



Evaluation of problems in self-injection of insulin at home in older diabetic patients

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Abstract

In Japan, 76.6% of the diabetic population is receiving some kind of treatment.

However, concerning patients cared for at home, there have been few reports of needle stick injuries, including injuries during insulin injection.

We conducted a fact-finding survey of insulin injection in home-care patients for whom a local pharmacy dispenses insulin. A questionnaire survey was carried out among patients aged 65 years and above for whom insulin was dispensed by 9 pharmacies for self-injection at home and who consented to cooperate in the survey to clarify problems with insulin injection at home. Of the 57 participants, 7 had sustained needle stick injuries caused by themselves. Two incidents of needle stick injuries sustained by a person other than the patient were reported.

This survey of 57 patients revealed that there are many problems in self-injection at home and that adverse events are more frequent than recognized by medical staff.

Keywords: needle stick injury, self-injection, insulin, Diabetes mellitus

1. Introduction

The number of diabetic patients has reached 425 million worldwide, and one of every 11 adults is diabetic ^[1]. The western Pacific region, including Japan, has 158.8 million diabetic patients, which is the largest diabetic population in the world ^[2].

In Japan, both the diabetic and high-risk populations are estimated to be approximately 10 million, 76.6% of the diabetic population is receiving some kind of treatment, and this percentage has increased markedly from the 45.0% 20 years ago ^[3]. The number of older diabetic patients has increased annually, and those who live alone or are cared for by old spouses receive outpatient treatment. Under such circumstances, there is concern over whether the injection procedure of patients who need insulin injection is satisfactory and whether they are handling instruments, such as the injection device and needles, properly. In diabetic patients with dementia, there is also the possibility of fatal accidents, such as hypoglycemia, due to errors in the number, time, or dose of injection. Presently, however, information about the risk of insulin self-injection at home or the demand for necessary supportive devices is lacking because no appropriate survey of the state of insulin self-injection at home has been implemented.

Regarding needle stick injuries, according to a report by the Center for Disease Control and Prevention (CDC) (Recommendations and Reports), the infection rate due to occupational exposure by needle stick injuries was HIV 0.3%, HCV 1.8%, and HBV 37-62% ^[4]. In the United States, the Needlestick Safety and Prevention Act based on a wide variety of evidence has been enforced, obligating employers to evaluate and introduce commercial safety equipment, and specifying training and education for the use of safety equipment as important elements for the prevention of needle stick injuries.

In Japan, the introduction of safety equipment has not been made obligatory because of the differences in the development of laws and insurance system, and education about needle stick injuries is not satisfactory. In addition, a case of the development of AIDS by a Japanese man who sustained repeated needle stick injuries due to used medical devices during the cleaning of medical facilities was disclosed by the Ministry of Health, Labour and Welfare in September 2001 ^[5], leading to a marked improvement in the awareness of medical facilities about the risk of needle stick injuries.

Needle stick injuries in medical facilities have been surveyed by Japan-EPINet Surveillance (JES) ^[6], and as their status, including cases due to insulin injection needles, has been clarified, safety measures for patients and medical workers have been developed. However, concerning patients cared for at home, there have been few reports of needle stick injuries, including injuries during insulin injection.

In addition, the method for retrieval of used insulin needles has not been standardized in Japan, and they are primarily collected by one of the following 3 methods: 1) they are brought by the patients into the hospital or clinic that has prescribed the treatment and are collected by the hospital or clinic; 2) they are brought by the patients into the pharmacy that has dispensed insulin and insulin needles and are collected by the pharmacy; or 3) the patients take some kind of safety measures such as placing used insulin needles in a plastic bottle and discarding them at the nearby waste-collection point as household garbage according to the instructions of the local government ^[7].

Needle stick injuries sustained by sanitation workers due to the disposal of used insulin needles as household garbage at usual collection points without abiding by the above rules and neglect of insulin needles by non-medical organizations,

such as office buildings, hotels, and shopping centers, have emerged as problems^[8].

Under such circumstances, we conducted a fact-finding survey of insulin injection in home-care patients for whom a local pharmacy dispenses insulin.

2. Materials and methods

The study protocol was reviewed and approved by the institutional review boards of the participating institutions. Written informed consent was obtained from the study participants, including consent to participate and to publish the findings.

2.1. Research Participants

A questionnaire survey was carried out among patients aged 65 years and above for whom insulin was dispensed by 9 pharmacies in Atsugi City, Kanagawa Prefecture for self-injection at home and who consented to cooperate in the survey to clarify problems with insulin injection at home (Table 1). Atsugi City, Kanagawa is a typical satellite town with a population of approximately 224,000^[9] located 45 km from Tokyo and 30 km from Yokohama. Those aged 65 years and above accounted for 24.6% of the population with an aging index of 198.1 (2018)^[10]. (The mean percentage of people aged 65 years and above in Japan was 27.3% (2017), and the aging index was 261.4 (2017)^[11].)

Table 1: Research participants and their age

Pharmacy	No. of participants	Sex		Mean age (SD)
		Male	Female	
A	21	14	7	71.4
B	10	6	4	70.9
C	8	4	4	73.3
D	4	4		71.0
E	3	2	1	67.7
F	3	2	1	75.7
G	3	2	1	69.7
H	2	1	1	79.0
I	2	1	1	77.0
J	1		1	72.0
Total	57	36	21	71.9 (5.6)

2.2. Questionnaire

Questions about self-injection of insulin at home and disposal of insulin needles were asked using a questionnaire. The questions are shown in Table 2.

Table 2: Survey of the circumstances of self-injection of insulin at home and disposal of injection needles in older outpatients

1. What are the names of the insulin and needles you are using now, and the amount of insulin you are injecting?
2. About insulin injection
a. How long have you been using insulin? (years and months)
b. How long have you been using the insulin you are using now? (years and months)
c. Do you think you sufficiently understand the method for the use of insulin? [I think so, relatively yes, neither yes nor no, relatively no, I do not think so]
d. Who is primarily injecting insulin? [myself, spouse (years old), son or daughter (years old), others (free answer (years old))]
I. If you have answered "myself",
i. Does anyone other than yourself ever inject you with insulin? (yes, no)
A. If you answered "yes", how frequently?

[Every day, a few times a week, a few times a month, when I do not feel well, others (free answer)]
B. Describe the details of the situation (all who answered question A: free answer)
e. Have you ever stuck the injection needle at the wrong site by mistake (a site other than the proper site of injection such as the hand or fingertip)? (yes, no)
I. If you have answered "yes",
i. When was it?
• Around the time when I started injecting insulin (years and months ago)
• I stuck myself even though I was fully used to the procedure (years and months ago)
ii. Where did you stick yourself by mistake? [fingertip, others (free writing)]
iii. Describe the circumstances of the accidental sticking.
• I stuck myself when I recapped the needle after injecting insulin.
• Others (free writing)
iv. Did you take any action after sticking yourself by mistake?
• I consulted a medical facility.
• I reported the incident to the doctor in charge of me
• I just applied a commercial adhesive tape or ointment.
• I did nothing in particular.
• Others (free writing)
f. Has anyone other than yourself ever stuck himself/herself while handling an insulin needle? (yes, no)
I. If you have answered "yes",
i. Who was the person? [spouse (years old), son or daughter (years old), others (free writing (years old))]
ii. What were the circumstances of the accident?
• When the person other than yourself tried to inject you with insulin
• When the person other than yourself tried to recap the needle after injecting insulin
• When the person disposed of the needle
• Others (free writing)
iii. Describe the details of the accident (all who answered question e)
iv. When was the accident?
• Around the time when I started using insulin (years and months ago)
• The person stuck himself/herself by mistake even though he/she was fully used to the procedure (years and months ago)
v. Did the person bleed at that time? [yes, no]
vi. Did the person take any action after sticking himself/herself by mistake?
• He/she consulted a medical facility
• He/she reported the incident to the doctor in charge of me
• He/she just applied an adhesive tape or ointment
• He/she did nothing in particular
• Others (free writing)
3. Insulin needles
a. Where do you usually keep used insulin needles?
• In a special container
• In a plastic bottle
• In an empty can
• Others (free writing)
b. How do you dispose of used insulin needles?
• I bring them to a hospital or clinic
• I bring them to a pharmacy
• I discard them at a garbage collection site near my house
• Others (free writing)
c. Mainly, who disposes the used injection needles? [Myself, spouse (years old), son or daughter (years old), others ((years old))]
I. Does anyone other than yourself ever dispose used injection needles? (yes, no)
i. If you have answered "yes", how frequently are they disposed of by others?

- Every day
 - A few times a week
 - A few times a month
 - When I do not feel well
 - Others (free writing)
- ii. Describe the details of the circumstances (all who answered question i: free writing)
4. Write freely about any problem you have concerning daily insulin injection or needles. (free writing)

2.3 Recording form of insulin self-injection at home used for the survey

The patients were asked to fill in a form for 2 weeks stating the date and time of insulin self-injection at home, dose of insulin, person who gave the injection, person who disposed of the needles, and special comments (Fig. 1).

Record the circumstances of insulin injection and disposal of injection needles for 2 weeks

Month	Day	Day of the week	Time of injection	Dose in units	Injector	Person who disposed of the needle	Special comments*
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	
			:		Myself ()	Myself ()	

*Special comments

(If there has been anything unusual, describe it)

Anything, including slight leakage of the drug before (after) injection, sticking the finger by mistake, or temporarily placing used needles on the chest of drawers because the plastic bottle in which I usually keep used injection needles was full.

Fig 1: Survey form for the circumstances of daily insulin self-injection at home and disposal of insulin needles

3. Results & Discussion

3.1 Questionnaire survey

The answers to the questionnaire about insulin self-injection and disposal of insulin needles are summarized in Table 3.

Table 3: State of insulin self-injection at home and disposal of insulin needles

1. Insulin self-injection

- a. Time from the beginning of the use of insulin : 2-336 months (median: 120 months) (n=57)
- b. Do you think you sufficiently understand the method for the use of insulin?

I think so	Relatively yes	Neither yes Nor no	Relatively no	I do not think so
39	15	2	0	1

- c. Mainly, who performs insulin injections?

Myself	Spouse	Son or daughter	Visiting nurse	No answer
53	1	1	1	1

- d. Have you ever stuck yourself with the injection needle at the wrong site (a site other than the intended site of injection such as the hand or fingertip)?

Yes	No	No answer
7	47	3

To the 7 participants who answered “yes”,

- Where did you stick yourself by mistake?

Finger tip	Others
7	0

- Describe the circumstances of sticking yourself by mistake.

While recapping	Others
7	0

- Did you take any action after you stuck yourself by mistake?

Consulted a hospital	Reported to my doctor	Only applied a commercial adhesive tape or ointment	Nothing in particular	Others
0	0	1	5	1

*Others: Pressed with alcohol-saturated cotton

- e. Has anyone other than yourself stuck himself/herself while he/she was handling the insulin needle?

Yes	No	No answer
2	54	1

	Case 1	Case 2
Person who sustained the injury	Wife	Daughter
Circumstances of needle stick injury	While discarding the needle	While discarding the needle

Details of the circumstances	The needle was difficult to remove from the syringe, and when she tried hard to remove it, it recoiled and stuck her finger a little.	She stuck herself while recapping the injection needle.
Bleeding	No bleeding	No bleeding
Action taken	She thought it was alright, but drank a sweet soft drink just in case.	There was no bleeding, so she did nothing in particular.

2. Insulin needles

a. Where do you usually keep used insulin needles?

Special box	Plastic bottle	Empty can	Others
19	29	5	4

*Others: trash can at home, empty coffee bottle, wooden box, plastic zipper bag, paper bag

b. How do you dispose of used insulin needles?

Bring them to a hospital or clinic	Bring them to a pharmacy	Discard them at a garbage collection site near my house	Others
51	3	1	2

*Others: I keep all of them, discarded by the doctor in charge

c. Mainly, who disposes of the used needles?

Myself	Spouse	Son or daughter	Others
49	5	2	1

*Others: nurse

d. Has anyone other than yourself ever disposed of used needles?

Yes	No	No answer
6	47	4

▪ How frequently does this occur?

Every day	A few times a week	A few times a month	When I do not feel well	Others
4	1	1	0	0

▪ Describe the details of the circumstances

Case 1: I go to the hospital with my daughter-in-law, and we return the needles in a plastic bottle to have them disposed of. They give us an empty plastic bottle.

Case 2: I have my wife bring them to the hospital. The container is a glass or plastic bottle.

3. Write freely about troubles with daily insulin injection or insulin needles if you have any

- I inject insulin in the abdomen, but the needle hits the muscle, which occludes the hole of the needle and prevents the drug from entering. Therefore, I force the drug to enter using 2 fingers, but this causes strain at the wrong place and bends the needle. One time, I did not know the needle was bent, and when I tried to cap the needle, I stuck myself in the finger.
- As the special container for disposal of needles is inconvenient, I temporarily put them in a paper bag, and my family later places them in the special container.
- When I set the injection needle and prepared to inject, the needle hit something and became bent. When I go out with the (injection) set and as I am about to inject, sometimes the needle gets clogged, and the drug will not come out.

- I wish that the needle was shorter and thinner so there was less pain. I have to inject 3 times each day.
- There are 2 types of needle caps, one covers the needle tip and the other covers the entire needle. The patient was used to recapping needles with the type that covers the needle tip after injection. I tell the patient that recapping of the needle tip is unnecessary and to recap only when the cap covers the entire needle, but they continue this habit even after several months and I am still telling them each injection. (comment by the patient's child)
- I have trouble disposing of used injection needles.
- In the case of injection errors, extra injection needles would be convenient.
- It is difficult to keep a good balance among the amounts of food, exercise, and insulin. Pricking the fingertip for blood sugar measurement is painful. As I have type I diabetes, I have to inject insulin before each meal and it is bothersome. In addition, I make it a point to bring a set containing the blood sugar meter, insulin, and needle when I go out. I inject in the abdomen, and it bothers me that I have to find an appropriate place for injection when I am out. It would help a lot if I can just spray the drug into my mouth or something.
- Sometimes, injection is very painful. The needle bends when I withdraw it.
- Occasionally, I forget the injection or do it after meal, but I wonder what effect it has on the blood sugar level.
- I worry about the future when it becomes impossible for me to self-inject due to old age.

3.2 Questionnaire survey

Special comments about the circumstances of daily insulin self-injection at home and disposal of insulin needles are shown below (Table 4).

Table 4: Special comments about daily insulin self-injection at home and disposal of injection needles

<ul style="list-style-type: none"> ▪ I end up using the same injection needle for a couple of days. ▪ I bent the injection needle 3 times in 20 days. One of the 3 times, I stuck myself in the fingertip. ▪ The injection needle is so thin that I feel little pain, but needles often become bent and wasted. ▪ Injection needles become bent about once every 5 injections. ▪ I had one too many injections [2 units] in 15 days. ▪ I am habitually reusing needles. ▪ I self-inject 3 times a day using the same needle throughout the day.
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Of the 57 participants, 7 had sustained needle stick injuries caused by themselves. All incidents occurred during recapping. In addition, 5 of them answered that they did "nothing in particular" after needle stick injury, 1 answered that they "just applied a commercial adhesive tape or ointment", and 1 answered that they "pressed with alcohol-saturated cotton". None of the 7 participants reported the incidents to the doctors in charge or consulted a medical facility.

Two incidents of needle stick injuries sustained by a person

other than the patient were reported. One occurred when the participant's wife had difficulty in removing the needle from the syringe to discard it. She applied extra force and pricked herself as the needle recoiled. Although no bleeding was observed, to the question, "Did you take any action after you stuck yourself by mistake?", she answered, "I thought it was alright, but I drank a sweet soft drink just in case." The second incident was a participant's daughter sticking herself by mistake when she tried to recap the injection needle to dispose of it. Similar to the 1st incident, she answered that "since I was not bleeding, I did nothing in particular."

Used insulin needles were most often kept in a plastic bottle, followed by a special container and empty can. One participant each answered that he/she kept them in a trash can at home, empty coffee bottle, wooden box, plastic zipper bag, and paper bag.

To dispose of injection needles, 51 patients "brought them to the hospital or clinic", 3 "brought them to the pharmacy", 1 "discarded them at a garbage collection point near the house", 1 "kept all needles", and 1 answered that "the doctor in charge disposes of them on his visits".

Based on the free comments, some patients (1) practiced a wrong recapping method for many years, (2) were unable to properly apply force with their fingertips and repeatedly bent the needle, resulting in sticking the fingertip, (3) injected insulin more than the prescribed dose, and (4) were habitually reusing injection needles. This survey of 57 patients revealed that there are many problems in self-injection at home and that adverse events are more frequent than recognized by medical staff. This suggests that problems that must be eliminated by the hospital are carried over into home care.

Used insulin needles were most frequently kept in plastic bottles, but safety is not ensured by plastic bottles and the use of special containers is recommended. However, whether a special container is used and who pays for the special container differ among municipalities, hospitals, and pharmacies. In addition, behaviors, such as transferring used insulin needles stored in a plastic bottle at home to a special container by the patient, are associated with the risk of infection by needle stick injury.

Insulin preparations used in Japan are mostly disposable syringes prefilled with insulin, and products that allow the needle to be attached and removed in a case, developed by medical device manufacturers, are widely available and in use. On the other hand, even when encased, the needle is exposed on the reverse side of the case, and problems remain to be solved.

Regional differences in government stances, medical facilities, and pharmacies are considered to be the greatest cause of confusion about the disposal method of used insulin needles, but efforts are currently being made to deliver information and instructions to patients and caregivers in each region even though differences persist. However, the best way to eliminate needle stick injuries is to develop a satisfactory national standard for disposal and having insulin needles that are entirely covered by a case after use, which eliminates the risk of needle stick injuries, pervade the Japanese market. We also strongly suggest the necessity of a large-scale investigation of self-injection at home, including assessment of the usability of insulin preparations based on safety, and simple blood sugar meters and puncture needles, in addition to the assessment of the

risk of needle stick injuries while attaching and removing insulin needles.

4. Conclusions

Our study suggested that self-injection of insulin at home in Japan contains complex problems, including needle stick injuries and disposal of used injection needles. Coordinated measures by governments, hospitals, and pharmacies are awaited.

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