (DM), many of whom use 'sharps' (lancets for self-monitoring of blood glucose, needles, injectable medications, insulin pumps and continuous glucose monitors).¹⁻³ Approximately 3 billion needles and syringes are used each year outside of health-care facilities in the USA.^{1,4} As the number of people living with diabetes grows, diabetes care-related

home waste required for self-management also increases. This waste places a burden on the environment. Many adults with DM are unaware of safe disposal methods available to them and simply throw medical waste in with household trash. This poses a risk of injury or potential infection to others in the community, such as sanitation and sewage treatment workers, janitors, housekeepers and children.⁵ Although many improvements have been made to waste and sharps disposal practices in health-care settings, disposal practices of people

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Table 1. Study handout for participants

Contaminated materials	Proper disposal technique		
	Puncture-proof container with screw cap	Household waste (like trash can)	Other
Blood glucose (BG) test strips	–	x	–
Blood ketone strips	–	x	–
Urine ketone strips	–	x	–
Cotton/Spirit Swabs	–	x	–
Old pills	–	–	Contact local pharmacy
Foot ulcer dressing bandages	–	x	–
Lancets	x	–	–
Insulin vials	x	–	–
Insulin pens	x	–	–
Needles	x	–	–
Pen needles	x	–	–
Plastic syringes	x	–	–
Broken insulin pump	–	–	Contact the company
Insulin pump supplies	Parts with needles	Parts without needles	–
Omnipod insulin pods	–	–	Contact company for pod disposal kit
Broken glucometers	–	–	Contact the company
CGM sensor supplies	Parts with needles	Parts without needles	–
Glucose transmitter	–	–	Contact the company

CGM (continuous glucose monitor).

with DM living at home have been poorly studied. Barriers to safe disposal include lack of education of where and how to dispose of diabetes care-related waste and lack of easy access to disposal sites.

The aim of this study was to determine how adults with diabetes followed at our centre dispose of diabetes care-related waste and to assess changes in diabetes waste disposal habits after receiving brief targeted education during their medical visits.

Methods

This prospective study was conducted at the Joslin Diabetes Center at SUNY Upstate Medical University, Syracuse, New York from August 2016 to July 2017.

Patients could be included in the study if they had a diagnosis of DM and were aged ≥ 18 years. Excluded were adults who were not responsible for, or capable of, disposing of their diabetes-related waste (these tasks were performed by others) or who could not provide informed consent. The study questionnaire was adapted from earlier research conducted in the USA, Pakistan and the Philippines.^{6–8} Participants ($n = 111$) were recruited at our centre for diabetes treatment when they came for their routine diabetes medical visit. They were seen by two investigators and informed consent was obtained.

Methods for patients' disposal of diabetes care-related waste were self-reported in an initial questionnaire. Then participants were given a simple three-page handout on safe disposal practices, which was discussed with them for up to 5 minutes. Key elements of the handout are shown in Table 1.

Three months after the initial education, participants were asked to complete a post-education questionnaire to assess potential changes in their disposal habits and to obtain feedback on their preference of disposal methods. The post-education questionnaire was completed either at a follow-up visit or by phone.

The primary endpoint was improvement in awareness and implementing of safe disposal techniques. The secondary goal was to better understand participants' preferred method for safe sharps disposal. Data from the pre- and post-education surveys were initially entered into Microsoft Excel spreadsheets (Microsoft Corporation, Redmond, WA, USA). After all responses were collected, all data were imported into IBM SPSS Statistics 22 (SPSS Inc., Chicago, IL, USA) for analysis. Descriptive statistics were produced for each survey question, examining the pre- and post-education responses separately. Frequencies provided overall counts and percentages of answer choices for each question, by time point. Cross tabulations were generated to examine possible differences in

response choices depending on demographic characteristics, again for each of the two time points separately. To assess the effectiveness of the training, the dataset was trimmed to include only participants with data for both the pre- and the post-education questionnaires. For each question, McNemar's Test for paired proportions was used to test for significant changes in the distribution of responses after administration of the safe disposal practices education. The Institutional Review Board (IRB) for the protection of human subjects at SUNY Upstate Medical University approved the study.

Results

Participants' ($n = 111$) mean age was 55 years (standard deviation (s.d.) 15.3 years); 54% were female; 70.3% were Caucasian, 15.3% were African American and 5.4% were Hispanic. Most (83.8%) had type 2 DM and 50.4% had DM for a duration of >10 years (Table 2). Seventy-four percent of participants were either using insulin alone or in combination with oral medication or other non-insulin injectable. Only 26.8% had been taking insulin for >10 years. With respect to diabetes education, 53.1% of participants had received formal DM education, mostly from the nurses in the physician's office. Out of the 59.4% of participants who were using home sharps containers, 43.9% and 45.4% (respectively) disposed of their container in the household trash or by dropping it off to pharmacies (Table 3). Approximately 79% were handling the sharps appropriately (not clipping or bending). When outside their home, 23.4% of participants

Table 2. Patient characteristics at baseline

	Total $n = 111$ (%)
Age: mean (years) (s.d.)	55.3 (15.3)
Gender	
Female	60 (54)
Male	51 (46)
Race	
Caucasian	78 (70.3)
African American	17 (15.3)
Hispanic	6 (5.4)
Asian	3 (2.7)
Others	7 (6.3)

(Continued)

Table 2. (Continued)

	Total $n = 111$ (%)
Insurance	
Commercial	42 (37.8)
Medicaid	23 (20.7)
Medicare	19 (17.1)
More than one insurance	24 (21.6)
Unknown/No insurance	3 (2.7)
Education	
Less than High School	11 (9.9)
High School	38 (34.2)
More than High School	61 (54.9)
Unknown	1 (0.9)
Type of DM	
Type 1	16 (14.4)
Type 2	93 (83.8)
Unknown	2 (1.8)
DM duration (years)	
<5	22 (19.8)
5–10	32 (28.8)
>10	56 (50.4)
Unknown	1 (0.9)
Treatment	
Pills	27 (24.3)
Insulin	44 (39.6)
Combination (pills and injectable)	39 (35.1)
Duration of insulin use (years)	
<1	19 (23.2)
2–5	17 (20.7)
5–10	18 (21.9)
>10	22 (26.8)
Unknown	6 (7.3)
Previous DM education	
No	50 (45.0)
Yes	59 (53.1)
Unknown	2 (1.8)

Data are presented as n (%) unless otherwise stated. s.d. (standard deviation); DM (diabetes mellitus).

disposed of sharps in the trash; the rest either brought sharps home in their sharps container (50.5%), used the available sharps container at the

Table 3. Pre-intervention data for sharps disposal

Sharp disposal	
Trash (unsafe)	45 (40.5)
Special container (safe)	66 (59.4)
Container disposal (Safe)	
Trash	29 (43.9)
Pharmacy/Drop off site	30 (45.4)
Landfill/Dump	5 (7.6)
Mail to facility	2 (3.0)
Handling sharps	
Clip (unsafe)	8 (7.2)
Bend (unsafe)	12 (10.8)
Clip and bend (unsafe)	1 (0.9)
Neither (safe)	88 (79.3)
Unknown	2 (1.8)
Sharps outside home	
Trash (Unsafe)	26 (23.4)
Special container (bring home)-Safe	56 (50.4)
Special container (outside)-Safe	12 (10.8)
Other	5 (4.5)
Unknown	12 (10.8)
Needle stick injury	
No	102 (91.9)
Yes	8 (7.2)
Unknown	1 (0.9)
'Red box' at home	
No	85 (76.6)
Yes	26 (23.4)

Data are presented as *n* (%).

outside facility (10.8%) or did not use sharps at all (15.3%). Fifty-nine percent of participants did not reuse their sharps (including lancets and needles). Most participants (91.9%) denied any needle stick injury. Only 23.4% had a 'Red Box' sharps disposal container at home.

Insulin use ($P = 0.048$), previous diabetes education ($P < 0.00$) and having a 'Red Box' at home ($P = 0.009$) were associated with safe disposal (Table 4). Of participants who used insulin or who had previous diabetes education, 67% and 77.9% respectively disposed of sharps appropriately at baseline. Gender, race, insurance status, education

level, type and duration of DM and duration of insulin use were not significantly associated with safe sharps disposal.

At the 3-month follow up, 86.5% of participants ($n = 96$) completed the questionnaire. Unsafe disposal of sharps fell from 39.6% to 10.4% ($P < 0.001$). The preferred method of sharps disposal was the use of drop-off sites (pharmacies, doctor's office or hospitals). Outside their home, 18.8% of completers of the both questionnaire had used regular trash for sharps disposal. Post education, this fell to 8.7% ($P = 0.065$). Post education, reuse of sharps decreased from 38.3% to 14.9% ($P < 0.001$) and improper handling of sharps (eg bending or clipping) fell from 18.8% to 9.4% ($P = 0.004$). Most participants did not complete the question regarding diabetes care-related non-sharp waste, so we could not assess the effect of education on non-sharp waste disposal.

Discussion

In our study, 40% of participants were inappropriately disposing of sharps in their trash. This compares to 50% in a 2010 study in Virginia and 82% in a study conducted in the Philippines in 2014.^{6,8} In our study, almost 45% of participants had not received education that included the proper disposal of sharps. Safe methods of sharps disposal in the community include drop boxes and supervised collection sites such as hospitals, health clinics, pharmacies, police and fire stations, and medical waste facilities. Other options include mail back and syringe exchange programmes, use of hazardous waste collection sites, special waste pickup services and use of at-home needle destruction devices.⁹

Not all services are available in every USA state, and within states, resources are not uniformly available; for example, some towns in New York state allow residents to dispose of proper sharps containers alongside their trash can for pickup but other towns do not.^{10,11} Also, clipping as a method of disposal is not allowed in New York State, but it is allowed in other states such as Maine. Our participants preferred to dispose of sharps at physicians' offices, hospitals and pharmacies. These sites are convenient as patients visit these locations regularly for health issues. In New York, increasing the number of days and hours at hospitals and nursing homes

Table 4. Factors associated with safe sharps disposal

DM treatment	Unsafe <i>n</i> = 45	Safe <i>n</i> = 66	<i>P</i> = 0.048
Pills	16 (59)	11 (40)	
Injectables	28 (33)	55 (67)	
Sharps disposal - 'Red Box'	<i>n</i> = 45	<i>n</i> = 66	<i>P</i> = 0.009
No	40 (47)	45 (52)	
Yes	5 (19)	21 (81)	
Previous diabetes education	<i>n</i> = 43	<i>n</i> = 66	<i>P</i> < 0.001
No	30 (60)	20 (40)	
Yes	13 (22)	46 (78)	
Duration of insulin use (years)	<i>n</i> = 24	<i>n</i> = 52	<i>P</i> = 0.15 (NS)
<1	3 (16)	16 (84)	
≥1	21 (37)	36 (63)	

Data are presented as *n* (%). DM (diabetes mellitus); NS (not significant).

for community sharps collections from 2001 to 2004 was associated with greater public use of those sites ($P < 0.001$).¹¹ Outside patients' homes, we also recommend that public restrooms should have sharps disposal containers. As we have awareness days for various medical and non-medical issues (and recently in March 2018, the first global recycling day was initiated), we also propose an awareness day for proper sharps disposal.

We found that discussion with patients during their medical visits about sharps disposal improved proper disposal over a 3-month period. Whether this improvement persists over a longer duration will require further study.

Strengths of our study include its prospective design and data collection conducted pre- and post-education; most previous studies have been cross-sectional surveys. Also, the education method used in this study was consistent and provided by two investigators. Limitations of our study include its single site, small sample size, short duration of follow up and one-time teaching.

Conclusions

For adults with DM, diabetes-related waste disposal can be improved by providing a simple handout with a brief discussion at the time of medical visits. Disposal methods that are easy, convenient and free-of-charge are needed to further increase safety.

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Competing interests

The authors declare that they have no competing interests.

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