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## Knowledge, Attitude and Practices Amongst Subjects with Diabetes on Insulin Therapy: A Need to Bridge the Gap

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**Keywords:** *diabetes mellitus; insulin injection technique; knowledge; attitude; practices.*

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# Knowledge, Attitude and Practices Amongst Subjects with Diabetes on Insulin Therapy: A Need to Bridge the Gap

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**Keywords:** diabetes mellitus; insulin injection technique; knowledge; attitude; practices.

## I. INTRODUCTION

Type 2 diabetes mellitus is a multi-systemic disease with multi-factorial etiology and needs multi-disciplinary approach. Due to the slowly progressive beta-cell failure, up to 50% of the beta cells are not functioning adequately at diagnosis itself <sup>(1)</sup>. The beta-cell failure continues further, at a rate of about 4% each year <sup>(2)</sup>. Therefore, most patients with type 2 diabetes will require stepwise intensification of anti-diabetic therapy to achieve good glycemic control. According to the UKPDS data, each therapeutic agent increases the proportion of patients attaining HbA1c

below 7%, (53 mmol/ mol) by 2 to 3 fold. But, only 50% of patients can maintain this goal after 3 years, and by 9 years only 25% can maintain glycemic control with the same drugs. Hence, it has been suggested that over a period of time, majority of patients will need addition of insulin therapy to attain an HbA1c level below 7% (53 mmol/ mol) <sup>(3)</sup>.

Insulin is the oldest of the anti-diabetic medications available and hence has the most clinical experience. It is also the most effective agent in lowering hyperglycemia, since it can decrease any level of elevated HbA1c to the therapeutic goal, when used in appropriate doses. There is no maximum dose of insulin beyond which therapeutic effect will not occur <sup>(4)</sup>. Despite of these advantages, there is significant delay in transitioning from oral agents to insulin therapy in most subjects with type 2 diabetes and insulin remains an underutilized tool for achieving glycemic control <sup>(5)</sup>.

Amongst patients on insulin therapy, many patients continue to have elevated HbA1c levels and experience years of uncontrolled hyperglycemia. This is attributable to several obstacles in designing and implementing suitable insulin therapy. These obstacles could be physician related, patient related or even health care system related <sup>(6)</sup>. Many studies have revealed poor knowledge, attitude and practices among subjects with type 2 diabetes on insulin therapy. It appears that there is a lot of scope for improvement in subjects with diabetes' approach towards insulin therapy. Insulin injection technique is one of the most common areas with likelihood of errors and it is imperative to look at these factors for formulating a strategy of optimising insulin therapy.

### a) Objectives

1. To assess the knowledge, attitude and practice (KAP) of subjects with diabetes who were self-administering insulin.
2. To assess the impact of KAP factors on their glycemic control.

## II. MATERIALS AND METHODS

A cross-sectional study was conducted in the outpatient department of Karnataka Institute of Endocrinology and Research, Bangalore from 1<sup>st</sup> January

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to 31<sup>st</sup> August 2015, through questionnaire based interview of 448 subjects with diabetes who were self administering insulin as a part of their diabetic therapy. The study was approved by the ethical committee of the hospital. The patients consent to participate in the study was taken, after the nature of the study was explained to them.

Subjects with diabetes, of any age and duration of diabetes, on insulin therapy and willing to participate in the study were included in the study. Patients who were not physically or mentally able to respond to the interview were excluded. The interviews with the patients were conducted by the diabetic educators cum nutritionists in our hospital. The questionnaire contained 33 questions, focussing on the type of insulin regimen, drug compliance, insulin storage, timing of insulin injection in relation to meal, insulin injection site rotation, etc. In addition to KAP data, we collected demographic data including gender, age, occupation, educational status, duration of diabetes, duration of insulin use, and level of glycemic control.

### III. STATISTICAL ANALYSIS

Data was entered into microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Chi-square was used as the test of significance. Independent t test was used as the test of significance for quantitative data. Continuous data was represented as mean and standard deviation. P value <0.05 was considered as statistically significant.

### IV. RESULTS

In the study, 95.5% of subjects had type 2 diabetes and 4.5% had type 1 diabetes. Mean age of the subjects in the study was  $55 \pm 10.78$  years. Mean age of type 1 DM subjects was  $15.95 \pm 10.78$  years and Type 2 DM subjects was  $56.82 \pm 11.66$  years. Significant number of subjects (44.9%) were in the age group of above 60 years. 61.38% of the subjects were male and 38.62% of the subjects were females. 36.4% of the subjects had duration of diabetes between 10 to 20 years; followed by duration between 5 to 10 years. 34.8% of the subjects were using insulin for < 1 year, while 33.9% between 1 to 5 years and 31.3% for > 5 years. Regarding the type of insulin used, 8.04% of the subjects were using basal insulin, 8.48% were using bolus insulin, 81.47% were using premixed insulin and 6.03% were using basal-bolus insulin. 82.6% of the subjects were using conventional insulin, 13.2% were using analogue insulin and 4.2% were using combination of conventional and analogue insulin. With respect to the insulin device used, 64.7% of the subjects were using insulin syringe, 33.5% were using insulin pen and 1.8% were using both. Mean HbA1c of subjects in the study was  $9.91 \pm 1.97$ . Among type 1 diabetics, mean HbA1c was  $10.85 \pm$

2.76% and among type 2 diabetic mean HbA1c was  $9.86 \pm 1.91\%$ . This difference in mean HbA1c between Type 1 and Type 2 DM subjects was statistically significant. 81.4% of the subjects had HbA1c >8% (64 mmol/ mol). Only 5.7% of the subjects had HbA1c <7% (53 mmol/ mol). Regarding education status of the patients, 14.1% had education up to primary school, 27.5% had education up to high school, and 12.7% had studied up to PUC / diploma, 23.7% were graduates and 22.1% were illiterate. 99.8% of subjects in the study were right handed and 17.9% of subjects had abnormal vision (Table 1).

In the study, 86.4% of subjects had obtained knowledge about insulin injection technique from trained professionals. Positive attitude regarding insulin therapy was seen in variable number of patients for different practices associated with insulin use. 91.2% subjects' verified the expiry date of insulin before use. 92.9% of subjects checked the name and type of insulin before use. 78.5% of subjects stopped using the insulin vial/ cartridge after one month of initiation and 21.5% of subjects continued to use the same insulin even after one month of initiation. Of the 297 subjects using syringes for insulin injection, 86.9% were using corresponding syringe with insulin, while 13.1% were using wrong syringes. 96.6% of the subjects were injecting insulin directly on the skin while rest were injecting often through clothing. 40.2% of the subjects reported that they were avoiding insulin injections at social gatherings and outings. Almost 49.4% of subjects felt that insulin injections are painful. Local reactions like lumps/discoloration/abscess at the injection site were noted by 32.1% of subjects (Figure 1).

With respect to the practices, 94.9% of the subjects were taking insulin regularly. 70.5% of the subjects were self injecting insulin and 85.4% were rotating the sites of injections regularly. 50.7% of the subjects used the pinch up technique and folded the skin between thumb and index finger while taking insulin injection. Only 32.2% of subjects waited 10 sec before withdrawing the needle. 25.2% of the subjects were taking insulin after meal. Only 20.1% of the subjects adjusted the insulin dose by self. Surprisingly, 1.5% of the subjects shared their insulin vials and pens (Figure 2).

71.4% and 54.8% of the subjects stored insulin in refrigerator when not in use and when in use respectively. 73.4% of the subjects preferred storing insulin in handbag while travelling. 58.9% of the subjects used insulin immediately after taking it out of the refrigerator. Most common sites used for insulin injection were thigh (53.1%), then upper arm (43.3%) and anterior abdomen (40.8%). Atleast 15.4% of the subjects used non-recommended sites for injection including inner thigh, around the umbilicus, hip, groin, calf muscle area, close to the knee, inner arm, forearm and hand. 57.2% of the subjects used clean site for insulin injection while 31.12% used spirit swab to clean the injection site. Only 45.91% of the subjects used 90 degree angulation for insulin injection, while 31.56% used 45 degree angulation

and 17.05% used 30 degree angulation. Among 412 subjects who used conventional insulin, 42.72% of them maintained a injection- meal gap of 11 to 20 minutes and only 8.33% maintained a gap of 20 -30 minutes between injection and meals. Out of 36 subjects who used analogue insulin, 27.78% injected within 10 minutes and 27.78% took injection immediately after meal. 98.2% of the subjects discarded insulin syringes in general waste (Table 2).

## V. DISCUSSION

Right injection technique is instrumental in making insulin therapy comfortable and acceptable to subjects with diabetes and also in achieving good glycemic control. Hence, it is essential to guide the patients on using insulin therapy with minimal discomfort and maximum benefits. The forum for injection technique, India has developed evidence based recommendations for the right insulin injection technique, to assist healthcare providers in guiding their patients. Apart from compliance with therapy and regular insulin dose titration, the forum has identified injection site selection, depth of injection, angulation of injection, time lapse before withdrawing the needle and time gap between injection and meals as some of the modifiable factors influencing the success of insulin injection therapy <sup>(7)</sup>.

Studies from different countries have demonstrated that diabetes knowledge, attitude and practices (KAP) are poor among subjects with diabetes, especially regarding insulin therapy. Different studies have looked at different aspects of KAP and used different scales of measurement of KAP. In a cross-sectional study (n -150) in North Western Ethiopia, 30.7% of the patients reported that they had missed their insulin due to different reasons at different times <sup>(8)</sup>. Another study of 575 subjects with diabetes in UAE showed that 57% had HbA1c levels reflecting poor glycemic control, while 10% admitted non-compliance with insulin therapy <sup>(9)</sup>. A multinational survey of 1530 insulin-treated patients showed that 33.2% of patients reported insulin omission at least 1 day in a month, with an average of 3.3 days. The most common reasons for insulin omission included being busy, travelling, skipping meals, stress and public embarrassment <sup>(10)</sup>. However, not many studies have been conducted to evaluate the errors in insulin injection technique.

Our findings show that there is gap in knowledge, attitude and practices amongst subjects with diabetes on insulin therapy. In our study, subjects with duration of diabetes more than atleast 5 years, were on insulin therapy. The study population consisted of subjects on insulin therapy for short and long duration equally. Despite of insulin therapy, the glycemic control was poor in most patients and only 5.7% of the subjects had HbA1c <7%. This can be explained by the fact that most of the respondents were patients visiting our

institute for the first time and the reason for their visit was poor glycemic control.

In our study population, premixed insulin was the most commonly used insulin regimen, conventional insulin was the commonest insulin used and insulin syringe was the commonest device used. It appears that exploring the use of multi dose insulin regimen, insulin analogues, and pen devices more frequently may contribute to better glycemic control.

Despite of injection technique training by professionals, subjects were found to be committing many errors in insulin injection technique. Usage of non corresponding syringes (100 IU syringe with 40 IU insulin and vice versa) was seen in significant number of subjects. This is due to the fact that patients don't have any knowledge of different types of syringes and their appropriate usage. Also, pharmacies dispense syringes without verifying the type of insulin being used by the patient. There have been instances when patients have drawn insulin from insulin penfills using 40 IU syringes. This obviously leads to erroneous dose delivery. Hence, clinicians should spend some time in educating their patients on the usage of corresponding syringes and vials and also verify at regular intervals if patients are following it. Delaying/ skipping insulin in social gatherings and outings, missing insulin often, taking insulin after meals, was noted in significant number of subjects. This can be minimised by counselling about the importance of each dose of insulin and how it can affect their overall glycemic control. Maintenance of time gap between the injection and meal was also not strictly followed both for conventional and analogue insulin. This shows that the knowledge about time for onset of action of each insulin should be provided to the subjects, so that they maintain the time gap everytime they take insulin injection. Rotating the site of insulin injection, use of pinch up technique, waiting for 10 seconds before withdrawing the needle, were not being followed in small number of subjects. Patient training in this aspect can reduce the pain associated with insulin injection and also maximise the insulin absorption. Shockingly, a small percentage of subjects' shared the pen device with spouse, changing only the needle. This emphasises the importance of highlighting about not sharing delivery device/ insulin between individuals on insulin therapy. Last but not least, most of the subjects disposed insulin waste in general waste. This is happening because many people in India do not have access to medical waste disposal system. Our subjects were educated to store the disposables in a container and deliver it to nearest hospital for disposal. Yet, there is urgent need for establishing better medical waste disposal method by the public waste disposal system.

Nearly half of the subjects found insulin to be painful and also reported local site reactions like lumps, discoloration, and abscesses. This provides evidence that measures to reduce the pain associated with insulin

therapy and avoid local injection site reaction must be provided by the health care providers. Self titration of insulin dose was infrequently done in this study population. This highlights the need for patients on insulin therapy to be educated about self titration of insulin dose, so as to achieve rapid glycemic control. Therefore, it appears that initiating insulin therapy is just the beginning of a long journey of continuous monitoring and modification. Paying attention to the above modifiable factors in insulin injection technique will go a long way in achieving maximum benefit from insulin therapy.

## VI. CONCLUSIONS

Our study has found several errors in insulin injection technique that makes the insulin injection painful, reduces patient compliance, prevents optimal utilisation of insulin therapy and also adversely effects glycemic control. The study confirms the need for pre-injection counselling, frequent reassessment of injection technique, and correction of errors in the insulin injection technique. Every clinician caring for diabetic patients must acknowledge, address, and alleviate these factors for achieving optimal success with insulin therapy.

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Tables & Figures:

Table 1: Baseline Characteristics of the study population

Characteristic		Frequency			Percent	
Type of DM	Type 1 Diabetes	20			4.5	
	Type 2 Diabetes	428			95.5	
Age	< 39 years	61			13.6	
	40 to 49 years	48			10.7	
	50 to 59 years	138			30.8	
	> 60 years	201			44.9	
Mean Age (Mean ± SD)		55 ± 14.36 years				
Mean Age Type 1 Diabetes (n =20)		15.95 ± 10.78 years				
Mean Age Type 2 Diabetes (n =428)		56.82 ± 11.66 years				
Gender	Male	275			61.38	
	Female	173			38.62	
Duration of Diabetes	< 1 year	47			10.5	
	1 to 5 year	68			15.2	
	5 to 10 year	115			25.7	
	10 to 20 years	163			36.4	
	> 20 years	55			12.3	
Education	Illiterate	99			22.1	
	Primary School	63			14.1	
	High School	123			27.5	
	PUC and Diploma	57			12.7	
	Graduate and Above	106			23.7	
Duration of insulin use	< 1 year	156			34.8	
	1 to 5 years	152			33.9	
	> 5 years	140			31.3	
Insulin regime used	Basal only	36			8.04	
	Bolus only	38			8.48	
	Pre mixed	365			81.47	
	Basal -Bolus	27			6.03	
Type of insulin used	Conventional	370			82.6	
	Analogue	59			13.2	
	Conventional + Analogue	19			4.2	
Insulin device used	Insulin Syringe	298	64.7	40 IU	290	97.3
				100IU	8	2.7
	Insulin pen	150	33.5	Refillable	99	62.6
				Disposable	59	37.4
HbA1c (n- 366)	< 7	21			5.7	
	7 to 8	47			12.8	
	> 8	298			81.4	
Handedness	Left	1			0.2	
	Right	447			99.8	
Vision	Abnormal	80			17.9	
	Normal	368			82.1	

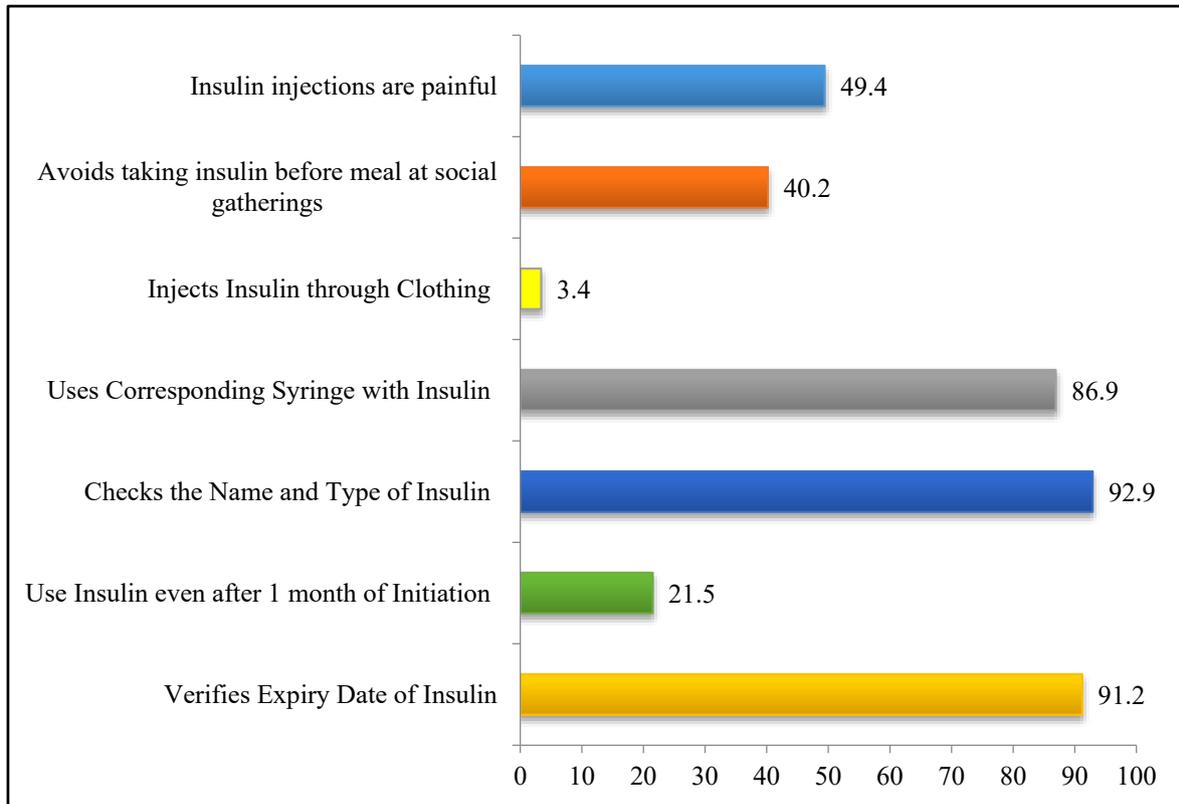


Figure 1: Bar diagram showing attitude of diabetic subjects towards insulin injection technique

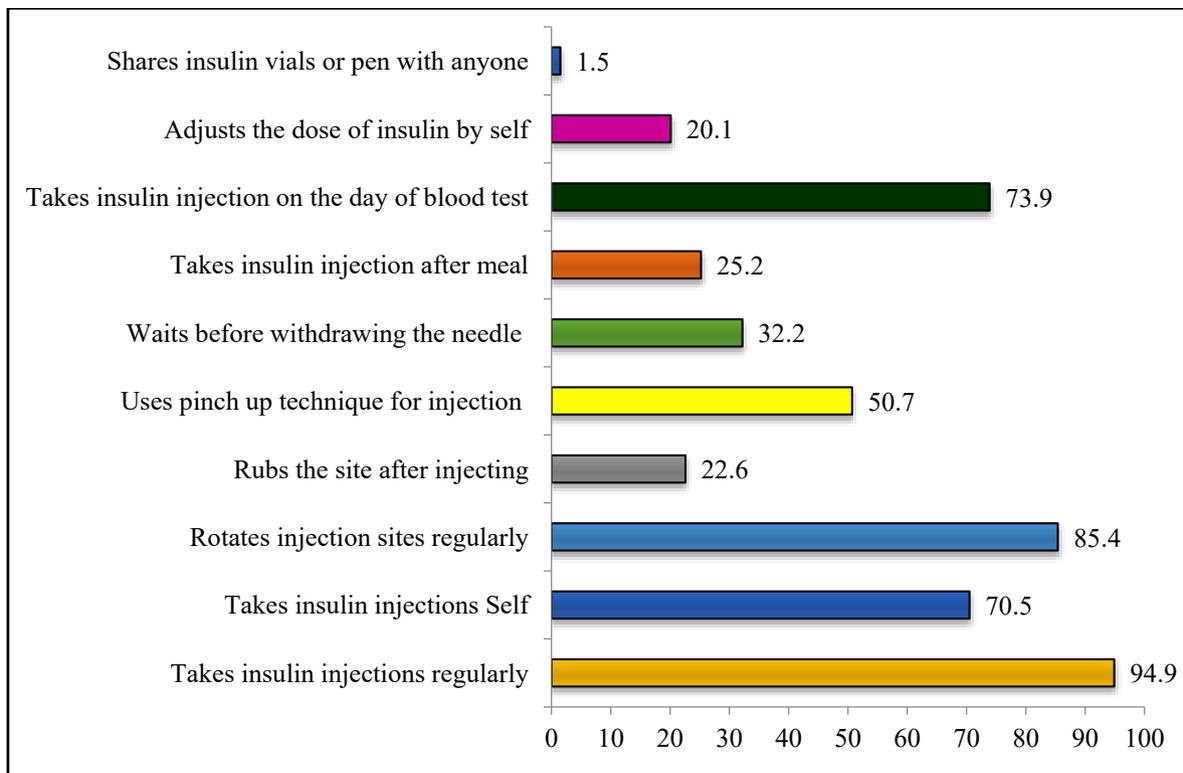


Figure 2: Bar diagram showing practices among diabetic subjects with respect to insulin injection technique

Table 2: Insulin storage, injection procedure and other aspects of injection technique

Parameter	Method	Number (Percentage)
Storage of insulin pens and insulin vials when not in use	Refrigeration	320 (71.4)
	Water Filled Earthen Pitcher	43 (9.6)
	Room Temperature	43 (9.6)
	Freezer	6 (1.3)
	Others	4 (0.9)
	NA	32 (7.1)
Storage of insulin pen in use	Refrigerator	102 (54.8)
	Room Temperature	84 (45.2)
Storage of insulin device while travelling	Hand bag at room Temperature	332 (73.4)
	Inside Water Bottle	33 (7.4)
	Icepack	25 (5.6)
	Others	52 (11.6)
Time for which refrigerated insulin vials are kept at room temperature before injecting. (n- 292)	Use Immediately	172 (58.9)
	< 5 min	40 (13.7)
	10 to 20 min	61 (20.8)
	> 30 min	19 (6.5)
While mixing NPH/ regular insulin, which insulin is drawn in to the syringe first?	NPH	1 (11.2)
	Regular	8 (88.8)
Site of injection	Anterior Abdomen	183 (40.8)
	Upper Arm	194 (43.3)
	Thigh	238 (53.1)
	Others	69 (15.4)
How injection site is cleaned	Don't bother much	28 (6.41)
	Use Spirit Swab	136 (31.12)
	Uses Clean Site	250 (57.21)
	Wash With Water	23 (5.26)
Angulation used while injection	90	202 (45.91)
	45	138 (31.36)
	30	75 (17.05)
	Others	25 (5.68)
Injection and meal time gap (Conventional, n = 412)	≤ 10 min	42 (10.19)
	11 to 20 min	176 (42.72)
	21 min to 30	104 (25.24)
	> 30 min	15 (3.64)
	Immediately after meal	69 (16.75)
	Not known	6 (1.46)
Injection and meal time gap (Analogues, n = 36)	≤ 10 min	10 (27.78)
	11 to 20 min	2 (5.56)
	21 min to 30	3 (8.33)
	> 30 min	0 (0.00)
	Immediately after meal	10 (27.78)
	Not known	11 (30.56)
Disposal of used insulin syringes, needles or pens	General Garbage	440 (98.2)
	Medical Waste	8 (1.2)

