Pharmacist-led counseling on insulin pens: A pre-post study in Nguyen Tri Phuong Hospital

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Abstract

Background: Improper insulin pen use remains a significant barrier to optimal glycemic control, leading to treatment inefficacy and increased risk of complications. This study aimed to evaluate the impact of pharmacist-led counseling on outpatients' knowledge, attitude, and practice (KAP) regarding insulin pen use at Nguyen Tri Phuong Hospital. **Materials and methods**: A pre-post intervention study was conducted with 127 post-intervention patients out of 219 pre-interventions in a month (10 - 11/2022). **Results:** 219 patients participated in the consultation, and 127 were research subjects. After the intervention, patients with good knowledge, positive attitude, and good practice increased significantly from 57.5% to 91.3%. (p<0.001), from 78.7% to 93.7% (p<0.001), and from 43.3% to 88.2% (p<0.001), respectively. Correct steps increased strongly were "perform a safety test or air shot" (from 18.9 - 24.4% to 69.3 - 76.4%), "keeping the injection button at the injection site for at least 5 seconds" (from 46.5% to 89.8%), and "remove and discard the needle" (from 17.3% to 67.7%). **Conclusions:** Pharmacist-led counseling significantly improved patients' knowledge, attitude, and practice regarding insulin pen use.

Keywords: *knowledge, attitude, insulin pen, practice skills, clinical pharmacist.*

1. INTRODUCTION

Diabetes is one of the global health concerns today. According to statistics from the International Diabetes Federation [1], more than 537 million adults worldwide were affected in 2021. This number is predicted to rise to 643 million by 2030. Over 3 in 4 adults with diabetes live in low- and middle-income countries. In Vietnam, according to the Ministry of Health [2], there were approximately 3.99 million people aged 20 - 79 affected by the disease in 2021, and this number is expected to rise to 4,96 million by 2030. In Ho Chi Minh City, the rate of new cases in middle-aged people is 11.2% [3].

Insulin is a high-alert medication in both inpatient and outpatient settings [4]. Many studies also found that the diversity of insulin preparations, the lack of knowledge of medicines, diabetes, and errors in the practice of using insulin pens in patients with diabetes were essential causes of non-compliance with treatment, reduced effectiveness and increased risk of harmful events of drugs such as severe hypoglycemia, injection site reactions, and diabetes complications [5]. Many studies showed that educational interventions led by clinical pharmacists improved patients' knowledge of the disease, insulin use, diabetes control, and prevented its complications [6-8].

As a developing country, Vietnam is at an early stage in implementing clinical pharmacy activities in chronic diseases. The most recent development in this area was Vietnam's Ministry of Health's release of a Guideline on clinical pharmacy practice for pharmacists in the number of non-communicable diseases in 2019 [9]. This is considered as a national and professional guide with scientific and practical value that will help implement and evaluate clinical pharmacy activities at hospitals. Of those, there is a detailed guideline of clinical pharmacy practice for the management of diabetes. Among the early adopters, Nguyen Tri Phuong Hospital, a tertiary care center in Ho Chi Minh City, established one of the first pharmacist-led outpatient clinics in the country. Despite serving a large diabetic population, improper insulin pen use remains common, highlighting the urgent need for effective patient education. This study aimed to evaluate the impact of pharmacist-led counseling on outpatients' knowledge, attitude, and practice (KAP) regarding insulin pen use, thereby contributing to the growing evidence base for clinical pharmacy roles in Vietnam.

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2. MATERIALS AND METHODS

2.1. Study design and participants

Study design was a pre-post study with one group measured before the educational intervention and again after the intervention. The inclusion criteria included patients 18 years and older who were prescribed an insulin pen to treat diabetes for at least one month, had fasting blood glucose (FPG) test results, and agreed to participate during October 2022. Exclusion criteria were patients with hearing problems or abnormal mental health conditions, inability to communicate or to self-administer insulin pen.

2.2. Sample size and sampling method

With the hypothesis that pharmacist-led counseling will improve the proportion of patients with good knowledge from 45.9% (according to the study of Cuc et al.) [10] to 70.0%, the minimum required sample size was determined by Sample Size Calculator for Comparing Paired Proportions in Statulator website [11] with specifying marginal proportions (expected proportion in the reference group was 45.9% and expected proportion in the comparative group was 70.0) and correlation between paired observations was 0.8. The result was at least 23 required patients to achieve a power of 80% and a two-sided significance of 5%. Sampling method was a purposive sampling with convenience sampling method.

2.3. Research process

The steps of research process include:

Step 1: Patients who received drugs at pharmacy and met the selection and exclusion criteria were invited by the pharmacist to participate in the study.

Step 2: Patients agreed to participate in the study and the pharmacist began to collect patient information, assess KAP at the pharmacist's clinic (about 7 minutes) (Time T1).

Step 3: Pharmacists consulted patients according to the printed booklet and invited patients to return to the pharmacist's clinic 3 months later (about 7 minutes).

Step 4: After 3 months, the pharmacist assessed KAP at the pharmacist's clinic (about 10 minutes) (Time T2).

The content of the patient's booklet was designed in A5 format, 10 pages, printed in color and distributed to patients during consultation. The booklet was based on sources from the Ministry of Health [9] including the following sections: types of insulins, structure of insulin pen, steps of injection of insulin pen, storage.

2.4. Measurement instrument

The patient information was collected through a face-to-face interview. The questionnaire consists of 4 parts: part 1: Socio-demographic and clinical characteristics of the patients; part 2: Knowledge of insulin pen; part 3: attitude of insulin pen, and part 4: practice of insulin pen use.

Socio-demographic and clinical characteristics form: The socio-demographic data (age, gender, BMI, location, occupation, education level) and clinical characteristics data (type, duration of diabetes, family history, comorbidities, duration of insulin treatment, type of insulin pen, number of insulin injections per day, whether ever using another insulin vial or pen than the currently prescribed type and double-checking the data in the outpatient medical records.

Development of KAP questionnaire and data collection: The questionnaire used for the survey related to KAP was developed based on similar questionnaires that have been developed and used in previous research [12].

The patient's knowledge was assessed using a multi-choice questionnaire, including knowledge about hypoglycemia (5 questions) and using insulin pens (14 questions). Each correct answer is "1 point"; the wrong answer or no answer is "0 point". Patients scoring ≥50% were considered to have good knowledge. The total score ranges of 0 to 9 and 10 to 19 were considered as poor and good knowledge, respectively.

Attitude was assessed with eight 5-point Likert scales related to patients' opinion on the role of insulin. For example: "Insulin use helps to improve your health". Responses to above questions were from strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), or strongly agree (5). The average attitude score of each patient was above 3 points, which was classified as having a positive attitude (neither agree nor disagree; agree; or strongly agree).

Practice was assessed using a 15-step checklist, in which patients were asked to demonstrate the insulin injection procedure using sample pens. Clinical pharmacists directly observed and evaluated each step as either correctly or incorrectly performed. Among the 15 steps, two were identified as critical for ensuring accurate dosing: (1) determining the correct injection dose, and (2) fully pressing the injection button and holding the needle in place for at least 5 seconds. These steps are essential because they directly influence the amount of insulin

administered and consequently the treatment's effectiveness. Based on these two critical steps, insulin injection practice was categorized as "good dosing practice" if both steps were performed correctly, or "poor dosing practice" if either of the steps was performed incorrectly [5].

The reliability of the 5-point Likert scale assessing patients' attitudes was evaluated by Cronbach's Alpha coefficient and Factor Loading factor in exploratory factor analysis. Cronbach's Alpha α = 0.872, and the observed variables all have a variable-total correlation (Corrected Item - Total Correlation) greater than 0.3, so the scale is reliable, and the observed variables are meaningful and suitable for the attitude factor. The results of the rotated matrix show that the eight observed variables are divided into two factors. Each factor has four observed variables, and all observed variables have a Factor Loading factor greater than 0.5, so all observed variables are accepted and will be used in the analysis.

2.5. Ethical considerations

The Research Ethics Committee of Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam, approved this study and its council (No. 1652/NTP-CĐT). The patients provided their written informed consent to participate in this study.

2.6. Statistical analysis

Microsoft Excel collected the responses, filtered and stored the study's data, and then calculated with SPSS version 20.0. The Kolmogorov-Smirnov validation determines the standard distribution. The demographic characteristics of the participants were analyzed using statistical tests described: continuous variables with standard distribution represented by mean ± standard deviation, non-standard distribution defined with median (interquartile range), and non-continuous variables described in percentage. Chi-square determines the statistically significant difference between the dependent variable and the subject's characteristics. Values are considered statistically significant when $p < 0.001$.

3. RESULTS

3.1. Patient characteristics

A total of 219 patients were initially recruited during the pre-intervention phase. Among them, 127 patients agreed to participate in the full intervention and completed both pre- and post-intervention assessments. Therefore, 127 participants were included in the final analysis of this intervention study (Table 1). Regarding general characteristics, the majority were female (60.6%) and 60 years old and older (61.4%), and the average age was 61 ± 10.5. 63.8% of patients were overweight and obese. Most patients lived in urban areas (88.2%), more than half lived at home or retired (59.1%), and 63.8% of respondents had a high school degree or higher. Regarding pathological characteristics, all patients have type 2 diabetes; more than 44% of patients had a relative with diabetes. Nearly 97% of people with diabetes had comorbidities. Patients with diabetes for more than ten years accounted for 37.8%, and 77.2% of respondents had the time prescribed insulin for more than one year. Regarding drug use characteristics, patients mainly used Lantus injection pens (46.5%), more than 70% of patients used a vial of insulin pens other than the type they were using, 78% of patients only got one injection during the day.

Table 1. Baseline data of participants (n=127)

Parameter	Distribution N (%)
Sex, Female Male	77 (60.6)
Age, 18-59 ≥ 60 years old	78 (61.4)
BMI (kg/m^2)	
Underweight (<18.5)	2 (1.6)
Normal (18.5 = 22.9)	44 (34.6)
Overweight (23 = 27.9)	28 (22.0)
Obese (≥28.0)	53 (41.8)

Parameter	Distribution N (%)
Location, Urban Rural	112 (88.2)
Active occupation, Yes No	51 (40.1)
Level of education	
Less than high school	46 (36.2)
High school or higher	81 (63.8)
Type of diabetes, type 2	127 (100.0)
Duration of diabetes (years)	
< 5	37 (29.1)
5 - 10	42 (33.1)
> 10	48 (37.8)
Duration of insulin use (years)	
< 1	29 (22.8)
1 - 3	64 (50.4)
> 3	34 (26.8)
Family history of having diabetes, Yes No	57 (44.9)
Comorbidity, Yes No	123 (96.9)
Insulin pens	
Long-acting insulin	
Lantus Solostar	59 (46.5)
Toujeo Solostar	24 (18.9)
Tresiba Flextouch	10 (7.9)
Insunova-G	3 (2.4)
Pre-mixed insulin	
Ryzodeg Flextouch	5 (3.9)
Humalog Mix 75/25 Kwikpen	5 (8.7)
Mixtard 30 Flexpen	11 (8.7)
NovoMix 30 FlexPen	10 (7.9)
Number of injections per day	
1	99 (78.0)
2	26 (20.5)
3	2 (1.5)
Used to take other vial of insulin pens, Yes	90 (70.9)

3.2. The impact of pharmacist-led counseling on insulin pen

3.2.1. Knowledge

After the intervention, patients with good knowledge increased significantly from 57.5% to 91.3%. (p<0.001) with median of total score from 10 to 16 while the maximum score was 19 (Table 2).

Table 2. Frequency distributions of correct answer to questions related to knowledge before and after intervention

Question	Right answer N (%)		P value
	Before	After	
Know the blood glucose levels of hypoglycemia	21 (16.5)	47 (37.0)	< 0.001
Understand the causes of hypoglycemia	52 (40.9)	104 (81.9)	< 0.001
Know the symptoms of hypoglycemia	113 (89.0)	126 (99.2)	0.144
Know how to use a glucometer to check blood glucose at home	18 (14.2)	80 (63.0)	< 0.001
Name measures to treat hypoglycemia	110 (86.6)	126 (99.2)	0.085
Know the various types of insulin	111 (87.4)	124 (97.6)	0.150
Know the body injection sites	41 (32.3)	122 (96.1)	< 0.001
Know how to rotate the injection sites	127 (100.0)	127 (100.0)	-
Know how to wash your hands and clean/disinfect the injection site before injecting	108 (85.0)	120 (94.5)	0.004
Know how long to keep the needle at the injection site	59 (46.5)	114 (89.8)	< 0.001
Know the injection site complications	95 (74.8)	116 (91.3)	0.023
Knowing the right time to inject insulin	99 (78.0)	107 (84.3)	0.102
Know the length of the insulin needle	62 (48.8)	117 (92.1)	< 0.001
Know how to handle needle tips after injection	9 (7.1)	30 (23.6)	0.017
Know how to throw away the needle tip after injection	13 (10.2)	20 (15.7)	0.673
Know how to preserve unused injection pens	123 (96.9)	127 (100.0)	0.014
Know how to preserve the injection pen in use	22 (17.3)	91 (71.7)	< 0.001
Know how to warm/shake the injection pen before injecting	77 (60.6)	119 (93.7)	< 0.001
Know how long to use your insulin pen after opening it	42 (33.1)	115 (90.6)	< 0.001
Total score, Median (InterQuartile Range)	10 (9-12)	16 (15-17)	< 0.001
Good knowledge	73 (57.5)	116 (91.3)	< 0.001

3.2.2. Attitude

After the intervention, patients' positive attitudes toward insulin use improved significantly, increasing from 78.7% to 93.7% (p<0.001). Some positive perceptions rose markedly, such as the belief that insulin helps prevent diabetes complications (from 46.5% to 70.1%, p=0.004) and improves health (from 54.3% to 74.8%, p = 0.011). However, the proportion of patients who found insulin injections easy to perform decreased from 81.9% to 51.2% (p<0.001), indicating potential challenges post-intervention. Overall, the intervention helped patients gain a more positive outlook on the effectiveness and necessity of insulin in diabetes management (Table 3).

Table 3. Frequency distributions of patients' responses regarding attitudes before and after intervention

Item	Positive response N (%)		p
	Before	After	
Insulin use helps to prevent complications of diabetes.	59 (46.5)	89 (70.1)	0.004
Insulin use helps to improve your health.	69 (54.3)	95 (74.8)	0.011
Insulin use helps to control blood glucose better.	100 (78.7)	106 (83.5)	0.247
Insulin pen injection techniques are very easy.	104 (81.9)	65 (51.2)	< 0.001

Insulin pen injections is not time consuming.	104 (81.9)	120 (94.5)	< 0.001
Once insulin is started diet, exercise, and oral anti-diabetic drugs are not enough to control diabetes.	26 (20.5)	76 (59.8)	< 0.001
Starting insulin does not means my worse diabetic condition.	43 (33.9)	65 (51.2)	0.057
Insulin therapy does not make me more depend on a physician	46 (36.2)	50 (39.4)	0.780
Positive attitude	100 (78,7)	119 (93.7)	< 0.001

3.2.3. Practice

Correct steps increased strongly were "perform a safety test or air shot" (from 18.9 - 24.4% to 69.3 - 76.4%), "keeping the injection button at the injection site for at least 5 seconds" (from 46.5% to 89.8%), and "remove and discard the needle" (from 17.3% to 67.7%). After the intervention, patients with good dosing practice increased significantly from 43.3% to 88.2% (p<0.001) (Table 4).

Table 4. Correct practice of each step when practicing insulin pen before and after intervention

Steps	N (%)		P value
	Before	After	
Remove the cap from the pen.	127 (100.0)	127 (100.0)	-
Gently roll the pen back and forth between the palms of your hands ten times. Tip the pen up and down ten times (90°) to ensure a consistently milky white appearance (You'll need the outer cap to remove the needle from the pen when you're done with the injection).	77 (60.6)	109 (85.8)	< 0.001
Remove the paper protecting the new needle.	127 (100.0)	127 (100.0)	-
Attach a needle to the pen.	127 (100.0)	127 (100.0)	-
Use the dose adjustment knob to rotate 1-2 units.	31 (24.4)	97 (76.4)	< 0.001
Hold the injection pen with the needle tip facing up. Gently tap the insulin chamber to push air bubbles onto the tip of the needle.	24 (18.9)	88 (69.3)	< 0.001
Hold the needle upward and press the injection button at the end of the pen. Until you see a drop of insulin flow out of the tip of the needle.	31 (24.4)	97 (76.4)	< 0.001
Turn the dose selector knob. If you overshoot, you can reverse it. Read the dose scale correctly.*	122 (96.1)	125 (98.4)	0.295
Disinfect the injection area and pinch the skin at the injection area.	97 (76.3)	120 (94.5)	< 0.001
Hold the pen correctly (thumb on the injection button) and inject it into the injection site at a straight angle of 90° or an angle of 45°.	94 (74.0)	123 (96.9)	< 0.001
Press the injection button until the end of the dose, keeping the injection button at the injection site for at least 5 seconds.*	59 (46.5)	114 (89.8)	< 0.001
Remove the needle from the injection site.	127 (100.0)	127 (100.0)	-
Take the large outer cap and cover it with the needle.	22 (17.3)	86 (67.7)	< 0.001
Turn counterclockwise to remove the needle, and throw the tip in the trash.	22 (17.3)	86 (67.7)	< 0.001
Reattach the pen cap.	127 (100.0)	127 (100.0)	-
Poor dosing practice	72 (56.7)	15 (11.8)	< 0.001
Good dosing practice	55 (43.3)	112 (88.2)	

* two step were identified as critical for ensuring "Good dosing practice"

4. DISCUSSION

The impact of pharmacist-led counseling on insulin pen on patient's knowledge

Before the intervention, several critical knowledge areas related to insulin use were poorly understood by patients. Notably, only 16.5% of participants correctly identified the blood glucose levels defining hypoglycemia (A1), and just 14.2% knew how to use a glucometer to check blood glucose at home (A4). Understanding of the causes of hypoglycemia (A2), the correct insulin injection sites (B2), the appropriate needle holding time (B5), and the duration of insulin use after opening (B14) were also substantially limited, with correct response rates ranging from 17.3% to 48.8%. Similar poor knowledge of patients related to diabetes and insulin use were reported in other studies [5-8].

After the pharmacist-led counseling intervention, significant improvements were observed across these knowledge domains. For instance, the proportion of patients knowing the blood glucose threshold for hypoglycemia increased from 16.5% to 37.0% ($p<0.001$), and knowledge of using a glucometer rose from 14.2% to 63.0% ($p<0.001$). Understanding of insulin injection techniques markedly improved, including knowing injection sites (32.3% to 96.1%), the length of insulin needles (48.8% to 92.1%), and the appropriate time to use insulin pens after opening (33.1% to 90.6%), all with p-values < 0.001.

These findings indicate that pharmacist counseling effectively addressed patients' knowledge gaps, especially in areas directly related to safe and effective insulin administration. The overall rate of patients with "good knowledge" rose significantly from 57.5% to 91.3% ($p<0.001$), emphasizing the importance of structured education in diabetes care [9].

The impact of pharmacist-led counseling on insulin pen on patient's attitude

The findings of this study indicate that pharmacist-led education had a positive impact on patients' attitudes toward insulin therapy. After receiving individualized counseling and practical guidance, patients demonstrated a more favorable perception of insulin use, particularly in understanding its role in preventing complications and improving overall health outcomes.

The positive attitude toward insulin in participants increased significantly from 78.7% to 93.7% after the intervention ($p<0.001$), showing a notable impact of the intervention on patients' perceptions. This result suggests that educational support not only improves knowledge but also addresses emotional and psychological concerns associated with insulin use. Similarly, Ngo et al. (2021) [10] found a high prevalence of positive attitudes (85%) among patients using insulin, although they did not report a specific intervention designed to shift attitudes. This highlights the added value of structured, pharmacist-led interventions in enhancing patients' acceptance of insulin therapy.

Educational interventions appeared to help mitigate some common misconceptions and psychological barriers to insulin use, such as fear of dependency or concerns about lifestyle limitations. Although some attitudes, especially those deeply rooted in personal beliefs or previous experiences, were less influenced, the overall shift toward more positive attitudes suggest that pharmacists can play a vital role in addressing emotional and cognitive resistance to insulin initiation and adherence.

This aligns with previous literature, which highlights that providing patients with clear, empathetic, and personalized information about insulin therapy can foster greater acceptance and willingness to engage with treatment plans. Moreover, by improving patients' confidence and reducing negative perceptions, pharmacist-led education may ultimately enhance long-term treatment success and diabetes management.

The impact of pharmacist-led counseling on insulin pen on patient's practice

A study by Nguyen Thi Thao et al. on drug-related problems (DRPs) in elderly outpatients with type 2 diabetes at Huu Nghi Hospital reported that nearly 50% of patients experienced behavioral DRPs, commonly due to non-adherence and incorrect insulin injection techniques [13]. Many studies showed poor practice of insulin pen use [5, 14, 15]. Similarly, in our study, the most frequent errors were observed in critical steps such as dose priming (Steps 5 - 7: using the dose adjustment knob, removing air bubbles, and ensuring insulin flow from the needle tip), correct injection technique (Steps 9 - 11: skin pinching, injecting at the correct angle, and holding the injection button), and safe needle disposal (Steps 13 - 14: capping and removing the needle). These steps showed statistically significant improvement post-intervention ($p<0.001$), indicating the substantial impact of pharmacist-led counseling on patient practice and safety in insulin use.

The limitation of our study is the limited time, so the intervention period of our study was only three months, so it did not significantly impact clinical

parameters. Many studies have shown that more extended intervention periods > 6 months significantly affect clinical parameters. This result is the foundation for the initial recognition of the role of pharmacists in consulting and educational intervention in improving treatment effetiveness in people with diabetes. Further research is needed, and repeated intervention time is required. More protracted intervention to achieve adequate blood sugar control for patients. Moreover, assessing clinical parameters such as HbA1c and FPG is essential to evaluate the effectiveness of pharmacist-led interventions.

5. CONCLUSION

Pharmacist-led counseling significantly improved patients' knowledge, attitude, and practice regarding insulin pen use. The intervention particularly enhanced critical steps in the injection technique, contributing to safer and more effective insulin administration. These findings highlight the essential role of pharmacists in diabetes education and support integrating structured counseling into routine outpatient care.

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