



Knowledge of Insulin Practices in Adult Diabetic Patients: A Cross-Sectional Survey-Based Study in a Specialized Diabetic Center of a Tertiary Care Hospital

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Abstract

Background: Insulin is being used in addition to oral hypoglycemic drugs in certain diabetic population while it is the only treatment in insulin deficient patients. There is little knowledge about the various aspects of the self-administration of the insulin so this study is planned.

Material and Methods: Patients who have been diagnosed with diabetes mellitus irrespective of the type of diabetes with either gender and of any age were taken in this research. Study sample included patients who were not on any alternative medicine and psychotic medicine. All the participants were using insulin for more than 6 months. After taking informed consent, patients were interviewed through a validated English language version of the Injection Technique Questionnaire (ITQ) which is available via the Fitter diabetes website and previously used in many studies. Questionnaire was asked and filled by a person who was expert in English as well as common local languages. The questionnaire covered all the aspects regarding knowledge about insulin injection technique. The data was then stratified according to the age group, gender distribution, duration of diabetes, duration of insulin use, habits of self-monitoring blood glucose, habits of waste disposal and family support regarding insulin use. Data was analyzed using SPSS 24 Inc.

Results: Almost all the cases were adult 350(96.2%), 11(3%) were self-injected adolescents and 2(0.6%) were self-injecting child above 10 years of age. On inquiring the duration of diabetes mellitus, >5-year older DM was in 239(65.7%), 1–5- year older DM in 109(29.9%) and 13(3.6%) have diabetes of <1 year older. Mean duration of the months since diagnosis was 96 ± 64.77 months. Most of the cases were taking oral hypoglycemic drugs along with insulin 248(68.1%), and 114(31.3%) were taking only insulin. Insulin was taken with syringe by 334(91.8%), while 29(8%) patients were using insulin pen. Mean number of injections taken was 2.45 ± 0.83 per day. 178(48.9%) tries to remove bubbles. 289(79.4%) reported that more training is needed for better injection technique. 292(80.2%) stated that they require more training to dispose syringe. 22% of patients had lipohypertrophy.

Conclusion: More training is needed to the diabetic patients for the proper administration of insulin and disposal of the waste.

Keywords: Diabetes mellitus; Insulin; Knowledge; Practice

Introduction

Diabetes Mellitus is a metabolic disorder leading to hyperglycemia either from impaired or absent insulin secretion or resistance to insulin or both and is due to combination of genetic, environmental and lifestyle factors. Diabetes mellitus is a silent killer that results in adverse events in the population. There is a rise in the cases of diabetes mellitus as per noted 36% in western pacific region of which majority live in eastern Asia. In developing countries this situation gets further worsened due to adaptation of the western culture and changes in the dietary pattern [1].

Researches have estimated that 693million people would be having diabetes mellitus by 2045. Females are equally affected with this condition as males. 21.3million live births to women were also affected by various forms of hyperglycemia. It results in the destabilization of the economic condition of any given territory [2]. Risk of diabetes has further increased due to the life style changes, aging and urbanization. Poor socio economic status leads towards stress and ultimately towards the DM [3]. Age greater than or equal to 43 years, family history of diabetes, hypertension, obesity and dyslipidemias were significant associated risk factors for diabetes [4].

Due to absence of any permanent cure, the diabetic population has to live with it and they have to use medication to keep the glycemic levels in the target range. Persistent hyperglycemia leads to micro and macrovascular complications including retinopathy, nephropathy, neuropathy, Ischemic heart disease, stroke and peripheral arterial disease. All these complications lead to overall poor quality of life and increase morbidity and mortality. So, as soon as someone contacts the DM, he or she should seek immediate advice about management of the disease and education so that damage to the body due to DM could be prevented [5].

Management of diabetes depends upon the insulin reserves and other cardiometabolic profile of the patient. Multifaceted ongoing lifestyle modification is the essential and foremost part of the treatment plan.

Oral antidiabetic drugs are the mainstay for the management of type 2 diabetes mellitus while Insulin is the prime therapy for type 1 DM. Many type 2 diabetic patients need insulin at some point for better control of hyperglycemia, so early patient education in case of type 2 DM about the progression of disease and future need for insulin is important as it can improve transition.

Good Insulin technique is essential for the successful therapy whereas poor insulin technique besides failure of therapy and economic losses, leads to many acute and chronic complications like diabetic ketoacidosis, lipodystrophy, lipohypertrophy, needle site infection and others. The poor glycemic control due to poor insulin technique further leads to increase cardiovascular morbidity, mortality. Many patients have not sufficient knowledge about the best practices

to use insulin. Resultantly, it leads to the other complications and organ failure [6,7].

In Pakistan majority of the cases have misconception about the use of insulin. It arises the need for the education of the patients with DM that how they can control it and why it is necessary [8].

Many small studies are conducted in different countries, two important studies conducted in India & Nepal showed that there is a huge room for improvement in understanding and applying proper insulin administration techniques [9,10].

As the diabetes is a lifelong condition so it demands that the patients and their family members should be well aware of the use of the insulin. A sound knowledge and best practices in the administration of insulin could help them in terms of improvement in quality of life. This is only possible if there is proper training and knowledge is delivered to the diabetic population. When the insulin is not administered as per good practices, it causes the complications and leads to poor disease control. Hence, it is important to inject the insulin in a proper way.

Due to absence of large-scale studies in Pakistan, it is not documented that what is the knowledge of insulin practices in our general population. As we do not know the actual facts about the insulin practices so we cannot suggest the authorities to make a comprehensive plan to educate the diabetic population.

This is the study carried out on this topic with a detailed questionnaire pertaining to the practices of insulin use among the diabetic cases. Not much study has been done so far usually in the developing countries. So, this study will generate the baseline information and also open the new horizon for upcoming researches on the same pattern.

Materials and Methods

This was cross sectional survey carried out in Diabetic center of Services Hospital Lahore in duration of 3 months. Diabetic center of Services hospital Lahore is one of the largest government sector centers in Punjab province which is providing care to average of 3000 diabetic patients per month.

Patients of both gender and age greater than 10 years were included in the study. The patients were considered diabetic on the presence of one of the three criteria i) FPG \geq 126 mg/dL (7.0 mmol/L), ii) 2-h PG \geq 200 mg/dL (11.1 mmol/L) during 75 grams OGTT. And iii) A1C \geq 6.5%. Only those patients were taken who has been using insulin either alone or with oral hypoglycemic drugs. Patients on psychiatric medicine, alternative medicine (including herbal, homeopathic and hakeem medications), dementia and those who refused to take part in the study were excluded. 363 diabetic cases were enrolled in this study. Missing information was analyzed through the missing value analysis technique. All the cases were selected consecutively. Once data is collected all the data is entered in the computer-based software. Data was analyzed using SPSS 24 Inc. Quantitative information was presented with mean and qualitative with frequency and percentages.

Results

Mean age of the enrolled cases was 49.44 ± 13.29 years. Majority of the cases were females 209(57%). Mean height of the patients was 159.52 ± 10.98 cm and mean weight was 67.23 ± 14.33 kg. Our data includes 202(55.5%) have normal weight, 91(25%) underweight,

50(13.7%) over weight and 21(5.8%) were obese as per WHO BMI criteria. Adults were 350(96.2%), self-injected adolescent 11(3%) and self-injecting people with age greater than 10 years were 2(0.6%). 239(65.7%) subjects have diabetes for more than 5 years, while 13(3.6%) have diabetes of <1 year and rest were having diabetes for 1-5 years. Mean duration of the months was 96 ± 64.77 months. Most of the cases were taking oral hypoglycemics 248(68.1%) along with insulin and 114(31.3%) were taking insulin only. Insulin was taken with syringe by 334(91.8%), while 29(8%) use insulin pen. Mean number of injections taken was 2.45 ± 0.83 per day. Majority of the patients has practice of not cleaning the injection site 310(85%). 331(90%) has reported to get injected >1 time. A high number of cases 176(48.4%) uses same syringe for 6-10 times. The reason of this practice was reported by 264(72.5%) as money saving strategy. 321(88.2%) have reported that injection was painful of which 145(36.3%) reported it to be painful sometimes. 173(47.5%) stated that their injection site bleed sometimes and 80(22%) reported the leak of insulin at the injection site. 344(94.5%) found to be remixing of the cloudy insulin vial with an average number of rolls 4.70 ± 3.07 (Table 1).

Study Parameter	N (%)
Clean skin before injection (Yes/No)	49(13.5%)/310(85.2%)
Do you clean stopper with disinfectant (Yes/No)	21(5.8%)/337(92.6%)
Inject with same syringe >1 time (Yes/No)	331(90.9%)/6(1.6%)
How many times you use single syringe	
2 times	9(2.5%)
3-5times	69(19%)
6-10 times	176(48.4%)
>10times	83(22.8%)
Why you use syringe >1 time	
To save money save	264(72.5%)
For convenience	33(9.1%)
Both	39(10.7%)
Are your injections ever painful(Yes/no)	321(88.2%)/42(11.5%)
If yes	
Sometimes painful	145(39.8%)
Almost painful	185(50.8%)
Attribute for painful injection	
Used the needle before	132(36.3%)
Technique was not right	18(4.9%)
Both	72(19.8%)
Don't know	95(26.1%)
Injection site bleed (Yes/No)	173(47.5%)/190(52.2%)
How often injection site bleed	

Almost never/Sometimes	165(45.3%)/32(8.8%)
Insulin ever leaks from site (Yes/No)	80(22%)/281(77.2%)
If Yes	
Almost never/Sometimes	107(29.4%)/14(3.8%)
Leakage at needle tip (Yes/No)	82(22.55)/277(76.1%)
If yes how often	
Almost never/Sometimes	91(25%)/18(4.9%)
Ever inject through cloth (yes/no)	18(4.9%)/34(94%)
Do you remix cloudy insulin	344(94.5%)/15(4.1%)
Average number of roles	4.70 ± 3.07

Table 1: Common practices regarding insulin injection technique. Majority of patients use needle for 6-10 times to save money.

Majority of cases 331(90.9%) dispose the syringe in household rubbish with the cap on. 243(66.8%) skipped or missed the dose. 121(33.2%) patients reported that they forgot to take their insulin dose occasionally. 179(49.2%) reported that last time they reviewed the injection technique instructions was more than 1 year ago. Hypoglycemia was experienced by 114(31.2%) and hyperglycemia was experienced by 311(85.4%) cases (Table 2).

Study parameter	N (%)
Do you wait for insulin to come to room temperature before injection	
Yes/No	67(19.4%)/291(79.9%)
Use insulin vial after expiry	
No/ don't track expiry date	92(25.3%)/264(72.5%)
If yes, frequency of hyperglycemia	
<4 times per month	214(58.8%)
1-2 times per week	85(23.4%)
3-5 times per week	12(3.3%)
>5 times per week	4(1.1%)
If yes how often	
Almost never/Sometimes	205(56.3%)/46(12.6%)
Reason for skipping injection	
Just did not want to inject	61(16.6%)
Low glucose level	44(12.1%)
Forget	121(33.2%)
Did not eat	14(3.8%)
Last time you reviewed injection instructions	
Within past 6 months	34(9.3%)
Within 6-12 months	107(29.4%)
Last 1-2 year/5-10 year	179(49.2%)/27(7.4%)

Experience hypoglycemia (yes/no)	
Yes/No	114(31.2%)/247(67.9%)
If Yes, then how many times in last 6 months you need assistance	
1-2 times	82(2.5%)
3-5 times	24(6.6%)
>5 times	4(1.1%)
Ever need ambulance service incase of hypoglycemia (yes/no)	6(1.6%)/14(39%)
How often pricks finger for blood glucose	
Rarely	143(39.3%)
several times a week	153(42%)
1-2 times a day	19(5.2%)
3-4times a day	3(0.8%)
Experience hyperglycemia (yes/no)	311(85.4%)/48(13.2%)

Table 2: Practices regarding monitoring and complications. Majority cases skip their insulin doses due to forgetting and many have frequent hyperglycemic and hypoglycemic episodes.

173(47.5%) participants have their training on how to take injection form the diabetic educator (Figure 1).

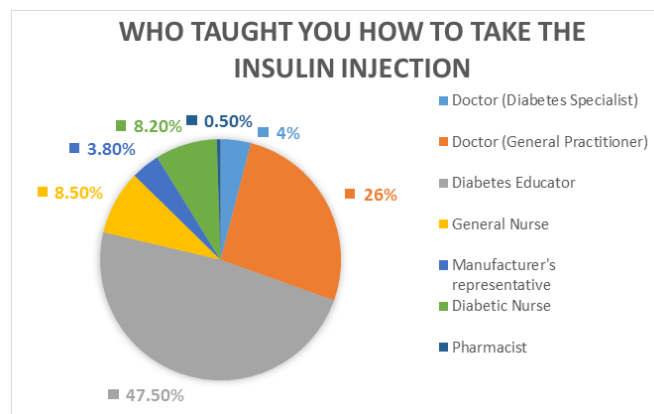


Figure 1: Learning of Insulin Technique. Majority of cases learnt it from diabetes educator.

Only 3(0.8%) reported that their healthcare provider regularly checks the injection site. 157(43.1%) cases reported that people around them were at risk of injury from the insulin syringe. 138(37.9%) participants were worried about their children to get pricked by their syringe due to no proper disposal devices. The

main reason of this was inappropriate disposal of syringes in 133(36.5%). 234(64.3%) participants knew about appropriate thickness of skin for injection. 178(48.9%) remove bubbles before injection. 289(79.4%) reported that the more training is needed about proper insulin technique. 292(80.2%) stated that they require more training about disposal of syringes (Table 3).

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Study parameter	N (%)
How often Healthcare provider examine the injection site	
Don't remember my sites ever being checked	281(77.2%)
Only on complaint	64(17.6%)
Anyone at risk of injury due to used syringe	
Yes/No	157(43.1%)/202(55.5%)
If yes, what was your relation with the person	
Children	138(37.9%)
Other family member	18(4.9%)
Please indicate why these are at risk	
Do not use devices that prevent injuries	3(0.8%)
Inappropriate disposal container	133(36.5%)
Do you feel the subject was covered when you were taught about it or you need more training	
Selection of injection site (yes/training)	125(34.3%)/232(63.7%)
Skin thickness to appropriate depth (yes/training)	234(64.3%)/124(34.1%)
Length of needle (yes/training)	38(10.4%)/317(87.1%)
Skin lift and pinch up (yes/training)	308(84.6%)/41(11.3%)
Angle of needle entry (yes/training)	329(90.4%)/24(6.6%)
Duration to keep needle in skin (yes/training)	151(41.5%)/201(55.2%)
Rotating the injection site (yes/training)	306(84.1%)/45(12.4%)
Prevention of bubble (yes/training)	178(48.9%)/178(49.1%)
Mixing of insulin (yes/training)	225(61.5%)/133(36.5%)
Re-suspension of cloudy insulin (yes/training)	160(44%)/195(53.6%)
Single use of pen (yes/training)	70(19.2%)/289(79.4%)
Safe disposal of sharps (yes/training)	65(17.9%)/292(80.2%)
How to dispose injection or pen after use	
In rubbish with cap on	331(90.9%)
In rubbish without cap on	14(3.8%)
Home container	14(3.8%)
Miss or skip dose (yes/no)	243(66.8%)/116(32.4%)

Table 3: Disposal practices & need for more training. Majority of cases dispose syringes in rubbish with cap on and most of the cases need more training regarding injection technique.

Discussion

Normal metabolism plays vital role in the regulation of the body organs and hormones. Due to normal metabolism all the vital organ works properly to keep the person healthy. Among diabetic patients this metabolism is severely affected by the less secretion of the insulin or insulin resistance or both [11]. In a review it was estimated that till 2035, 592million people around the globe will be suffering for the DM. Once the person suffers from DM, it is mandatory to check the glycemic levels regularly. Hyperglycemia could prove fatal as it impacts badly on the kidney and cardiac functions besides its acute complications. Managing hyperglycemia is not possible only with insulin and medications alone but patients have to change their lifestyle as well [12].

Besides adherence to the lifestyle, medications including oral hypoglycemics and insulin in many cases also needed to maintain the appropriate glucose levels in the blood. For this purpose one must be aware of the target glucose levels, appropriate method to inject insulin, checking the quality of insulin and should also be able to recognize the complications of disease and complications of poor insulin technique [13,14].

This goal is difficult to achieve if there is lack of coordination between the patients and their healthcare provider. In order to optimize the glucose levels in the body, healthcare providers must teach their patients about the method of self-monitoring blood glucose, its optimum levels and exact time and proper technique to administer the insulin. By this one will be able to manage the diabetes and will be able to avoid the associated mortality and morbidities [15,16].

In our study the mean age of the patients was 49.44 ± 13.29 years which is lower but comparable to the mean age of a recent study by Venkataraman et al. performed in India where mean age was 53.51 ± 6.48 years. The gender prevalence was in accordance to the international data as in Pakistan higher number of the females (57%) cases reported as diabetic as compared to male (43%) cases [17]. On contrary to our study, In two Indian studies, there was 58% male population in the study by Venkataraman et al and 64% males in another study by Ismail et al. Another study performed in Ethiopia by Nasir et al. shows male diabetic population of 54% [17-19].

Hypoglycemia is one of the major and fatal complications of diabetes treatment. In our survey, 31% of patients reported hypoglycemia as opposed to the study from India which shows much higher statistics, where 90% of the cases who receive insulin reported hypoglycemic episodes.17 but our data is in line with the study done by Tewabe et al. where this percentage was 40% [20].

In our study 68 % of patients skip their insulin dose often and majority claims that they forgot to administer injection (33.2%) and some (16.6%) reported that they just do not want to take injection sometimes. A few patients skip insulin due to their hypoglycemia. This was in contrary to previous studies by Shanmugam et al. and Tewabe et al. which reported that 28% and 40% diabetics miss their insulin doses respectively [20,21].

Tewabeet al. reported the reasons for skipping insulin is due to forgetting in 47% of study participants which is higher than our study population, and according to their study 13% study participants miss their dose of insulin purposely which is comparable with our study [20].

Regarding self-monitoring of blood glucose levels, our data shows that 40% of patients check their blood glucose several times in a week and 40% of patients rarely check their blood glucose which is comparable with a previous study by Shanmugam et al which reported that 51% of the study population do not get the post meal sugar check on a regular basis.

In our study majority of the cases (88.2%) reported that their injection site is often painful. One third of participants (33.6%) attribute this to use of needle more than once and a small group (5%) attribute this to the absence of rotating the injection site. In a study by Gerensea et al. 72.5% of the study participants knew the advantage of site rotation in reducing the pain and prevention of lipohypertrophy and a study by Neteret al. shows that 60% of their study participants practice rotation of sites [22-24]. As this is an established fact that by rotating the site there are little chances of lipodystrophy and lipohypertrophy, the incidence of which was very high (22%) in our study but that is comparable with the study by Frid et al. where the self-reported lipohypertrophy was 29% and on examination this percentage was 31% [25]. 91% of our patients use syringe for more than once comparable to 85 % of the study done by Kalra et al. 23% of patients in our research use their needle for more than 10 times as oppose to 10% of Kalra et al. study. Interestingly the frequency of lump at injection site (22.8%) is equal to frequency of patients using their needle more than 10 times (23%) (Figure 2) [26].

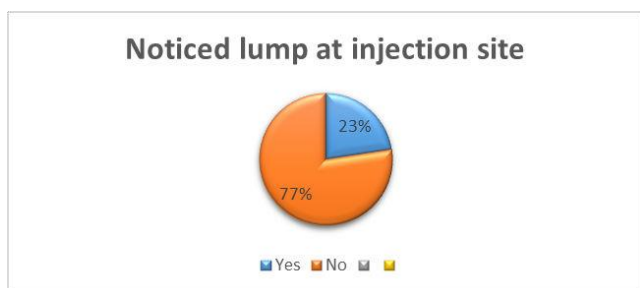


Figure 2: Frequency of lump formation. A significant population has lump formation

There is little knowledge among the patients about the appropriate sites for injecting insulin. Our study shows that 66% of patients just use single site *i.e.*, abdomen for injecting insulin and remainder 34% knows about the thigh and arm being the other possible sites. This is comparable to previous studies as one recent study by Gerensea et al reported that 39% of their participants knew more than three sites for insulin injection (Table 4; Figure 3) [22].

Study Parameter		N (%)
Site of Injection	Abdomen	237(65%)
	Arm	61(16.8%)
	Thigh	65(17.9%)

Table 4: Common sites used for Insulin injection. Most common site being used are abdomen.

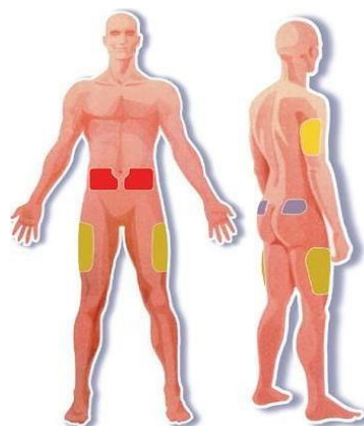


Figure 3: Four principal sites of insulin injection.

We observed that (94%) cases mix the cloudy insulin before use. In an Indian study this frequency was (66%) and in another study it was (73%) with an average roll up for <10 times among (97%) cases [24,26]. In our study the mean roll up was 4 times on average. When self-assessment of knowledge about the insulin practices is inquired, there was less number of the cases who have stated about having adequate knowledge. Majority of the cases have stated that they require more training especially related to injection sites (64% cases), length of needle (87% cases), duration to keep needle in the skin after injecting (55% cases), resuspension of cloudy insulin (53.6% cases), single use of needle (79.4% cases) and safe disposal of sharps (80.2% cases) so that they could administer the insulin properly, which was in accordance to the previously published literature [7,21,22]. The areas about which majority of patients were confident of having adequate knowledge includes appropriate skin thickness (64.3 % cases), skin pinch (84.6% cases), angle of needle (90.4 %), rotation of site (84.1% cases) and mixing of cloudy insulin (61.5% cases) (Table 4).

Regarding disposal habits majority of participants (90%) put the used needles into household rubbish with cap on and only 3% of patients use some specific container. In contrary to the data published by Kalra et al. which reported that 60% of their population put waste into household rubbish while 20% population use specific container for disposal of insulin needles which is a better practice [26]. The same study also depicted that 34% of participants were worried about getting injury to their children due to not having appropriate disposal containers for used sharps while 43% of our study population feels the same risk of getting their children injured with the used sharps due to not having appropriate disposal container [26].

Conclusion

Conclusively, it is suggested that among Diabetic population of Pakistan, there is need of more training regarding correct insulin injection technique. People need to know about the injection sites, rotation of injection site and proper disposal of their syringes or pen needles. No study has emphasized about injury after the syringe is disposed. This study has revealed a drastic situation as most of the patients think that their children can get injured with the used syringe. Hence, more educational campaigns are needed on the mass level using technology and utilizing all forums for education of the people.

As diabetes is a major burden in Asia, the awareness of knowledge, clinical implication about diabetes, and its complications should start from under graduate level as a part of early clinical exposure and learning. This will help in improving standard diabetic care at primary level.

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