

Worldwide Injection Technique Study: Education and the Health Care Professional

Introduction

In a previous paper¹ we described this landmark survey of injection practice worldwide, the ITQ from 2014-2015. The ITQ provided evidence that the diabetes teaching nurse has the primary role of educating the patient concerning all aspects of injecting. In almost all countries the diabetes teaching nurse is the primary guide and teacher for giving injections although other health care professionals (HCP) often participate. This places a heavy responsibility on such nurses. It is increasingly apparent that that proper injection technique is absolutely essential to good diabetes management. It may be as important as the choice and dose of injected agent, otherwise the latter will not act with optimal effect.

The tasks of the teaching nurse are to teach patients (and other care-givers) how to inject correctly and to address the many psychological hurdles the patient may face when injecting, especially at the initiation of such treatment. Hence this person must have an understanding of the anatomy of injection sites in order to help patients avoid intramuscular (IM) injections and to ensure that injections are consistently made into the subcutaneous (SC) tissue, without leakage/backflow or other complications. In addition the HCP must have knowledge of absorption profiles of the various agents from different tissues.

Methods and Materials

Our previous paper² described the methods, materials, centers and patients who participated in the study.

Results

Patients were asked who gave them their injection training.

Injection Instructor	%
General Nurse	22.9
Diabetes Nurse	46.7
Diabetes Educator	12.3
Doctor (General Practitioner)	5.1

¹ Worldwide Injection Technique Study: Population Surveyed 2015.

² Worldwide Injection Technique Study: Population Surveyed 2015.

Doctor (Diabetes Specialist)	10.0
Pharmacist	2.0
A representative of the pen or needle manufacturer	1.0

Patients were asked how often their injection sites were checked by their primary health care giver.

Frequency	%
Routinely every visit.	28.3
Once a year	12.6
Only if I complain of a problem at a site	20.2
I can't remember my sites ever being checked	38.9

They were asked when was the last time they got instruction or advice on injections.

Frequency	%
Within the past 6 months	37.4
Within the past 6-12 months	17.6
Sometime in the last 1 to 5 years	21.5
Sometime in the last 5 to 10 years	13.5
Never	10.0

They were asked what injection topics they could not remember ever being trained on.

TOPIC	%
Injection sites (e.g. thigh, arm, buttock, abdomen)	11.6
Skin thickness and appropriate depth of injection	27.2
Length of needle	25.6
How to do a skin lift or “pinch up” the skin	18.2
How long to hold a skin lift or “pinch up”	25.7
Angle of needle entry	16.1

How long to keep the needle in the skin after injection	16.4
Rotating within an injection site	18.4
Prevention of air bubbles (syringe) or proper priming of pen needle	19.7
Mixing insulin in a syringe (for syringe users)	30.3
Re-suspension of cloudy insulin	25.0
Single use of pen needle/syringe	19.0
Safe disposal of sharps (pen needles, syringes)	28.2

The health care professional filling out the ITQ was asked to identify themselves.

Professional	%
General Nurse	17.1
Diabetes Nurse	56.1
Diabetes Educator	22.8
Doctor (General Practitioner)	1.0
Doctor (Specialist)	3.0

These HCP were asked if they were aware that there were New Injection Recommendations that had been published and 100% said yes. They were then asked, by injection topic, what if their practice had changed as a result of these recommendations.

TOPIC	% WHO CHANGED THEIR PRACTICE
Psychological care of patients who inject	53,3
Therapeutic injection technique education	71,8
Injection site care	69,3
Insulin storage and suspension	48,8
Injecting process	62,1
The proper use of pens	53,2
The proper use of syringes	33,2
Absorption rates of differing insulin types	47,7
Needle length for children or adolescents	47,5
Lifted skin folds	59,2
Lipohypertrophy	62,7
Rotating injection sites	65,1

Bleeding and bruising at injection sites	37,9
Injections in pregnancy	33,3
Safety needles	43,0
Disposal of injecting material	49,0

This permitted a comparison of various parameters between the most recent ITQ and the two previous ones.

Parameter	1999-2000	2008-2009	2014-2015
Number of Participants	1002	4352	13,264
Number of Participating Centers	22	171	423
Number of Countries	7	16	42
Age of Participants (mean in years)	47.0	48.4	51.9
Duration of therapy (mean in years)	14.7	13.9	13.2
BMI of Participants (kg/m ² , mean)	26.5	27.3	26.6
HbA1c (% , mean)	8.0	8.1	8.5
Participants taking 4 or more injections/day	46.2%	43.9%	44.9%
Participants using Insulin Pen	78.8%	92.3%	89.6%
Participants using 8mm needle	55.0%	48.6%	29.2%
Participants using needle <8mm	9.5%	44.4%	70.8%
Participants using needle >8mm	35.5%	7.0%	0.9%
Participants injecting into Abdomen	85%	88%	90.9%
Participants injecting into Thigh	69%	59%	43.0%
Participants injecting into Buttocks	24%	16%	13.8%
Participants injecting into Arm	34%	29%	31.9%
Participants injecting using pinch up	69.4%	72.9%	63.7%
Rotation of injecting sites	38%	91%	83.9%
Prevalence of occasional bleeding or bruising	62%	61%	60.2%
Prevalence of lipohypertrophy	29%	48%*	30.8%**
Times single needle used (mean)	3.3	3.6	***
Injections sites checked on every office visit	22%	36%	28%
Needles disposed into rubbish directly	47%	38%	55%
Disposal into rubbish without recapping	22%	3.5%	6.9%
Participants desiring more education on injection technique	70%	25%	***

* patient reported (nurse found lipohypertrophy in 24%)

**nurse found

***question posed differently

In the current ITQ, the checking of sites was clearly related to what kind of patient was being cared for.

Identity	Frequency of Checking Sites
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	Routinely	Yearly	‘As Needed’	Never
Adults	26.7%	14.5%	22.8%	35.9%
Adolescents	65.1%	11.3%	12.8%	10.8%
Children	62.3%	14.1%	15.2%	8.4%

p <0.000

The frequency of checking sites was also related to whom gave the Injection Training.

Frequency of Checking Sites				
Educator	Routinely	Yearly	‘As Needed’	Never
General Nurse	407	203	445	988
%	16.0%	16.0%	22.8%	33.1%
Diabetes Nurse	1514	720	771	1024
%	59.6%	56.8%	39.6%	34.3%
Diabetes Educator	348	156	293	256
%	13.7%	12.3%	15.0%	8.6%
GP	70	56	124	212
%	2.8%	4.4%	6.4%	7.1%
Diabetologist	180	106	256	342
%	7.1%	8.4%	13.1%	11.5%
Pharmacist	16	14	43	106
%	.6%	1.1%	2.2%	3.6%
Industry	4	13	17	57
%	.2%	1.0%	.9%	1.9%
TOTAL	2539	1268	1949	2985
%	100.0%	100.0%	100.0%	100.0%

p <0.000

Patient HbA1c also differed according to whom gave the Injection Training, with the lowest values associated with the Diabetes Nurse.

Injection Instructor	HbA1c		
	Mean	SD	N
General Nurse	8.64	2.0	1237

Diabetes Nurse	8.37	1.8	3868
Diabetes Educator	8.54	2.0	934
Doctor (General Practitioner)	8.97	2.0	339
Doctor (Diabetes Specialist)	8.48	1.8	627
Pharmacist	9.10	1.9	128
A representative of the pen or needle manufacturer	8.79	1.9	83

p <0.000

The frequency of checking injection sites does not vary from males to females or from syringe to pen users, but is much more frequent in adolescents and children than in adults. Over 70% of patients with GSM have their sites checked routinely, while less than half of T1DM do and only about a quarter of T2DM. Most Diabetes Nurses check sites routinely while others (including Educators and Diabetes Doctors) rarely do. Checking sites routinely is associated with lower HbA1c levels, less LH and more correct rotation. Patients are also more likely to rotate correctly if they have received injection instruction in the last 6 months. More recent instruction is also associated with lower levels of needle reuse and fewer hospitalizations for hypoglycemia. (Data not shown but all differences statistically significant at p<0.05.)

Discussion

This survey shows that at present Injection training is done mainly by Nurses and Educators. Only 10% of patients get training from a Diabetes Doctor. Less than a third of patients have their injection sites checked at each visit. 2 out of 5 have never had their sites checked at all. The frequency of checking sites however varies enormously from country to country. Fewer than 2 out of 5 patients claim to have gotten instructions on injecting in the last 6 months. Ten percent of injectors say they have never gotten injection training. Interestingly, needle reuse is less frequent when General Nurses, Diabetes Nurses or Diabetes Educator give injection training than when Doctors, Pharmacists or representatives of Industry do it.

In a recent Italian study³ 346 patients with diabetes from 18 ambulatory centers throughout northern Italy who had been injecting insulin \geq four years received a thorough evaluation of their Injection Technique (IT). Their doctors and nurses then examined all injection sites for the presence of LH, followed by an individualized training session in which sub-optimal IT practices were addressed. All patients were taught to rotate sites correctly in order to avoid LH and were begun on 4 mm pen needles to increase potential injection sites, while avoiding intramuscular (IM) injections. Patients were also

³ G. Grassi, Scuntero P, Trepiccioni R, et al. Optimizing insulin injection technique and its effect on blood glucose control. Journal of Clinical & Translational Endocrinology 1 (2014): 145-150. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

instructed not to reuse needles. Results showed that 49% of patients had LH at study entry. After three months, patients had mean reductions in HbA1c of 0.58%, in fasting blood glucose of 14 mg/dL and in total daily insulin dose of 2.0 IU (from baseline 50.5 IU), all statistically significant at $p < 0.05$. Follow-up questionnaires showed significant numbers of patients recognized the importance of IT and were performing their injections more optimally. The majority found the 4 mm pen needle convenient and comfortable. LH prevalence did not change over the 3 months, but it would be too early to expect that. This is the first published study to show improved glucose control (both by HbA1c and fingerprick blood glucose values) from improving injection technique (IT), including switching all patients to 4 mm pen needles. The study cannot be considered definitive as there was no concurrent control group, and ~ 25% of enrolled subjects did not have a follow-up HbA1c measured. It is strongly suggestive, however.

The relationship between diabetes education and glucose control is far from simple. A recent study has suggested that education alone (including empowerment) may not be sufficient to ensure behavioral change and improved glycemic control, at least in T2DM patients managed in primary care.⁴

The Role of the Health Care Professional in Injection Education

There are currently three classes of injectable medications available for diabetes therapy: insulin, GLP-1 agents and amylin analogue^{5 6 7}. Of these only insulin is in common usage for Continuous Subcutaneous Insulin Infusion (CSII). The health care professional plays a crucial role in the optimal use of these agents. Despite more than 90 years of use, insulin injections and infusions are often performed incorrectly with adverse clinical consequences for patients and additional costs for payers. Often even simple rules are not taught or followed. Proper injection technique by patients is essential for achieving good diabetes management, reducing absorption variability and attaining optimal treatment effect^{8 9 10 11 12 13 14}. Often the most important determinant of patients' injection technique is the knowledge and commitment of their HCP.

⁴ Mujika-Zabaleta A et al. Relationship between diabetes knowledge, glycaemic control and quality of life: Pilot study. *Diabetes & Primary Care* 2010;12:376-81.

⁵ Birkebaek N, Solvig J, Hansen B, Jorgensen C, Smedegaard J, Christiansen J. A 4 mm needle reduces the risk of intramuscular injections without increasing backflow to skin surface in lean diabetic children and adults. *Diabetes Care* 2008;22: e65.

⁶ De Meijer PHEM, Lutterman JA, van Lier HJJ, van't Laar A. The variability of the absorption of subcutaneously injected insulin; effect of injection technique and relation with brittleness. *Diabetic Med* 1990;7: 499-505.

⁷ Baron AD, Kim D, Weyer C. Novel peptides under development for the treatment of type 1 and type 2 diabetes mellitus. *Curr Drug Targets* 2002;2:63-82.

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⁹ Baron AD, Kim D, Weyer C. Novel peptides under development for the treatment of type 1 and type 2 diabetes mellitus. *Curr Drug Targets* 2002;2:63-82.

¹⁰ Frid A, Gunnarsson R, Güntner P, Linde B. Effects of accidental intramuscular injection on insulin absorption in IDDM. *Diabetes Care* 1988;11:41-45.

¹¹ Vaag A, Damgaard Pedersen K, Lauritzen M, Hildebrandt P, Beck-Nielsen H. Intramuscular versus subcutaneous injection of unmodified insulin; consequences for blood glucose control in patients with type 1 diabetes mellitus. *Diabetic Med* 1990;7: 335-342.

¹² Hildebrandt P. Subcutaneous absorption of insulin in insulin-dependent diabetic patients. Influences of species, physico-chemical properties of insulin and physiological factors. *Dan Med Bull* 1991;38:337-346.

Therapeutic Education

Studies have shown that not all patients receive education about injections and for those who do, not all essential topics are covered.^{15 16 17} Essential topics include:

the injecting regimen
the choice and management of the devices used
the choice, care and self-examination of injection sites
proper injection techniques (including site rotation, injection angle and possible use of skin folds)
injection complications and how to avoid them
optimal needle lengths
safe disposal of used sharps.^{18 19 20 21 22 23 24 25}

Decisions regarding these injection parameters should be made in a discussion context where the patient is a partner and the HCP offers experience and advice.^{26 27} When educating in a group setting, there is evidence that better adherence and lower subsequent HbA1c values are achieved if the HCP has formal training as an educator.²⁸

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¹³ Johansson U, Amsberg S, Hannerz L, Wredling R, Adamson U, Arnqvist HJ, Lins P. Impaired Absorption of insulin Aspart from Lipohypertrophic Injection Sites. *Diabetes Care* 2005;28:2025-2027.

¹⁴ Frid A Linde B. Clinically important differences in insulin absorption from the abdomen in IDDM. *Diabetes Res Clin Pr* 1993;21:137-141.

¹⁵ Strauss K, De Gols H, Hannel I, Partanen TM, Frid A. A pan-European epidemiologic study of insulin injection technique in patients with diabetes. *Pract Diab Int* 2002;19:71-76.

¹⁶ Martinez L, Consoli SM, Monnier L, Simon D, Wong O, Yomtov B, et al. Studying the Hurdles of Insulin Prescription (SHIP): development, scoring and initial validation of a new self-administered questionnaire. *Health Qual Life Out* 2007;5:53.

¹⁷ Cefalu WT, Mathieu C, Davidson J, Freemantle N, Gough S, Canovatchel W, OPTIMIZE Coalition. Patients' perceptions of subcutaneous insulin in the OPTIMIZE study: a multicenter follow-up study. *Diab Tech Ther* 2008;10:25-38.

¹⁸ Davidson M. No need for the needle (at first). *Diabetes Care* 2008;31:2070-2071.

¹⁹ Reach G. Patient non-adherence and healthcare-provider inertia are clinical myopia. *Diab Metab* 2008;34:382-385.

²⁰ Genev NM, Flack JR, Hoskins PL, et al. Diabetes education; whose priorities are met? *Diab Med* 1992; 9: 475-479.

²¹ Klonoff DC. The pen is mightier than the needle (and syringe). *Diab Tech Ther* 2001;3:631-3.

²² Heinemann L, Hompesch M, Kapitza C, Harvey NG, Ginsberg BH, Pettis RJ. Intra-dermal insulin lispro application with a new microneedle delivery system led to a substantially more rapid insulin absorption than subcutaneous injection. *Diabetologia* 2006;49:755, abstract 1014.

²³ DiMatteo RM, DiNicola DD, eds. Achieving patient compliance. *The psychology of medical practitioner's role.* Oxford: Pergamon Press Inc. 1982, 233-256.

²⁴ Joy SV. Clinical pearls and strategies to optimize patient outcomes. *Diabetes Educator* 2008;34:54S-59S.

²⁵ Seyoum B, Abdulkadir J. Systematic inspection of insulin injection sites for local complications related to incorrect injection technique. *Trop Doct* 1996;26:159-161.

²⁶ DiMatteo RM, DiNicola DD, eds. Achieving patient compliance. *The psychology of medical practitioner's role.* Oxford: Pergamon Press Inc. 1982, 233-256.

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We believe that our overall survey gives a detailed, up-to-date and representative view of injecting practice in the most commonly-used diabetic health care facilities in the world. We further believe that it lays the groundwork for new recommendations concerning best practices for patients, guides the care and education strategies for HCP and provides a road map for improving diabetes care to public health professionals and government officials worldwide.

Duality of interest:

Kenneth Strauss is employed by BD, a manufacturer of injecting devices.

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