Investigating The Effect of of Pharmacist Educational Intervention on the Proper Use of Insulin Pen in Older Patients with Type 2 Diabetes Mellitus in Primary Health Care and Diabetic Centres in Makkah Al-Mukarramah, Saudi Arabia

Yosra Alhindi[1], Shahd Sharaf [2], Asayel Almeflahi[2], Renad Felemban[2], Enas Hamza[3], Aziza Aljehani[2], Sarah Mukhtar[2]

[1]Assistant Professor in Clinical pharmacy, Faculty of pharmacy, University of Umm Al-Qura, Makkah, KSA,
[2]B Pharm undergraduates, Faculty of pharmacy, University of Umm Al-Qura, Makkah, KSA.,
[3] Pharm D undergraduates, Faculty of pharmacy, University of Umm Al-Qura, Makkah, KSA.

Abstract

Objective: Diabetes mellitus (DM) is one of the fastest-growing health problems in the world, which is now reaching an epidemic proportion in some countries. There were around 3,852,000 cases of diabetes in Saudi Arabia in 2017. Geriatric patients are at particularly high risk, especially those who lack the knowledge of self-care to control their blood glucose levels. When reviewing the literature, we did not find any focus on educational interventions to reduce the errors related to the use of an insulin pen. Therefore, it is essential to conduct research to measure these outcomes and apply the applicable intervention if needed. **Aim:** The aim of this study was to evaluate the impact of pharmacist-conducted educational intervention on reducing the errors related to inappropriate insulin pen use. **Methods:** A multicentred, prospective, before-and-after study with an educational intervention component was carried out. The study was conducted on (n = 1500) elderly type 2 diabetic patients. **Results:** The patients' mean age was approximately 65.2 ± 3.5 years old with a male to female ratio of 60:40. Around 95.5% of patients stated that they had received instructions for insulin pen use from their physicians. The average duration of their diabetes was approximately 15 ± 2.8 years. After giving complete instructions to the patients, we found an improvement in insulin pen use by approximately 30 %, and a significant decrease in the rate of errors. **Conclusion:** Pharmacists can play an important role in the safety and efficiency of the use of insulin pens in elderly diabetic patients by decreasing the likelihood of medication errors associated with them.

Key Words: *Insulin pen, Diabetes, Old age, Educaional intervention.*

Introduction

Diabetes is considered a public health concern that is correlated with serious long-term consequences and escalating healthcare costs [1, 2]. For the elderly, treatment of type 2 diabetes represents a huge challenge both in terms of clinical management and public health [3, 4]. In general, the aging process can develop a marked increase in the pandemic of diabetes in elderly people. However, scientific evidence to support the most appropriate treatment for diabetes in the elderly is not very common [4]. Given the heterogeneity of the elderly population, which contains subjects with very different functional and cognitive capacities, co-morbidities and life expectancies, it is essential to make a development assessment from a biopsychosocial perspective to address the vascular risk factors integrally and to establish individually tailored targets for glycaemic control [5]. The elderly or individuals with a short life expectancy may be expected to maintain HbA_{1c} level between 7.6%–8.5% [5]. However, the ideal HbA_{1c} target

Corresponding author
Yosra alhindi
Assistant Professor
Yzhindi@uqu.edu.sa
00966504530609

level of < 7% may be difficult to achieve in the elderly but is recommended for all adults. Research is lacking regarding the benefit of tight control in the very elderly (> 80 years of age) [2].

Furthermore, the therapeutic management of elderly patients with type 2 diabetes should be individualised and agreed with the patient and their caregivers, according to the objective. Improving the quality of life, assuring patient safety and avoiding the adverse effects of antidiabetic treatment should be prioritised. Given the increased susceptibility of the elderly to severe hypoglycaemia and its consequences, antidiabetic therapies that minimise the risk of hypoglycaemic events should be selected [4, 5].

Insulin is an excellent way to maintain normal blood glucose levels. As insulin does not come in the form of pills, it should be injected through the skin [6]. The most common insulin injection methods are through a flask, injector (needle), pump or insulin pen. Generally, the health care provider should talk to the patient about the use of an insulin pen, and there are leaflets available that have been designed to give good and easy to read guides[6].

The ease of using the pen is especially important, not only for older patients who suffer from manual dexterity and tremors but also for younger individuals who are too busy to devote considerable time to inject themselves. Insulin pens are portable and, therefore, provide flexibility in daily life [9]. Lee et al. (2017) examined how the quality of life was improved when switching to insulin pens in 65 diabetic patients. Patients received an assessment on their glucose control after 12 weeks and were asked to fill out a questionnaire on quality of life related to health. The study showed that the use of insulin pens improved the control of blood sugar and health related to the quality of life in patients with diabetes. Thus improving the functional situation is an important aspect of this millennium [8].

It is important to understand that the role of the pharmacist should always be as an important member of the clinical team, to optimise a better clinical outcome [7]. We all think that the education and management of type 2 diabetes depends only on the physician, which is not accurate. Indeed, pharmacists have a key role in education and management which is important in successful medication adherence [7, 11,12].

Therefore, our main aim of this study was to evaluate the impact of pharmacist-conducted educational interventions on reducing the errors related to inappropriate insulin pen use. The objectives were to determine how elderly diabetics are using, storing and preparing their insulin pen. Moreover, to determine their adherence to using the insulin pen. In addition to determine if they receive any educational information to guide them about the insulin pen.

Method

Study design

A multicentred, prospective, before-and-after study with an educational intervention component with a total of 1500 type 2 diabetic patients was carried out. The study was conducted on elderly diabetic patients.

The study took place in

1. Al-Noor Hospital, Makkah (Diabetic centre)

2. King Abdullah Medical City, Makkah (Diabetic clinics)

3. Primary health care centre, (Aleskan)

Data were collected from medical case records and laboratory records.

The inclusion criteria were male and female elderly patients above 50 years old with type 2 diabetes, while the exclusion criteria were patients aged less than 50 years with type 1 and 2 diabetes, and other types of diabetes (e.g. gestational).

Data were collected through interviews using researcher-administered questionnaire, as well as the patients' medical records. Patients consented to take part and were then asked about the preparation, injection and storage techniques they followed when using insulin pens. Blood glucose parameters were extracted from the laboratory records. After the detection of errors, patients were instructed about insulin pen use by the (Graduated) pharmacist (authors of this study). Patients were re-evaluated after four weeks using the same questions from the questionnaires and new lab results.

Descriptive statistical analyses were used, and data were mean ± SD, data were analysed using Excel software (2018) $P < 0.05$ was considered statistically significant.

Results

Around 1500 patient were included in this study, their mean age was 65.2 ± 3.5 years old with a male to female ratio of 60:40. Around 95.5% of the patients stated that they had received instructions for insulin pen use from their physicians. However, the mean diabetes duration was 15 ± 2.8 years (Table 1).

Approximately 56.8 per cent of the study population reported that they changed the insulin pen needle with each use, 7.6 per cent daily, about 23.7 per cent after two uses, 0.8 per cent after seven uses, and 1.7 per cent did not change their needles. Moreover, the study showed that about 68.6 per cent of the study population indicated that they had no site-related injection reactions during use, while only 31.4 per cent complained about this side effect (Table 1). Almost 30 per cent (450 patients, $P < 0.05$) indicated that they had tried successfully to change their injection site, 22 per cent of patients tested and slightly successful, 11.7 per cent of patients tested but failed, and about 25 per cent of patients did not attempt to change the injection site at all.

In Comparing the patients' blood glucose parameters (last fasting blood glucose [FBG] read before intervention vs. 4 weeks after educational intervention) demonstrated a significant decline in the FBG levels which were found to be 143.7 ± 12.5 to 122.4 ± 13.1 mg/dl pre- and post-intervention, respectively ($P < 0.05$). There were no significant changes in the 2-hour postprandial glucose and random blood glucose measures.

Laboratory data analysis showed that HbA_{1c} levels did not significantly change (96.8% ± 0.7%- 95.7 ± 0.4%, $P = 0.18$) after 4 weeks of intervention (Table 2).

During the initial phase of the study, a total of around 50% of insulin pen-related errors were detected. This figure experienced a considerable decline after education to around 30% of errors $P < 0.05$ (Table 3).

Table 1. Base line characteristics and survey questions for the diabetic patients using insulin pens.

	Participants (n=1500) No. (%)
Characteristic	
Average age	65.2 ± 3.5 (30.02%)
Male: Female ratio	71:51 (41.0%: 30.0%)
Onset of patient diabetes?	
> 15 year	103(68.4%)
< 15 years	22(14.5%)
< 1 year	24(16.2%)
Instruction on how to use the insulin pen done by?	
Physician	143(95.5%)
Nurse	8(5.3%)
Pharmacist	3(2.0%)
Family member	2(1.0%)

Cont... **Table 1. Base line characteristics and survey questions for the diabetic patients using insulin pens.**

Frequency of changing the insulin pen needle	
With every use	68(57.3%)
After 7 uses	2(0.9%)
Every 2 days	3(1.7%)
None	3(1.7%)
Percentage of injection-related sites and related reactions	
Yes	600 (68.6%)
No	150 (31.4%)
Number of patients who tried to change their injection site	
Tried and succeed	42 (30.0%)
Tried and failed	25 (11.7%)
Tried and slightly succeed	28(22.0%)
Did not try	35(25.0%)

Table 2. Average blood glucose parameters before and after the educational intervention.

	Blood glucose levels mg/dl. (%)	**HBA1C > 6.5% No. (%)**	**HBA1C < 5.3% No. (%)**	**P-value**
Fasting blood glucose (FBG)				
Before	143.7 (97.5%)			*0.05
After	122.4 (74.4%)			
Random blood glucose (RBG)				
Before	122 (67.5%)			0.314
After	120 (74.4%)			
2 hours glucose tolerance (GTT)				
Before	177 (87.5%)			0.532
After	175 (73.4%)			
HBA1C%				
Before		145(96.8%)	15(10.0%)	0.18
After		134(95.7%)	13(9.0%)	

Table 3. Rate on incorrect insulin pen use among pateints before and after educatinal intervention

Errors in insulin pen use	Before intervention	After intervention	P
Multiple use of a needle	46.2%	22.9%	<0.05
Incorrect time of administration	2.7%	2.5%	0.23
Blocked needle	13.5%	9.2%	<0.05
Rolling insulin pen before use	32.6%	26.4%	<0.05
Detaching needle immediately after use	15.7%	11.3%	<0.05
Storage in refrigerator before opening the insulin pack	35.6%	20.8%	<0.01
Incorrect injection angle	33.2 %	15.5%	<0.01
Injection site related reactions	31.4%	30.4%	2.34
Rotation at the site of injection	30.0%	29.7%	1.67
Remaining needle within the injection site for 5-6 s	31.5%	28.7	0.17

Data are presented as n (%) of participants

Discussion

The main aim of our study was to assess the impact of pharmacist-conducted educational interventions on appropriate insulin pen use among elderly type 2 diabetic patients in primary health care and diabetic centres in Makkah AlMukarramh. 1500 outpatients who were using insulin pens and who visited the hospital outpatient clinics were considered for inclusion.

The main finding of our present study indicated that pharmacists giving complete instructions to patients improved insulin pen use by 30%, and significantly decreased the rate of errors associated with the inappropriate use of insulin pens. Regardless of the efforts in the health-care systems to decrease the rate of medication errors, insulin is still considered a high-alert medication that may need extra attention [11]. Data from previous studies among insulin pen users showed that in 75% of the patients, the method of insulin pen use was not in accordance with the manufacturer's instructions in terms of proper administration and storage. Therefore, it is essential to conduct coordination between health care professionals and patients for the rational use of insulin pens that can be of great help in this matter [11, 12, 14,15].

Most of the studies that have looked at appropriate insulin pen use have been performed on hospitalised patients while information about the correct use of insulin pens among outpatients in developing countries is rare. Mitchell, Porter and Beatty (2012) investigated the effect of educating hospitalised patients about insulin pen usage by pharmacists or nurses. They elucidated that an initial education on insulin pen use results in significantly better rates of correct usage [13]. Another study that assessed the role of the pharmacist in optimising insulin use in the hospital setting showed that the pharmacist's contribution could decrease the rate of medication errors in the prescription, transcription, dispensing and administration stages [11, 16, 17,18].

In our study, we collected data and performed the educational intervention in the outpatient diabetic clinics at Makkah Al-Mukarramah. We found that patient education reduced the number of insulin pen-related errors from 50% to 30% errors per patient. Despite this considerable decrease in the number of errors, this figure still remains high. There may be several factors contributing to this finding. First, more than 45% of the participants in this study had only a primary school education. Our results are similar to the results from another study that assessed the health of diabetic patients

and showed that patients with low knowledge of health are more susceptible to poor glycaemic control, and are more likely to develop retinopathy due to diabetes. The second factor is that the time in which we conducted our education was very short and we need more time to give patients multiple educational visits throughout the year.

In our study, around 95.5% of patients stated that they had received instructions for insulin pen use from their physician, while 4.5% of patients received instructions from their family members. We found that multiple use of the insulin pen needles constituted the largest proportion of detected errors with nearly 46.2%. Although a lack of knowledge might be the main reason for this error, some patients stated that they use the needles several times due to cost considerations; however, this issue decreased slightly after the educational intervention to about 22.9%.

Our current results showed that the patients' fasting blood glucose (FBG) had a significant decline after patient education from 143.7 ± 12.5 to 122.4 ± 13.1 mg/dl. Multiple factors can have a large part in achieving this improvement as patients were injecting their insulin pen without being aware that the attached needle was blocked. Moreover, taking into consideration that each needle was used multiple times in many of these patients, the effect of this error on the glycaemic control of patients becomes even more concerning.

Unlike the FBG levels, HbA_{1c} did not show a significant change in this study. The reason for this might be that this study was conducted over a relatively short period of time; it was not possible to assess the long-term impact of patient education about insulin pen use on HbA_{1c} levels.

Despite that HbA_{1c} did not decrease significantly in this current study, a previous study that assessed the short-term impact of HbA_{1c} on the morbidity of people with type 2 diabetes over a 6-year period showed that in diabetic people who have an initial HbA_{1c} level above 8%, a decrease in this percentage is associated with a reduced mortality among these patients [11, 19, 20]. Therefore, future plans to continue and expand this study is considered essential.

In our study, we found that around 30% of the patients tried to rotate and change their injection sites, while 25% did not change the site at all with no obvious reasons. Moreover, around 68.8% of the study population denied any injection site-related reactions during their use, while 31.4% complained of this side effect. Therefore, we need to improve patient knowledge to decrease this harmful effect especially after educational intervention showed no changes in this matter.

Although most of the study population denied any injection site-related reactions, there were still some issues with the proper use of the insulin pen such as the multiple use of the needle, adherence and not changing the site of injections regularly. Pharmacist-conducted educational interventions to these patients led to a significant decrease in the rate of medication errors associated with inappropriate insulin pen use, as well as an improvement in the glycaemic control of the patients.

Indeed, educating older patients and their caregivers on the appropriate techniques of insulin pen use will have a positive impact on diabetes management and error prevention. Thus, pharmacists can play an important role in the safe and efficient use of the insulin pen in elderly diabetic patients by minimising the likelihood of medication errors associated with insulin pen use.

We had multiple limitations to this study as it was conducted over a short period of time on patients who visited the outpatient clinics. The studied sample may not be a complete representation of the general population of diabetic patients. Moreover, the answers given by old and mainly uneducated patients make judgments about the reliability of the answers even harder. Finally, the time for the educational interventions and follow-ups were also limited and needed further future plans for a better outcome.

Ethical approval was obtained from the Umm Al-Qura University IRB Committee UQU- COP-EA-#143911.

Funding : There was no funding for this study

Competing Interests: Authors declare no competeing of interests**.**

References

[1]. Chau D, Edelman SV. Clinical management of diabetes in the elderly. Clinical Diabetes. 2001 Oct

1;19(4):172-5.

[2]. Kalra S, Sharma SK. Diabetes in the Elderly. Diabetes Therapy. 2018 Apr 1;9(2):493-500.

[3]. Chiniwala N, Jabbour S. Management of diabetes mellitus in the elderly. Current Opinion in Endocrinology, Diabetes and Obesity. 2011 Apr 1;18(2):148-52.

[4]. Huelgas RG, Díez-Espino J, Formiga F, Tejedor JL, Mañas LR, González-Sarmiento E, Menéndez E, Sangrós J, Grupo de Trabajo para el Documento de Consenso sobre el tratamiento de la diabetes tipo 2 en el anciano. Tratamiento de la diabetes tipo 2 en el paciente anciano. Medicina Clínica. 2013 Feb 2;140(3):134-e1.

[5]. Meneilly GS, Tessier D. Diabetes in elderly adults. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2001 Jan 1;56(1):M5-13.

[6]. Cobden D, Lee WC, Balu S, Joshi AV, Pashos CL. Health outcomes and economic impact of therapy conversion to a biphasic insulin analog pen among privately insured patients with type 2 diabetes mellitus. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy. 2007 Jul;27(7):948-62.

[7]. Lee WC, Balu S, Cobden D, Joshi AV, Pashos CL. Medication adherence and the associated health-economic impact among patients with type 2 diabetes mellitus converting to insulin pen therapy: an analysis of third-party managed care claims data. Clinical therapeutics. 2006 Oct 1;28(10):1712-25.

[8]. Korytkowski M, Bell D, Jacobsen C, Suwannasari R, FlexPen® Study Team. A multicenter, randomized, open-label, comparative, two-period crossover trial of preference, efficacy, and safety profiles of a prefilled, disposable pen and conventional vial/syringe for insulin injection in patients with type 1 or 2 diabetes mellitus. Clinical therapeutics. 2003 Nov 1;25(11):2836-48.

[9]. Keith K, Nicholson D, Rogers D. Accuracy and precision of low-dose insulin administration using syringes, pen injectors, and a pump. Clinical pediatrics. 2004 Jan;43(1):69-74.

[10]. Krapek K, King K, Warren SS, George KG, Caputo DA, Mihelich K, Holst EM, Nichol MB, Shi SG, Livengood KB, Walden S. Medication adherence and associated hemoglobin A1c in type 2 diabetes. Annals of Pharmacotherapy. 2004 Sep;38(9):1357-62.

[11]. Balatbat J. Glycated (glycosylated) hemoglobin: HbA1c new directions to diagnose diabetes. Journal of Continuing Education Topics & Issues. 2010 Aug 1;12(3):112.

[12]. Milligan FJ, Krentz AJ, Sinclair AJ. Diabetes medication patient safety incident reports to the National Reporting and Learning Service: the care home setting. Diabetic medicine. 2011 Dec;28(12):1537-40.

[13]. Mitchell VD, Porter K, Beatty SJ. Administration technique and storage of disposable insulin pens reported by patients with diabetes. The Diabetes Educator. 2012 Sep;38(5):651-8.

[14]. Sanghara H, Kravariti E, Jakobsen H, Okocha C. Using short message services in mental health services: assessing feasibility. Mental Health Review Journal. 2010;15(2):28–33.

[15]. Kannisto KA, Koivunen MH, Välimäki MA. Use of mobile phone text message reminders in health care services: a narrative literature review. Journal of medical Internet research. 2014;16(10):e222.

[16]. Selvin E, Coresh J, Brancati FL. The burden and treatment of diabetes in elderly individuals in the US. Diabetes care. 2006 Nov 1;29(11):2415-9.

[17]. Bohannon NJ. Insulin delivery using pen devices: simple-to-use tools may help young and old alike. Postgraduate Medicine. 1999 Jan 1;106(5):57-68.

[18]. Davis EM, Christensen CM, Nystrom KK, Foral PA, Destache C. Patient satisfaction and costs associated with insulin administered by pen device or syringe during hospitalization. American Journal of Health-System Pharmacy. 2008 Jul 15;65(14):1347-57.

[19]. Farsaei S, Karimzadeh I, Elyasi S, Hatamkhani S, Khalili H. Glycemic control in the infectious diseases ward; role of clinical pharmacist interventions. The Journal of Infection in Developing Countries. 2014 Apr 15;8(04):480-9.

[20]. Eppley MA, Serr G. Hyperglycemia Management in the Hospital: The Pharmacists Role. Hospital Pharmacy. 2009 Jul;44(7):594-603.