Research Article

KNOWLEDGE OF USE OF INSULIN AMONG PATIENTS OF TYPE 2 DIABETES MELLITUS

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ARTICLE INFO	ABSTRACT
	Introduction: Insulin is essential for the normal carbohydrate, protein and fat metabolism in the body. There has been emphasis on early initiation of Insulin in routine diabetes care. Insulin therapy presents many challenges due to complexities associated with its intricate use. An inadequate knowledge of its use can result in preventable complications, adverse patient outcome, poor adherence to therapy and invariably poor glycaemic control. This study aimed at determining the level of awareness among the Insulin taking populations, both urban and rural, about Insulin and the methods of Insulin administration, storage and disposal of syringe. **Method:** This study was a cross-sectional study conducted on100 participants with Type 2 diabetes mellitus (T2DM) who took inpatient or outpatient care under Department of General Medicine, St Johns' Medical College Hospital, Bangalore, India. A self-administered standardized questionnaire was used to collect the data. The tool assessed knowledge on administration, storage, usage and disposal of Insulin or insulin syringe. With proportions, mean & standard deviation, details of knowledge of insulin use was classified as Adequate and Inadequate knowledge. **Result:** The hundred participants consisted of 59 males and 41 females who were present in a tertiary care hospital in Bangalore, south India. The majority of population belonged to urban/ peri-urban background. Most participants 57(57%) were found to have inadequate knowledge with regard to administration, storage and usage of Insulin. Poor disposal technique was present among 82% of the study population. **Conclusion:** The knowledge regarding Insulin use - administration, storage, usage and disposal among the Insulin using participants was inadequate, indicating the need for better awareness programs by health care professionals before starting insulin among patients.

INTRODUCTION

The number of patients with diabetes had risen from 108 million in 1980 to 422 million in 2014[1]. According to an official WHO estimate, it has been estimated that the total global population of Diabetes in the year 2000 was 171 million and this is expected to increase by over 100% and by the year 2030, it is estimated to be 366 million[2].India contributed in a large way to these estimates where in the year 2015 it was estimated by IDF (International Diabetes Federation, Atlas 2015) that India stood at 78.3 million patients and this too is expected to rise by over 100%[3]. Since the discovery of hypoglycaemic effects of Insulin in 1921 by Banting and Best, the hormone has been studied in great detail. Insulin is believed to improve glycaemic control by increasing glucose uptake in the muscle and inhibiting hepatic glucose production[4]. Insulin therapy is recommended for all patients with Type 1 diabetes mellitus. However, for patients with T2DM, Insulin is initiated when glycaemic control is not achieved with oral anti-diabetic drugs.

Insulin has been recognized as the ideal treatment for diabetes mellitus and has to be administered in the injectable form. There has been a stimulus in recent times for early initiation of Insulin in routine diabetes care[5].A research conducted in Northern Ireland on Insulin knowledge and practice: a survey of district nurses stated that approximately 30% of people diagnosed with diabetes in the UK used injectable form of Insulin. This study also brought to light the deficits in knowledge of practice of Insulin administration with regard to Insulin dosage, storage, injection site, technique relating to rotation of injection site [6].

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Insulin therapy presents many challenges due to complexities associated with its intricate use. A sufficient knowledge of its use can help prevent complications, adverse patient outcome, poor adherence to therapy and invariably poor glycaemiccontrol[7]. Appropriate injection technique is fundamental for proper delivery to subcutaneous tissues and to prevent intramuscular injuries and lipohypertrophy[8]. The American Diabetic Association formulated a set of guidelines for insulin storage, mixing of insulin, proper use of insulin syringe and other considerations[9].

Insulin, though recognized as the ideal treatment for T2DM, studies reported lack of knowledge and coordination among the doctors (general medicine and specialists) and patients[10,11] about insulin use. However, no such study has been done in India which focuses on the knowledge and practice of insulin administration, storage and disposal of needles. Therefore, this studywas conducted to determine the level of awareness among the Insulin taking populations, both urban and rural populations, about Insulin and the methods of Insulin administration, storage and disposal of Insulin syringes.

METHODOLOGY

This was a cross sectional study which included a total of 100 participants. The study was conducted in a Tertiary Health Care Centrein Bangalore over a period of three months(1st April - 30th June, 2016). Both inpatients and outpatients from urban and rural background, diagnosed to have T2DM and on Insulin (months to years) were included in the study. Ethical approval was obtained from the St. John's Medical College Institution Ethics Committee (IEC Study Ref. No. IEC/123/2016). Patients diagnosed withT2DM on Insulin therapy were recruited in this study. A written informed consent was obtained from the participants prior to the interview.. Vulnerable groups like children, pregnant women and terminally ill were not included due to varied physiological and pathological status that could hinder the results of our study.` A face validated semi structured questionnaire was formulated and collected data on demography, details on T2DMtreatment, insulin knowledge and practice. Based on a study done by S.Gremer *et al*[12]we assumed that 53% of the population had adequate knowledge with a p=53, alpha error of5% and d=55, a sample size of 96 was deduced but a total of 100 patients were recruited.

Data collected were entered in Microsoft excel and analysed using descriptive statistics such as frequency, mean and standard deviation. Chi Square test was used to assess associations and p value less than 0.05 was considered significant. Data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 16.0.The proforma was divided and a scaling system was deduced where in a subject answering ≥8 questions out of a total of 11 essential questions was categorised to have adequate knowledge.

RESULTS

This study included a total of 100 patients of which 59 were males and 41 were females. Majority of the subjects were <60 years of age(52%) with a mean duration of insulin therapy of 12 years. The majority of the population belong to urban/ peri-urban background. The responses to clinical parameters of the proforma are represented in Table1.

Table 1 Responses to self-administered Proforma on Knowledge and Practices on Insulin use.

	N=100
Gender:	
Men	59(59)
Women	41(41)
Duration of insulin administration:	
<1 year	27(27)
1-5 years	25(25)
5-10 years	20(20)
>10 years	28(28)
Type of Insulin	
Regular/ rapid acting	51(51)
Regular + long acting	29(29)
Long acting	0(0)
Mixed insulin	20(20)
Storage of insulin	
Refrigerator	81(81)
Pot of water	9(9)
Pen case	5(5)
Kept outside	5(5)
Mix insulin	
Yes	12(12)
No	88(88)
Mixing method:	
No mixing	88(88)
Clear first	7(7)
Cloudy first	5(5)
Mixing of Insulin On doctor's advice:	
Yes(Both clear and cloudy)	12(12)
No	88(88)
Mixing the Clean and Cloudy Insulin adequately just before use:	
Yes	8(8)
No	92(92)
SelfAdministration	
a. Medical personnel	54(54)
b. Non-medical personnel	1(1)
Assisted Administration	
a. Medical personnel	22(22)
b. Non-medical personnel	23(23)
Use of Insulin pen:	
Yes	18(18)
No	82(82)
Administration Before food	
Immediately	27(27)
5min	14(14)
10min	23(23)
15min	17(17)
20min	10(10)
30min	9(9)
Regularity:	
Regular	91(91)
Irregular	9(9)
Wipe injection site:	

Yes	47(47)
No	53(53)

Clean injection site with:	
Did not clean the site of injection	53(53)
Cotton only	22(22)
Sprit only	1(1)
Both spirit and cotton	24(24)

Alternate injection sites:	
Yes	84(84)
No	16(16)

Skin pinch while administration:	
Yes	73(73)
No	27(27)

Inject at 90 degrees:	
Yes	72(72)
No	28(28)

Wait for 10 seconds before withdrawing the needle out after administration of Insulin:	
Yes	35(35)
No	65(65)

Check for expire date:	
Yes	85(85)
No	15(15)

Check for potency:	
Yes	61(61)
No	39(39)

Shake the vial/Insulin preparation before use:	
Yes	86(86)
No	14(14)

Bring to room temperature before use:	
Yes	65(65)
No	35(35)

Disposal of needle:	
General waste	73(73)
Separate bin	18(18)
Throw outside	9(9)

Table 2 Association of adequate practice and demography.

	Inadequate Practice	Adequate Practice	P Value
Adequate practice and Diabetes Mellitus			
Diabetes Mellitus type 2 N=100	57(100)	43(100)	
Adequate practice and gender:			
Male N=59	33(57.9)	26(60.5)	
Female N=41	24(42.1)	17(39.5)	Chi Square test=0.796
N=100	57(100)	43(100)	
Adequate practice and Education			
Primary (<5std) N=51	32(56.1)	19(44.2)	
Secondary (5-13std) N=31	18(31.6)	13(30.2)	Chi Square test=0.211
Graduate(>13std) N=18	7(12.3)	11(25.6)	
N=100	57(100)	43(100)	
Adequate practice and Age			
<40 N=10	5(8.8)	5(11.6)	
41-50 N=11	7(12.3)	4(9.3)	Chi Square test=0.863
50-60 N=31	20(35.1)	11(25.6)	
61-70 N=28	14(24.6)	14(32.6)	
71-80 N=17	9(15.8)	8(18.6)	
>80 N=3	2(3.5)	1(2.3)	
N=100	57(100)	43(100)	
Adequate practice and duration of insulin use			
<1 year N=27	12(21.1)	15(34.9)	
1-5 years N=25	14(24.6)	11(25.6)	Chi Square Test=0.102
5-10 years N=20	16(28.1)	4(9.3)	
>10years N=28	15(26.3)	13(30.2)	
N=100	57(100)	43(100)	
Adequate practices and assisted administration			
Self N=55	37(64.6)	18(41.9)	
Medical assistant N=22	7(12.3)	15(34.9)	Chi Square test=0.018
Nonmedical assistant N=23	13(22.8)	10(23.3)	
N=100	57(100)	43(100)	

Table 2 shows that majority of study participants had inadequate Insulin practice. Gender, Education, Age and duration of Insulin use is not associated with the chance of having adequate practice of Insulin administration. We found that self-administration of Insulin was significantly associated with having adequate practices(P=0.018).

Table 3 Disposal of syringe and Number of times needle reused

Disposal of syringe and number of times needle reused			
	General waste	Separate container	Throw outside	P Value
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Single use N=14	6(8.2)	8(44.4)	0(0)	
2-5 times N=44	33(45.2)	7(38.9)	4(44.4)	Chi square test=0.008
6-10 times N=22	18(24.7)	1(5.6)	3(33.3)	
11-20 times N=18	15(20.5)	1(5.6)	2(22.2)	
>20times N=2	1(1.4)	1(5.6)	0(0)	
N=100	73(100)	18(100)	9(100)	

Table 3 shows that 73% of the study participants threw their Insulin syringe in the General waste and 53.4% of the participants reused their needles <5 times which was significant (p = 0.008).

Table 4 Education level and duration of Insulin use

	Primary (<5std)	Secondary (5-13std)	Graduate (>13std)	P Value
Education and how long on insulin use				
<1 year N=27	8(15.7)	9(29.0)	10(55.6)	
1-5 Years N=25	15(29.4)	4(12.9)	6(33.3)	
5-10 Years N=20	14(27.5)	5(16.1)	1(5.6)	Fisher's Exact Test=0.003
>10 Years N=28	14(27.5)	13(41.9)	1(5.6)	
N=100	14(27.5)	31(100)	18(100)	

Table 4shows that level of educational qualification ie being a graduate and above was significantly associated with being on Insulin therapy (p = 0.003)

Table 5

	<40 Years	41-50 Years	51-60 Years	61-70 Years	71-80 Years	>80 Years	P Value
Age and Self Administration							
YesN=56	8(80.0)	10(90.9)	16(51.6)	12(42.9)	8(47.1)	2(66.7)	Fisher's
NoN=44	2(20.0)	1(9.1)	15(48.4)	16(57.1)	9(52.9)	1(33.3)	Exact
N=100	10(100)	11(100)	31(100)	28(100)	17(100)	3(100	Test=0.044

Tabel 5 shows that need of an assistant for administration of Insulin significantly increased as the age of the subject increased more than 60 years.

Table 6

	Single us	2-5 times	6-10 times	11-20 times	>20times	P Value

Number of times needle reused and Leave for 5-10 seconds					
YesN=35	10(71.1)	17(38.6)	4(18.2)	4(22.2)	0(0)	Fisher's Exact Test=0.008
NoN=65	4(28.6)	27(61.4)	18(81.8)	14(77.8)	2(100)	
N=100	14(100)	44(100)	22(100)	18(100)	2(100)	

Number of times needle reused and Method of cleaning injection site					
Do not wipe N=53	3(21.4)	26(59.1)	10(45.5)	14(77.8)	0(0)	
Cotton N=22	5(35.7)	9(20.5)	5(22.7)	1(5.6)	2(100)	
Spirit N=1	0(0)	0(0)	0(0)	1(5.6)	0(0)	Fisher's Exact Test=0.011
Cotton and spirit N=24	6(42.9)	9(20.5)	7(31.8)	2(11.1)	0(0)	
N=100	14(100)	44(100)	22(100)	18(100)	2(100)	

Table 6. shows that reusing of needles for injection >6 times was significantly associated with failure to wipe the injection site and failure to wait as per the WHO guidelines of 10seconds before withdrawing the needle from the body.

Table 7 Multiple sites of administration

Multiple sites		
		N=100
Multiple site	Abdomen	28(28)
	Thigh	8(8)
	Abdomen and thigh	13(13)
	Arm	20(20)
	Arm and abdomen	12(12)
	Arm and thigh	8(8)
	Abdomen, thigh and arm	11(11)

Table 7 shows that abdomen was the most common site of Injection.

Table 8 Storage of insulin and Bringing to room temperature before injection

Storage of insulin and Bringing to room temperature			
	Refrigerator	Other	P Value
YesN=65	58(71.6)	7(36.8)	Chi Square
NoN=35	23(28.4)	12(63.2)	test=0.004
N=100	81(100)	19(100)	

Table 8 shows that only 58(71.6%) of the participants who stored their Insulin vials brought the Insulin vial to room temperature before administering the drug into the body.

DISCUSSION

Being one of the very few studies on the subject, we had very few studies to compare our results with. This study indicates that only 43% of the subjects had adequate knowledge about Insulin use. Only 10 subjects in the study population had excellent knowledge and practices and got the maximum score possible. A study done by Gremer et. al. concluded that only 2% of the subjects were found to be have proper knowledge of insulin[12]. Another study from Karachi, Pakistan showed that 75% of the insulin taking population didn't even know the basic information about insulin administration like the dosage[13]. A Mexican study showed that the overall knowledge about diabetes and its treatment in T2DM patients was low[14].

Our study results were compared with guidelines from - 'The Consensus' study[15,16,17] which included the findings of the International Technique Proforma-ITQ[16] study and Indian Injection Technique study-IIT study[17].Our study looked into various aspects of knowledge in insulin practice among the study participants. It was seen that 28(28%) patients on insulin had adequate knowledge and had adopted this for a period of greater than 10years (Mean-12.02years) which was similar to the ITQ study[16]. Similarly, almost an equal number of patients were on insulin for less than 1 year27(27%).Our patients were

on either Regular or Rapid acting insulin (51%).Long acting Insulin was coupled with rapid acting Insulin in 29(29%) subjects and long acting Insulin was not preferred as the sole mode of Insulin administration. Refrigeration (81%) was the preferred method of Insulin storage. When compared to a similar study done by Geoffry et al[18], which showed other methods of Insulin storage such as clay pot (Tropical countries), it was similarly seen that there were other modes of storage such as pot of water (9%), pen cases (5%) and keeping outside at atmospheric temperature (5%)

Only 12(12%) mixed their insulin before administration - seven subjects mixed the clear insulin first as per guidelines and the other five mixed the cloudy insulin first. It was noticed that both these categories i.e. all 12(12%) participants mixed their insulin after consultation with a doctor. Only 8(8%) participants followed guidelines and mixed their insulin immediately before administration. Self-administration was followed by 55(55%) subjects of which 54(54%) did so with the guidance of a medical personnel. Among the 45(45%) participants who required an assistant to administer insulin into their bodies, 23(23%) did so with the help of a nonmedical personnel which was almost equal to the 22(22%)subjects who did so with help of a medical personnel.

Good compliance with Insulin therapy was seen in 91(91%) participants. Site of Insulin injection in order of frequency was abdomen (40.1%), arm (33.5%) and thigh (26.6%);no one administered Insulin over the buttocks possibly due to cultural beliefs similar of the IIT[17]and ITQ study[16]. Risk factors such as not wiping the site on infection was seen in 53(53%) of our participants. Out of the47% who did wipe the site of injection, only 24% used cotton and spirit (as per guidelines) and the remaining 22(22%)subjects used only cotton and one subject poured spirit on the site.

When looked into practice of alternating the site of injection, it was seen that 84(84%) of our participants alternated the site of injection similar to that of IIT study (83.9%). A good skin pinch was taken by 73(73%) of participants which was again similar to the IITstudy (79.6%)[17] and little more compared to ITQ study (63.7%)[16]. It was also found that 72(72%) participants injected at 90 degree similar to IIT study (84.9%)[17].

A small portion (35%) of participants waited for 10 seconds at the site of injection with the needle in-situ before the needle was withdrawn from the body similar to the ITQ and the IIT studies(ITQ-29.3%; IIT-31.8%)[16,17]. Expiry date was checked by 85% of the participants before use of Insulin vials. Only 61% checked for potency before use, 86% participants used to shake the preparation of insulin as per guidelines before use and 65% brought their preparation of insulin to room temperature after removing insulin from refrigerator or other storage places.

When looked into various associations, it was found that gender did not play a role in having adequate practice (p>0.05) which is similar to a study done by A Jabbar et al[13]. Although not statistically significant, good educational status had its effect on having a better chance of having adequate practice probably due to understanding of the complications following poor injection technique that was better in the graduate group in our study, similar to the findings reported by Das and Chaudhury et al[19]. It was seen that primary education

participants were on insulin for a period of more than 10 years (27.5%, p=0.003). Though it cannot be concluded from this study, this could be due to failure in going to regular check-ups, not following advised lifestyle modifications and lack of understanding for the need for adequate Insulin technique that existed in the graduate group.

Our study also showed that age had no role to play when it came to having adequate practice of Insulin Technique (p>0.05).These findings were similar to a study done by S.Gremer *et al* which claimed that the knowledge on Insulin awareness was unrelated to age, duration of diabetes and education[12].

Adequate practice was noticed in only 18 (41.9%) of the participants who self-administered insulin(p=0.013). However, among those participants who needed assisted administration, only 15(34.9%) and 10(23.3%) had adequate practices when insulin was administered by either a medical personnel or non-medical personnel respectively (p=0.018).

Participants who self-administered insulin were between the ages of 51-70 years (51-60 years: 51.6% and 61-70 years: 42.9%, p=0.044). This may indicate the self-administration of Insulin significantly decreased beyond 60years of age probably due to lack of confidence. Most patients who did not reused their insulin syringe had the practise of leaving the needle at the site on injection for 5-10 seconds (p=0.008) as compared to those who reused their needles more than once, probably due to the pain caused due to multiple use of syringe needle and loss of silicon coating[16]. It was noticed that 26(59.1%, p=0.011) participants who reused their needles 2-5 times did not wipe the site of injection which is a high risk for abscess formation. The reuse of Insulin needles significantly increased with the duration of Insulin use (p=0.042). Out of the 81 participants who stored their insulin in the refrigerator, only 71.6% participants brought it to room temperature before administration as per recommendations. A significant number of participants (63.2%) of those who stored insulin in various other forms like pot of water did not bring it to room temperature before administration (p=0.004).

A potential risk factor was noticed such that 73% of participants threw their Insulin syringe in the general waste (with no waste segregation) which was comparatively higher compared to the IIT study (57%) and ITQ study 55%[16,17].Out of the remaining participants who did not throw their syringe in the general waste, 18 participants disposed the needles as per guidelines (separate puncture proof container) which as per the IIT study is 9.8%. Some subjects (9%) threw their syringes outside on their way to work. These results were similar to a Nigerian study done by Bazan*et al*[20],looked into the disposal technique in patients that used insulin which stressed that incorrect sharp disposal caused injuries to the public. Compared to 75% of participants in our study, this Nigerian study showed that 80.7% of the participants had poor Insulin practice.It was noticed that 15 participants reused their syringe 2 to 5 times and kept a separate puncture proof container for disposal of insulin syringe/ pen. This study also showed that participants who reused their syringe > 5 times had the practice of using a puncture proof container (p<0.05). One study done by Chaudhury *et al* in eastern India reported that 32% of the patients did not rotate the site of injection which in to our study

was 16%[19]. Insulin pens were used only by 18(18%) of our subjects, although the ITQ study showed 89.6%[16]. Only 57.6% on Rapid acting Insulin were taking their insulin adequately as per the consensus guidelines of immediately before or after a meal (with a buffer time of 10 minutes). Only 30% participants followed guidelines and administered mixed Insulin adequately (20-30 minutes before food). When compared to another study done by Smallwood that claimed that insulin pens were cost effective and had better patient compliance, it was noticed although there are insulin pens in India - our study population did not prefer to do so probably due the cost factors, lack of health personnel to teach them the basics of pens[21].

CONCLUSION

From this study, it can be concluded that knowledge and practice regarding Insulin administration was inadequate in the study population. It is also seen that age, gender, education, duration of Insulin use are not significantly associated with correct insulin practice. Method of disposal of Insulin syringes is poor. There exist beliefs that make it difficult to implement the correct practice in the population groups. There is lack of communication between the patients and the health care providers when it comes to insulin administration.

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