

A Prospective Study on Common Errors in Insulin Administration and the Impact of Patient Counselling on Minimizing Administration Errors in Type II Diabetic Patients in A Tertiary Care Hospital

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ABSTRACT

Introduction: Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels and its management requires appropriate pharmacological interventions and lifestyle modifications. Accurate insulin injection techniques and the use of advanced delivery systems helps in achieving optimal glycemic control. The role of pharmacist counselling in enhancing patient outcomes is well-established. This study aimed to evaluate the impact of targeted patient education on insulin administration errors and patient counselling.

Methods: A 6-month prospective observational study was conducted at Pushpagiri Medical College Hospital, Thiruvalla, Kerala in 113 participants with Type II diabetes. Data pertaining to insulin administration techniques and medication adherence was collected using a predesigned proforma and analyzed using the SPSS.

Results: The majority (75) used insulin syringes, while 38 used pens. Baseline assessments using the BIAS scale identified administration errors. Following the educational intervention and pharmacist counselling, insulin administration accuracy improved from 83.3% to 100% in syringe users and from 81.8% to 100% in pen users. Medication adherence also significantly improved post-education.

Conclusion: Insulin pen users made more administration errors than syringe users, especially during preparation and injection. However, targeted patient education helped reduce these errors and improved adherence in people with Type II diabetes.

Keywords: Insulin administration errors, Type 2 DM, Insulin pen, Insulin syringe, BIAS, MARS

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder marked by high blood glucose due to insufficient insulin production or poor insulin use. Uncontrolled diabetes can cause serious complications affecting blood vessels and nerves [1]. Type 1 Diabetes (T1D) is an autoimmune disease needing lifelong insulin therapy [2], while Type 2 Diabetes (T2D), more common in developed countries [3], is linked to sedentary lifestyles and poor diet. T2D develops when the body becomes insulin resistant or produces inadequate insulin. Prediabetes, a warning stage, involves elevated blood sugar not yet diagnostic for diabetes. Risk factors include obesity, inactivity, age over 35, family history, smoking, and certain ethnicities. Lifestyle changes like diet, exercise, and weight loss can delay or prevent T2D onset [4],[5],[6].

Gestational diabetes affects 15% of pregnancies worldwide. India has about 67 million diabetics, projected to reach 87 million by 2030[7]. Proper insulin injection techniques, including using shorter needles and rotating injection sites, are critical to avoid complications [8]. Medication adherence is vital; the Medication Adherence Rating Scale (MARS-10) helps track adherence and reasons for non-compliance [9]. Insulin delivery errors can cause dangerous blood sugar fluctuations. Insulin pumps, pens, and syringes are common delivery methods, with newer options like artificial pancreas systems available. Pharmacist counselling improves glycemic control and patient outcomes, suggesting expanded pharmacist roles in diabetes care, especially in countries like India [10].

This study aims to identify common errors in insulin administration among Type II diabetic patients in a tertiary care hospital using the BIAS scoring rubric, assess the impact of patient counselling on minimizing these errors, and enhance patient knowledge of insulin therapy, diabetes management, and lifestyle modifications through a patient information leaflet. Additionally, the study will evaluate patient medication adherence using the Medication Adherence Report Scale (MARS).

MATERIALS AND METHODS

Study Design

A prospective observational study was conducted in the department of general medicine at Pushpagiri Medical College Hospital, Thiruvalla, Kerala.

Study Population

The study population included all patients aged 25 years and above diagnosed with Type II Diabetes Mellitus in the Department of General Medicine.

Sample Size

The sample size was calculated using the formula: $n = d^2 Z_{\alpha}^2 (SD)^2$, where Z_{α} is the Z-value of α error at 5% (1.96), $\mu = 81.9$, $SD = 10.8$, and $d = 2$. This yielded a sample size of $n = 113$.

Inclusion Criteria

The study will include male and female in-patients and out-patients aged 25 years and above, diagnosed with Type II Diabetes Mellitus, who are currently on insulin therapy administered via syringe or pen, and who have voluntarily consented to participate.

Exclusion Criteria

The study will exclude patients who do not provide consent, those admitted to departments other than General Medicine, and patients who have been newly prescribed insulin therapy.

Study Procedure

It was a 6-month study that was conducted after getting approval from the ethical committee.

Patients were selected based on predefined inclusion and exclusion criteria. Informed consent was obtained from each participant. Demographic details (age, gender, etc.), insulin administration details (frequency, duration of therapy, type of insulin, device type, and prior instructions), and information on common insulin administration errors were collected. The BIAS scoring rubric was used to evaluate administration accuracy, and the MARS scale assessed medication adherence. Patients received counselling on insulin usage and educational leaflets to reinforce correct administration practices. A follow-up was conducted post-counselling to monitor changes.

Statistical Analysis

Data were properly coded and entered in Microsoft Excel and was statistically analysed using SPSS software, version 23.

RESULTS AND DISCUSSION

1. Distribution of study population based on type of insulin device used

Out of 113 participants in this study, a majority (66.4%, n=75) used insulin syringes, while a smaller proportion (33.6%, n=38) preferred insulin pens. The higher usage of syringes in our study may reflect factors such as cost or patient familiarity with traditional methods. The result negatively correlates with findings from **Graff et al. (1998)**⁸², where 92% of patients using the Novolin Prefilled pen reported that these devices were easy to use.

2. Distribution of study population based on type of insulin device used and frequency of administration

In this study, a higher proportion of insulin pen users (21.1%) administered insulin once daily compared to syringe users (2.7%), administering insulin twice daily. The chi-square test ($\chi^2 = 10.842$, $p = 0.004$) indicated a statistically significant association between the type of insulin device used and the frequency of administration, suggesting that insulin pen users were more likely to administer insulin once daily compared to syringe users, who predominantly followed a twice-daily regimen.

3. Distribution of study population based on type of insulin device used and insulin type used

In this study, the majority of syringe users (85.3%) used Mixtard, followed by Actrapid (10.7%) and Isophane (4%), with no participants using Glargine. Among insulin pen users, Mixtard was also the most commonly used (63.2%), followed by Actrapid (21.1%), Isophane (13.2%), and Glargine (2.6%). The chi-square test ($\chi^2 = 8.475$, $p = 0.037$) indicated a statistically significant association between the type of insulin device and the type of insulin used, suggesting that Mixtard was predominantly used among syringe users, while insulin pen users showed a slightly more diverse distribution of insulin types, including a small proportion using Glargine.

4. Comparison of correct insulin administration techniques before and after patient counselling

In this study of 113 participants syringe users demonstrated a 100% correctness rate in preparation and injection techniques, whereas pen users had a significantly lower rate of 71.4%. Post-counselling, syringe users improved from 60% to 100% in drawing up insulin. The intervention led to a significant improvement in insulin administration techniques among both syringe and pen users, with overall correctness increasing to 100% in both groups. This highlights the effectiveness of targeted counselling in enhancing self-administration skills. The findings from this study and the article by **Trief et al. (2016)**¹⁰ align in highlighting the prevalence of errors in insulin self-administration among patients with diabetes. Their study found that syringe users had a mean BIAS score of 89.1%, while pen users had a mean score of 80.8%, with pen users performing poorly in preparatory steps like priming the pen. This suggests that

errors in insulin administration are prevalent across both delivery methods, with pen users exhibiting more frequent omissions.

5. Comparison of medication adherence score (MARS) before and after patient counselling

This study utilized the MARS-10 to assess patient adherence to insulin therapy and demonstrated its practical application in a clinical setting. A significant increase in median MARS-10 scores from 8 to 10, post-counselling was observed, highlighting the improved adherence among syringe and insulin pen users following pharmacist-led counselling. The findings were compared with the article by **Chan et al. (2020)**⁹ and depicted similar results, reinforcing the effectiveness of structured health education in improving medication adherence.

Table1: Distribution of study population based on type of insulin device used.

Type of insulin device	Frequency	Percentage
Syringe	75	66.4
Insulin Pen	38	33.6
Total	113	100.0

Figure1: Distribution of study population based on type of insulin device used.

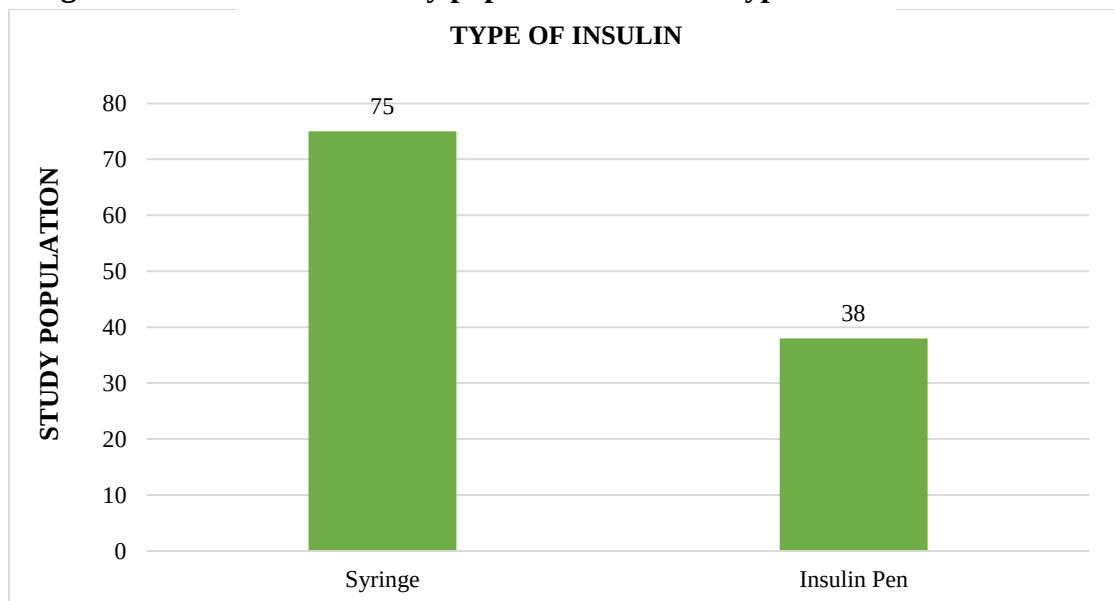


Table 2: Distribution of study population based on type of insulin device used & frequency of administration

Type of insulin device used	Frequency of administration			Total
	Once	Two Times	Three Times	
Syringe	2(2.7%)	68(90.7%)	5(6.7%)	75(100%)

Insulin Pen	8(21.1%)	27(71.1%)	3(7.9%)	38(100%)
Total	10(8.8%)	95(84.1%)	8(7.1%)	113(100%)

$\chi^2 = 10.842$, $P = 0.004$ (Significant)

Figure 2: Distribution of study population based on type of insulin device used & frequency of administration

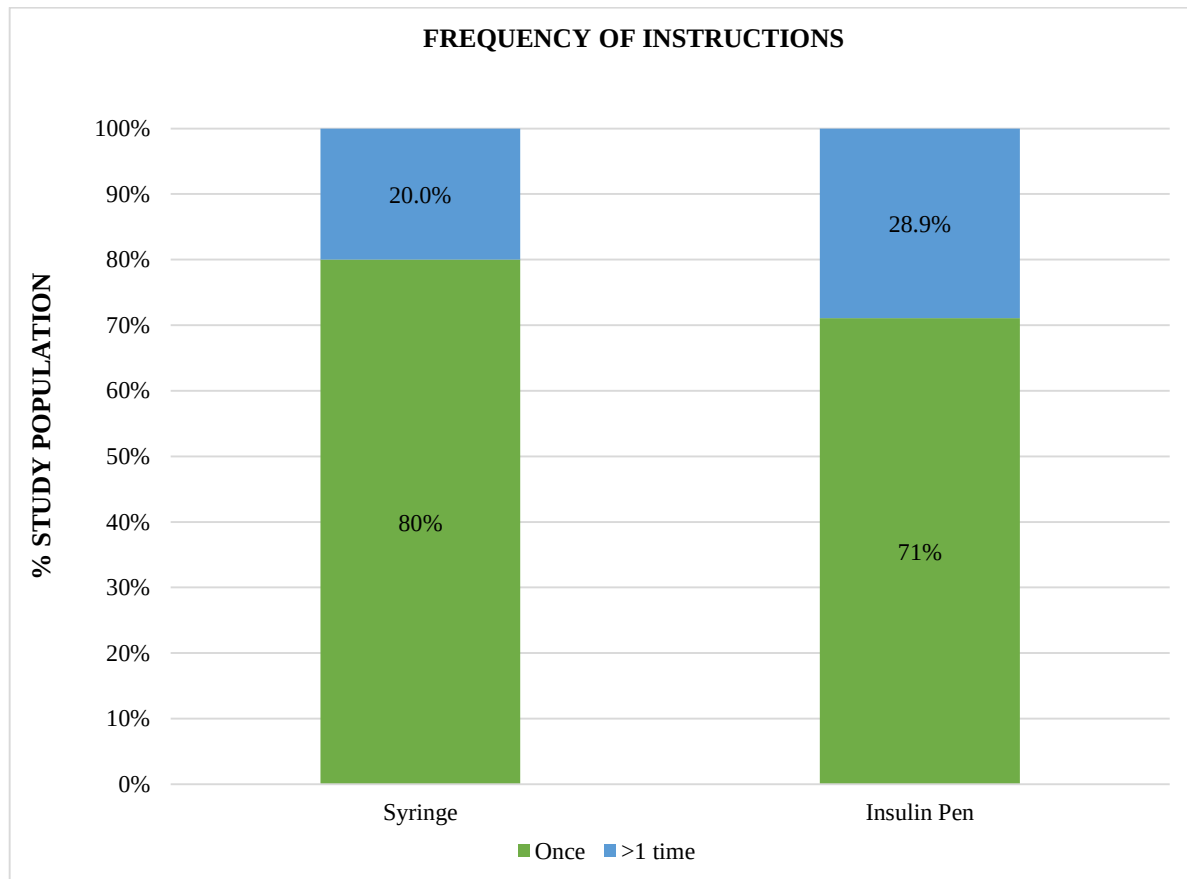


Table 3: Distribution of study population based on type of insulin device used & Insulin type used.

Type of insulin device used	Insulin type used				Total
	Mixtard	Actrapid	Isophane	Glargine	
Syringe	64(85.3%)	8(10.7%)	3(4%)	0(0%)	75(100%)
Insulin Pen	24(63.2%)	8(21.1%)	5(13.2%)	1(2.6%)	38(100%)
Total	88(77.9%)	16(14.2%)	8(7.1%)	1(0.9%)	113(100%)

$\chi^2 = 8.475$, $P = 0.037$ (Significant)

Figure 3: Distribution of study population based on type of insulin device used & Insulin type used.

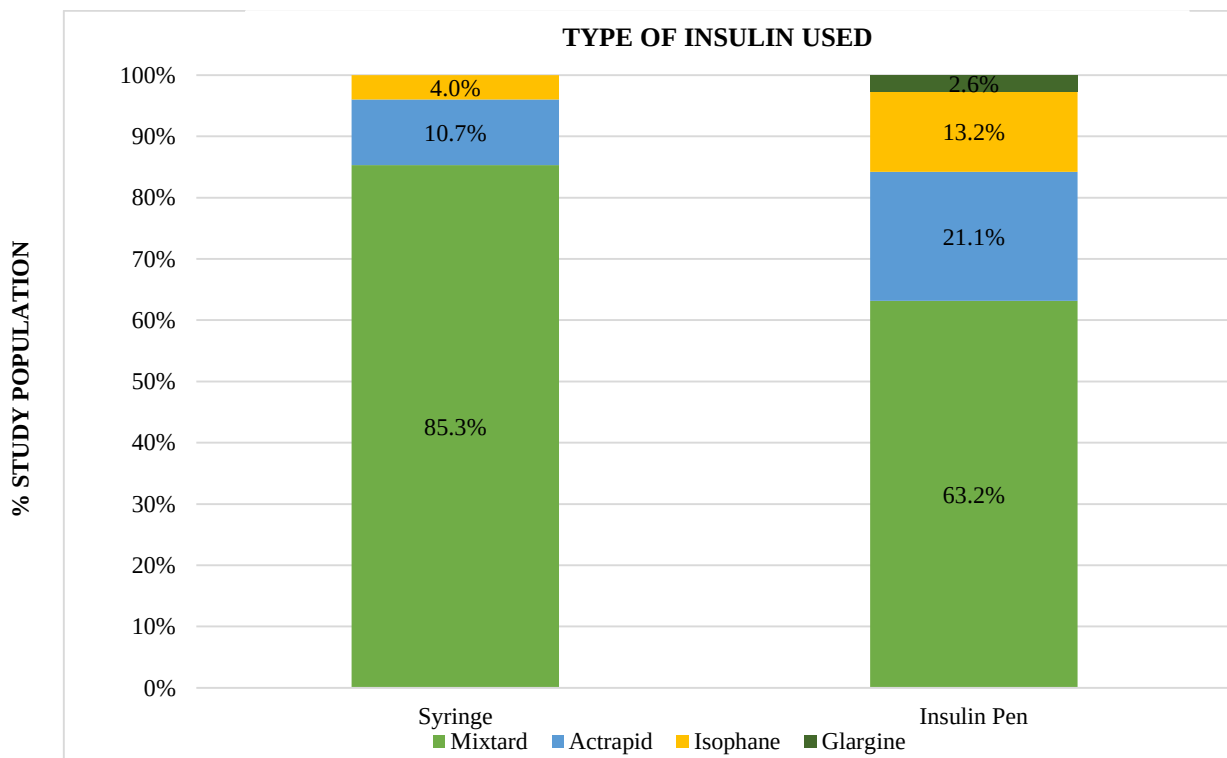


Table 4: Comparison of Correct Insulin Administration Techniques before and after patient counselling

Type of insulin device used	Stage of insulin administration	% of correct observations -Median (IQR)		Test statistic [#] & P value
		Before counselling	After counselling	
Syringe	Preparation	100 (0)	100 (0)	Z= 1.00,P=0.317
	Drawing up insulin	60 (20)	100 (0)	Z= 6.297,P<0.001*
	Injecting Insulin	100(0)	100 (0)	Z= 3.271,P<0.001*
	Overall	83.3 (8.3)	100(8.3)	Z= 6.667,P<0.001*
Insulin Pen	Preparation	71.4 (0)	100 (0)	Z= 5.260,P<0.001*
	Injecting Insulin	71.4(0)	100 (0)	Z= 5.157,P<0.001*
	Overall	81.8(9.1)	100 (2.3)	Z= 4.965,P<0.001*

[#] Wilcoxon Sign Rank Test, * Statistically significant at $p < 0.05$

Table 5: Comparison of medication adherence Score (MARS) before and after patient counselling

Study Group	Medication adherence (MARS)Score-Median (IQR)		Test statistic [#] & P value
	Before patient counselling	After patient counselling	
Syringe	8(3)	10(1)	Z= 6.162 p<0.001*
Insulin Pen	7.5(3)	10(1)	Z= 4.367 p<0.001*
Overall	8(3)	10(1)	Z= 7.529 p<0.001*

[#] Wilcoxon Sign Rank Test, * Statistically significant at $p < 0.05$

CONCLUSION

Insulin administration errors are a common challenge in diabetes management and can have a significant impact on patient health. These errors often stem from factors such as incorrect dosing, improper injection techniques, and misunderstandings regarding the timing and storage of insulin. Effectively addressing these issues is vital for achieving optimal glycemic control and reducing the risk of complications like hypoglycemia and hyperglycemia.

The findings of the study indicate that while insulin administration errors are widespread, they can be substantially reduced through patient counselling. It strongly indicates that structured education not only improves insulin administration techniques but also enhances adherence.

Future studies could explore the impact of insulin administration techniques on glycemic control by correlating them with clinical parameters such as HbA1c, thereby providing further validation for the current findings.

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