Evaluations of knowledge, skills and practices of insulin storage and injection handling techniques of patients in Ethiopian primary hospitals

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Abstract

**Background:** Diabetes mellitus is a group of metabolic disorders and resulting from deficits in insulin secretion, insulin action, or both. Insulin therapy is primarily required to attain the recommended goal of blood sugar. The primary aim of this study was to evaluate the knowledge, skills and practices of insulin storage and injection technique of patients.

**Methods:** An interview based cross-sectional study was conducted in conveniently selected participants in Northwest Ethiopian primary hospitals from March, 1, 2019 to May, 30, 2019. Knowledge and practice were measured by administering structured questionnaire with a Likert scale of 1–5 through face-to-face interviews and skills were assessed by five observational (demonstration) techniques from a total of 166 clients.

**Results:** Of the total 166 participants, 54.8% were males and the mean age was 38.33±14 years. The overall knowledge (65.4%) and practice (53.89%) rate on insulin storage and handling techniques were showed moderate knowledge and fair practices. About 94.6% of participants correctly shown insulin injection sites. One-way ANOVA showed that the level of education \(F(3, 162) = 7.283, p<0.001\), ways of instruction of insulin injection \(F(2, 163) =3.32, p = 0.039\), insulin therapy duration \(F(3,162) = 3.59, p= 0.015\) and assessing insulin storage \(F(2,163) = 4.45, p = 0.013\] had a significant effect on level of knowledge. Similarly, knowledge level \(F(2,163) = 14.17, p < 0.001\], educational status \(F(3,162) = 10.57, p <0.001\], occupation type \(F(4,161) = 5.43, p <0.001\], time since insulin therapy \(F(3, 162) = 5.46, p = 0.001\] and diagnosis \(F(3,162) = 3.36, p= 0.02\] had a significant effect on patients’ insulin storage and administration practices.

**Conclusion:** Patient had marginal knowledge and practices on insulin storage and administration techniques. The patients’ skills on the important and critical steps of administrations are poor. The engagements of healthcare professionals and stakeholders should be in developments of instructions and guidelines are very crucial in addition to focusing on educating and changing their wrong perceptions, believes and attitudes towards storage and administering techniques.

**Background**

Diabetes mellitus (DM) is a group of metabolic disorders that are characterized by a phenotype of
chronic hyperglycemia resulting from deficits in insulin secretion, insulin action, or both [1-3]. It is classified as; type I, type II, gestational and specific types of diabetes [1, 4].

The worldwide the prevalence of DM in all age group is predicted to be 4.4% [5]. Nowadays, 415 million of individuals have diabetes with ages between 20–79 years. Of these, three-fourth of them belong to low- and middle-income countries. Available articles, done from 2004–2011, showed that the occurrence of T1DM in the horn of Africa accelerated from 4.8 to 16.4/100,000 [6] and T2DM has reached from 1.4% to 12% with these, more than 50% were formerly undiagnosed; and these patients possibly arrived late in time with serious acute and prolonged complications of DM that must require insulin therapy [7, 8]. In 2015, there were over 1.33 million diabetic cases in Ethiopia, giving a prevalence rate of 2.9% among people of 20–70 years of age [1]. Recent systemic review and meta-analysis study on glycemic control in Ethiopia indicated that there is a high proportion of diabetic patients who were unable to achieve optimal glucose level, with no difference between T1DM and T2DM [9].

Insulin therapy is primarily required to attain the recommended goal of blood sugar in all T1DM and ultimately T2DM patients [10-12]. The fact that insulin is easily destroyed and that it loses its efficacy if not appropriately stored. Unopened (currently not being used) vials and cartridges of insulin should be kept in the refrigerator (2°C-8°C) till expiry date away from freezing coils and freezer. Opened (currently being used) vials and cartridges should be stored at room temperature (15–25°C) which makes them comfortable, stable and potent for 28 days (if not exposed to temperature above 30°C or below 2°C) and should be disposed after 28 days of opening. But insulin must be stored in refrigerator, if the temperature in the environment is beyond the room temperature range. Under 2°C insulin will freeze and might sting as well as the therapeutic action could be delayed (lack of its stability and potency) [10, 11, 13–15]. Nonetheless, in resource disadvantaged nations, inaccessibility of right storage equipment and harsh climatic conditions may compromise the overall quality of insulin.

Additionally, insulin administration techniques impart and greatly affect the overall control of plasma
sugar levels in DM patients. Skillful skin pinching, injections practices, accurate measurements, and regular injection site rotations are the play crucial roles in improving therapeutic outcomes. Untrained parenteral injection techniques, wrong measurement, and poor administrations of insulin possibly will result in poor control of blood glucose.

Unfortunately, there is no known evidences in the study areas that indicates the patients’ trend on storages and administrations practices of insulin. But, previous published findings in UK and European countries discovered that inappropriate insulin injection practices resulted to unpredictable and erratic insulin absorption; and eventually to either hyperglycemia or hypoglycemia, that is poor blood sugar control [10, 16]. Worldwide studies showed that various recommendations on the insulin injections and storage had no enough logical and scientific supports, but rather it is based on the community habits and traditions [16]. Furthermore, commonly diabetic clients are desiring of other means of administering insulin other than by injections, which may further compromise their interest to learn the appropriate instructions of storage and handling techniques. Thus, educating and changing their wrong perceptions, believes and attitudes towards storage and administering techniques should be an additional goal of experts [17].

To the best of the authors’ knowledge and search, no study was found to evaluate the knowledge, skills and practices of insulin storage and injection technique of patients in the study area. With this, the purpose of the current study was to evaluate the knowledge, skills and practices of insulin storage and injection technique of patients as well as to explore the challenges and the hidden reasons why patients are not keen to receiving and applying instructions given from health care professionals for the standards of care.

Methods

**Study design and setting**

An institutional-based cross-sectional study in the form of an interview was conducted in primary hospitals of Northwest Ethiopia, located Northwest of Addis Ababa. The study period was from March, 1, 2019 to May, 30, 2019. The essential information was gained by administering structured questionnaire-based interview for the participants. The study area had one comprehensive specialized
referral and teaching hospital, one private general hospital in Gondar town, ten primary hospitals and a number of health centers. The study participants were recruited from randomly selected primary hospitals such as: Addis Zemen, Debark, Wogera, Kolladiba, Chilga, and Metema.

Source population, Sample size determination and Sampling procedure
The source population were all diabetic patients who were being treated with insulin in the study area and the study population were those diabetic patients who were using insulin as their primary therapy or as an additional therapy and visited those hospitals during the study period. Clients or care givers of the clients who were 18 years of age and above were included in the study. The clients should be on insulin treatment for at least one month and refilling insulin prescription at the hospital. Clients who did not volunteer to participate in the study and seriously ill, unable to hear or speak, physically disabled, having dementia or cognitive impairment, and difficulty of getting consent were excluded from the study. A convenient sampling technique was used to collect data.

Data collection instruments, procedure and management
The data collection format was initially prepared in English. It was then translated to the local language (Amharic) and back-translated to English to ensure proper meaning. Trained pharmacy professionals were the data collectors and they were supervised daily by the investigators. The questionnaire included four major parts which focused on: 1-socio-demographic and related information, 2-the technical skills of drawing and injecting single or mixed insulin, 3-experiences, practices and knowledge of insulin storage and handling techniques, and 4-observational checklist of patients’ skill related to self-insulin administration. Both the practice and the knowledge questions contain 14 items. The practice was measured by Likert scale type (Never=1; Sometimes=2; Often/Usually =3; Always=4) and graded as poor, fair and good if they scored < 28, 28-42 and >42 out of 56 points, respectively. The knowledge of respondents’ will be measured as “right” who answered the question correctly and “wrong” who did not answer the question correctly. A score of >75% (>10.5), 50-75% (7-10.5) and < 50% (<7) out of 14 points were said to be adequate, moderate, and inadequate, respectively [18]. The respondents’ skills were measured through five observational (demonstration) techniques related to self-insulin administration procedures. The
checklist marked as correct =2, incorrect =1 and skipped =0 based on American diabetic association of insulin administration [19, 20]. If a client or a care giver correctly performed all the critical steps, the observation (demonstration) was considered as correct; if any of the critical step was missed or performed incorrectly, the demonstration was considered as incorrect; and it is considered as skipped if any of the steps was jumped. Those who performed correctly were given a score 10 and were considered skillful and those who were doing it incorrectly and those who skipped were not considered as skilled respondents.

Data entry, analysis, and interpretation

The data was entered and analyzed using statistical package for social sciences (SPSS) for windows, version 22.0. [21]. Frequencies, percentages, and a chi-square test were used to estimate the differences in magnitudes of categorical variables while student t-test and one-way ANOVA (analysis of variance) were done for analysis of the mean of continuous variables. Post-hoc comparisons using Tukey HSD test was done for those groups who have significant knowledge and practice mean differences on the one-way ANOVA analysis. The knowledge and practice data were transformed into categorical values and expressed as inadequate knowledge and poor practice, moderately adequate knowledge and fair practice, and adequate knowledge and good practice. P-value < 0.05 and 95% confidence interval (CI) were used as cut-off points for determining statistical significance of associations among different variables. Variances were assessed using the Levene’s test. Equal variances were assumed if p ≥ 0.05 level of significance upon Levene’s test. On the other hand, equal variances were not assumed if p < 0.05 level of significance.

Data quality control

Pretest was done before any data collection performed on 15 patients, which was not be included in final data analysis, in one of the randomly selected primary hospital. The important amendments were made and formatted as needed. The data accuracy and completeness were consistently checked by using double entry and any mistakes and omissions was corrected.

Informed consent and Confidentiality

Before any of the activities, written informed consent were sought from the participants. The
voluntariness of the participation and the aims of the study were explained clearly and shortly. The participants were given the right to interrupt at any time if they do not want to continue. The respondents were interviewed and observed while doing a demonstration privately and independently. All information was kept confidentially by giving serial numbers.

Results

Respondent characteristics

This study involved a total of 166 participants of this (54.8%) were males while the remaining (45.2%) were females. Most of respondents (29.5%) were between the ages of 15-27 years with a mean age of 38.33±14 years. There is no gender difference (p= 0.778) among the age groups. Greater than half of the respondents (56.6%) were married and 33.7% were single. There is a gender difference in marital status (p=0.02). Most of the study samples (31.32%) completed their primary (1-8 grades) and secondary (9-12 grades) education. Almost half (48.8%) of the participants were living with DM for 1-5 years with a mean (SD) of 2.51 ± 0.89 years and there was a significant gender difference with durations of the diseases (p=0.002). Majority (58.4%) of the respondents used insulin therapy for about 1-5 years with a mean (SD) duration of 2.31 ± 0.76 years. There was a substantial gender difference with insulin therapy (p<0.001). More than half (55.4%) of the participants had to pay for getting insulin (Table 1).

Knowledge score

The mean knowledge score of the study subjects on insulin storage and handling techniques was found to be 9.16 ± 2.58 (out of 14) (65.4%) (Fig. 1). Most of the participants (44%) had moderately adequate knowledge, while 31.3% had adequate knowledge and the remaining (24.7%) had inadequate knowledge. One-way ANOVA was conducted to compare the effect of education level, ways of instruction of insulin injection, insulin therapy duration, and assessing insulin storage on the level of knowledge for insulin storage and administration techniques. There was a substantial effect of the level of education [F (3, 162) = 7.283, p<0.001], ways of instruction of insulin injection [F (2, 163) =3.32, p = 0.039], insulin therapy duration [F (3,162) = 3.59, p= 0.015], and assessing insulin storage [F (2,163) = 4.45, p = 0.013] on level of knowledge for insulin storage and administration.
techniques. The post hoc comparisons using Tukey HSD test showed that the mean score for joined colleges and above (mean (M) = 10.5, SD = 2.89) was significantly different than the Illiterates (M = 8.00, SD = 2.59). But there was no difference between colleges (above) and other educational ranks. This test result showed that patients achieved higher education ranks had good knowledge on insulin storage and administration techniques. However, those who could only read and write and attended primary and secondary educations do not seem to improve storage and injection knowledge.

Likewise, post hoc Tukey HSD test showed that the mean score of instructed both orally and practically (M = 9.61, SD = 2.04) was importantly differ than orally instructed alone (M= 8.42, SD =3.42); the mean score of taking insulin for 5-10 years (M = 9.92, SD = 2.59) was better than those who were on for 0.25-1 year (M= 7.69, SD = 2.81) and the mean score of patients whose storage conditions assessed last month just before data collections (M= 10, SD = 2.22) was greater than those whose conditions had been never assessed (M= 8.65, SD =2.37) (Table 2).

An independent samples t-test was conducted to compare the effect of residency, means of getting insulin, receiving training by professionals, and receiving injection demonstration at first prescriptions on the levels of knowledge for insulin storage and administration techniques. There was a significant difference in mean knowledge score between patients resided in the urban areas and rural areas ($t_{159.956}=3.11$, $P= 0.002$), getting insulin for free and with payment ($t_{158.75}=-5.47$, $P < 0.001$), trained by professionals and not trained ($t_{164}=2.11$, $P= 0.036$), and receiving injection demonstration or not ($t_{164}=2.813$, $P= 0.006$). The mean knowledge score for respondents live in urban areas was 1.21 greater than the mean knowledge score for respondents live in rural areas. The mean score of patients getting insulin for free was -2.03 less than from getting by payment means, the mean score of subjects trained by professionals was 2.73 greater than from not trained and getting insulin by free means was 2.03 less than by payment means, and the mean score of individuals performed injection demonstration in first encounter was 1.27 better than not preformed (Table 3).

**Practice score**

The participants ‘insulin storage and injection practices score were assessed by the stated 14 item
questions and the mean score of practice of study subjects was 30.18 ± 5.34 (out of 56) (53.89%) (Fig. 2). Most (64.5%) participants practiced fairly, but only 1.2% of them had good practice and the rest (34.3.3%) had poor practice. The effects of predictor variables on the level of practice for insulin storage and administration techniques was computed with one-way ANOVA; and there was a substantial effect of knowledge level [F (2,163) = 14.17, p < 0.001], educational status [F (3,162) = 10.57, p <0.001], occupation type [F (4,161) = 5.43, p <0.001], time since insulin therapy [F (3, 162) = 5.46, p = 0.001] and diagnosis [F (3,162) = 3.36, p= 0.02] on patients’ insulin storage and administration practices. The post hoc Tukey HSD test comparison on practice disclosed that the mean score of patients who had adequate knowledge (M = 32.83, SD = 4.93) was significantly different than those who had moderate (M = 29.88, SD = 4.65) and inadequate knowledge (M = 27.37, SD = 5.49) and the mean score of moderate knowledge also (M = 29.88, SD = 4.65) had a noteworthy difference than inadequate knowledge (M = 27.37, SD = 5.49). The mean score of patients that attended in colleges and above (M = 33.14, SD = 5.1) was significantly different than illiterates (M =27.71, SD = 4.98) and those who can only read and write (M = 28.5, SD = 4.58). The mean score of employers (M = 32.32, SD = 5.93) was significantly different than farmers (M =28.15, SD = 4.82) and merchants (M = 28.29, SD = 5.0). Students mean score (M = 32.41, SD = 3.53) was also substantially different from farmers and merchants. The mean score for taking insulin for 1-5 years (M = 31.39, SD = 5.56) was significantly higher than who used for 0.25-1 years (M = 26.5, SD = 6.55) and 5-10 years (M = 28.85, SD = 3.67). Similarly, the mean score of patients who stayed with the disease for 1-5 years (M = 31.31, SD = 5.57) was higher than those who stayed for 0.25-1 year (M= 27.13, SD = 6.74) (Table 2).

**Self-insulin administration skill assessment**

Based on the observational checklists used to assess the patients’ skills related to self-insulin administration, only insulin injection sites on their body parts were correctly shown by significant (94.6%) number of respondents and about seventy percent of the participants properly indicated how to rotate the injection sites. Conversely, about half of the respondents either performed incorrectly or skipped very critical and important steps like shaking of cloudy NPH insulin, skin pinching and 45°
injection skill, and drawing of insulin from the vails (Table 4).

Discussion

On the knowledge and practice assessment our study discovered that the overall knowledge (65.4%) and practice (53.89%) of the study samples on insulin storage and handling techniques showed moderate knowledge and fair practices. Proper knowledge and good practices on insulin storage and administration habits has a remarkable outcome on the control of acute and chronic insulin related complications of DM. Moreover, many of the DM patients are not well aware of wrong insulin practice complications and its management skills. However, the results in our study showed a higher degree of knowledge and practice level than a study done in India [18]; it indicates that patients are still in need of further professionals help on the instructions and demonstration for self-care practices and compliances of their handling traditions. Various published articles had revealed that DM patients are poorly knowledgeable for disease’s managements and self-care practices [22, 23].

The patients’ level of knowledge and practical activities are affected by their rural residency, getting insulin with payment, level of education, ways of instruction of insulin injection, insulin therapy duration and assessing insulin storage. Since being educated enabled patients to understand and practiced the written, oral and any other means and directions and commands of storage and administration techniques better than illiterates. Similarly, participants taking insulin for prolonged time had better knowledge which enabled them to do the recommended practices. This illustrated that the duration of self-insulin administered (ISA) might probably heightened the clients’ knowledge and the practices. It is clear that as time spent on insulin therapy increases the being exposures to information also raised; or usually patients might be learnt from the bad consequences of poor insulin handling manners. The study lined with our findings reported that the durations of ISA was meaningfully influenced the patients level of knowledge (p < 0.05) [18]. Even though, worldwide studies showed that various recommendations on the insulin injections and storage had no enough logical and scientific supports, but rather it is based on the community habits and traditions [16]; insulin handling knowledge, practice and skills are highly improved if patients are trained by both orally and practical demonstrations means rather given by either alone. This is because, the ways of
delivering the instructions is highly complement to one another and clients could remember the given orders easily. This study explored that trained \( t_{164} = 2.11, P = 0.036 \) and practically demonstrated the administration procedures \( t_{164} = 2.813, P = 0.006 \) at first visit had good knowledge for insulin storage and administration techniques. Assessing the storages and injections practices of the clients at least every month, may possibly enhanced their knowledge level on handling of insulin than their counterparts. The patients’ practical activities on insulin handling manners were highly correlated with their level of knowledge \( (r = 0.5; p < 0.01) \) and a one-way ANOVA revealed that there was a substantial effect of knowledge \( [F (2,163) = 14.17, p < 0.001] \) on patients’ practices and skills. This indicated that when clients’ knowledge become adequate their practices will be remarkably improved.

Only injection sites were correctly shown by patients when the practical skills assessed by an observational checklist on self-insulin administration technique. On the contrary, about half of the respondents were either performed incorrectly or skipped very important practical skills and critical steps. Even though study result indicated that the client’s knowledge and practice level was found to be moderate and fair, their practical skills were so poor. This is probably the fact that patients are reluctant to be adhered with what they have been told to do so or forgotten and may be difficulty of remembering all the steps. Our results were concur with the previous studies [24, 25]. Furthermore, commonly DM clients are desiring of other means of administering insulin other than by injections, which is furtherly compromised their intense to learn the appropriate instructions of storage and handling techniques. Thus, educating and changing their wrong perceptions, believes and attitudes towards storage and administering techniques should be an additional goal of professionals [17].

**Limitation**

Since we used only patients visited the hospitals during data collection period and cross-sectional survey, all potential respondents might not include. Due to the small sample size and taken from only five hospitals, multi-culture, traditions and practices of the population it might be difficult to generalize to the whole Ethiopian populations. Therefore, the mean scores on the levels of knowledge and practices may be overestimated. Because of interviewed was conducted in the hospitals where
professionals are available, patients may possibly think that they are blamed of their poor practices. So that some of the respondents possibly hide and not genuinely provide the real practices. The patients perhaps have a problem of understanding of the questions and leads to possible information bias.

Conclusion
As to our findings DM patient had marginal knowledge and practices on insulin storage and administration techniques. The patients’ skills on the important and critical steps of administrations are poor. The engagements of Healthcare professionals and stakeholders should be in developments of instructions and guidelines are very crucial in addition to focusing on educating and changing their wrong perceptions, believes and attitudes towards storage and administering techniques. Moreover, to assess the knowledge, practices and skills further bigger studies are necessary.

Declarations

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Ethics approval and consent to participate: This study was reviewed and ethically approved by the Institutional Review committee of University of Gondar, School of Pharmacy with the approval number of SOP286/2018. The data collected was kept anonymous and recorded in such a way that the identity of the involved pharmacy professionals could not be known. The exit interviews were conducted where a third-party could not overhear questions and answers so as to ensure privacy and confidentiality of clients. The information obtained from the study was not disclosed to the third body. Only coded numbers were used to identify study participants.

Availability of data and materials: All relevant materials and data supporting the findings of this study are contained within the manuscript and the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication: Not applicable

Competing interests: The authors declare that there is no competing interest.

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Authors contribution: AKN contributed in conceptualization, project administration, formal analysis,
investigation, methodology. AKN and SAB contributed supervision, data curation, resources, writing and original draft of the manuscript and writing, review and editing of the final manuscript. EA and EA contributed in formal analysis, methodology, data curation, writing and original draft of the manuscript. All authors of this manuscript read and approved the final version of this manuscript.

Abbreviations
ANOVA: analysis of variance; CI: confidence interval; DF: Degree of freedom; DM: diabetic mellitus; T1DM: type one diabetic mellitus; T2DM: type 2 diabetic mellitus; MD: mean difference; SD: standard deviation; SPSS: Statistical packages for social science.

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Tables
Table 1: Distribution of selected characteristics of patients with diabetes mellitus by gender (N=166); 2019
| Variables                          | Total          | Male          | Female         |
|-----------------------------------|----------------|---------------|----------------|
|                                  | N (166)        | N (91)        | N (75)         |
|                                  | % (100.0)      | % (54.8)      | % (45.2)       |
| Age in years:                     |                |               |                |
| 15-27                             | 49 (29.5)      | 28            | 21             |
| 28-40                             | 43 (25.9)      | 22            | 21             |
| 41-50                             | 43 (25.9)      | 22            | 21             |
| >50                               | 31 (18.7)      | 19            | 12             |
| Mean ± SD                         | 38.33±14       |               |                |
| Residence: Rural                  | 86 (51.8)      | 43            | 43             |
| Urban                             | 80 (48.2)      | 48            | 32             |
| Marital status:                   |                |               |                |
| Single                            | 56 (33.7)      | 31            | 25             |
| Married                           | 94 (56.6)      | 52            | 42             |
| Divorced                          | 10 (6)         | 8             | 2              |
| Widowed                           | 6 (3.6)        | 0             | 6              |
| Occupation:                       |                |               |                |
| Farmer                            | 34 (20.5)      | 31            | 3              |
| Employer                          | 31 (18.7)      | 18            | 13             |
| Merchant                          | 38 (22.8)      | 21            | 17             |
| Housewife                         | 36 (21.7)      | 8             | 28             |
| Student                           | 27 (16.3)      | 13            | 14             |
| Educational status:               |                |               |                |
| Illiterate                        | 48 (28.9)      | 27            | 21             |
| Read & write only                 | 30 (18.1)      | 17            | 13             |
| Primary and secondary education   | 52 (31.32)     | 31            | 21             |
| College & above                   | 36 (21.7)      | 16            | 20             |
| Duration of DM (in years): 0.25-1 |                |               |                |
| >1-5                              | 81 (48.8)      | 38            | 43             |
| >5-10                             | 40 (24.1)      | 23            | 17             |
| >10                               | 30 (18.1)      | 25            | 5              |
| Mean ± SD                         | 2.51 ± 0.89    |               |                |
| Duration of Insulin therapy       |                |               |                |
| (in years): 0.25-1                |                |               |                |
| >1-5                              | 97 (58.4)      | 44            | 53             |
| >5-10                             | 39 (23.5)      | 27            | 12             |
| >10                               | 14 (8.4)       | 14            | 0              |
| Mean ± SD                         | 2.31 ± 0.76    |               |                |
| Getting of insulin:               |                |               |                |
| Free                              | 74 (44.6)      | 39            | 35             |
| Payment                           | 92 (55.4)      | 52            | 40             |

Table 2: One-way ANOVA test for predictor variables on the level of knowledge and practices on insulin storage and injection differences among categories of respondents’ in northwest Ethiopia primary hospitals, Gondar, 2018
### Table 3: The independent samples t-test for the mean score of level of knowledge differences of between categories of predictor variables

| Variables | Overall knowledge score | t     | df     | P      | Mean difference (MD) |
|-----------|-------------------------|-------|--------|--------|----------------------|
| Residence: | Urban                   | 3.11  | 159.956| 0.002* | 1.21                 |
|           | Rural                   |       |        |        |                      |
| Getting of insulin: | Free | -5.47 | 158.75 | < 0.001* | -2.03                |
|           | Payment                 |       |        |        |                      |
| Professionally trained on how to administer insulin? | Yes | 2.11  | 164    | 0.036* | 2.73                 |
|           | No                      |       |        |        |                      |
| Demonstrate injection technique during first training: | Yes | 2.813 | 164    | 0.006* | 1.27                 |
|           | No                      |       |        |        |                      |

### Table 4: Observational checklist of patients’ skill related to self-insulin administration
| Items                                                   | Correct | Incorrect | Skipped |
|---------------------------------------------------------|---------|-----------|---------|
| Showed injection sites                                  | 160(94.6) | 4(2.4)    | 2(1.2) |
| Showed injection site rotations                         | 116(69.9) | 46(27.7)  | 4(2.4) |
| Showed how to shake NPH                                 | 92(55.4)  | 44(26.5)  | 30(18.1) |
| Showed how to pinch (fold) skin and inject with (45°)   | 108(65.1)  | 54(32.5)  | 4(2.4) |
| Showed how to draw insulin from the vial                | 86(51.8)   | 49(29.5)  | 31(18.7) |

Figures

![Knowledge of insulin storage and administration techniques score (%)](image)

**Key**
1. Do you know that vials and cartridges of insulin not currently (unopened) being used should be stored in the refrigerator (2 to 8 degrees) or (traditional equivalent methods) until their date of expiry away from freezing coils or freezer?
2. Do you know that Vials and cartridges which are in current use (opened) should be kept at cool and dark places of room temperature (15-25°C) or traditional equivalent methods?
3. Do you know that opened insulin should be discarded after 28 days of opening?
4. Do you know that in use cartridges should not be kept in the refrigerator?
5. Do you know that if using a vial, you should gently roll the vial between the palms of the hands and/or moving the insulin up and down 20 times?
6. Do you know that shaking or jarring can make insulin more likely to frost or clump?
7. Do you know that excess amount of insulin does not squirt back into the vial?
8. Do you know that insulin vials or cartridges should not keep in the glove box of a car?
9. Do you know that outdated (expired) insulin never be used?
10. Do you know that high temperatures/light/heat exposure can alter the effectiveness of insulin?
11. Do you know that cold insulin may bring and the action could be delayed?
12. Do you know that insulin should not be frozen?
13. Do you know that the distance to rotate on the same site is one thumb?
14. Do you know the suggested measures to avoid or minimize pain with injections?

Figure 1

Knowledge of insulin storage and administration techniques
**Insulin handling and injection experiences and practices score (%)**

| Practice                                                                 | Score |
|--------------------------------------------------------------------------|-------|
| Overall practices score                                                  | 53.89 |
| Ever rotated the injection site                                          | 60.75 |
| Clean the injection site prior to injection                              | 52.5  |
| Wash your hands and injection site before injection                      | 59    |
| Wipe the top of the bottle with Alcohol Swab                             | 40.25 |
| Ever been injecting insulin through your clothing                        | 33.75 |
| Remove insulin kept in the fridge and allowed to reach room temperature | 56    |
| Ever used opened (starting from stick a needle in the vial) insulin      | 43.25 |
| after 28 days                                                             |       |
| Labeled a newly opened vial and indicating the date of discarding        | 46    |
| Inspect insulin before inject it                                          | 63.5  |
| Ever used clumpy/frosted insulin after it has been thawed                | 46    |
| Discard if the insulin is discolored                                     | 63.75 |
| Mix well cloudy (NPH) insulin prior to use                               | 73.25 |
| Avoid extremes of cold or heat of insulin storage                        | 63    |
| Check expiry date of insulin vial or cartridge                           | 70.25 |

**Figure 2**

Insulin handling and injection experiences and practices