

Errors in insulin administration reported by people with diabetes mellitus at home



Erros na administração de insulinas relatados por pessoas com diabetes mellitus no domicílio

Errores en la administración de insulina reportados por personas con diabetes mellitus en casa

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How to cite this article:

Ferreira MA, Cestari VRF, Gonçalves PWC, Brilhante RRC, Sordi CC, Correia DL, et al. Errors in insulin administration reported by people with diabetes mellitus at home. Rev Gaúcha Enferm. 2025;46:e20240321. <https://doi.org/10.1590/1983-1447.2025.20240321.en>

ABSTRACT

Objective: to identify errors related to insulin administration reported by people with diabetes mellitus at home.

Method: cross-sectional study, conducted at an endocrinology service in Fortaleza, from August 2022 to February 2023. 106 people with diabetes mellitus and insulin users participated. A questionnaire with 52 items containing sociodemographic and clinical data and information on insulin self-administration at home was used during the interview. To test the association between performance variables, the Pearson chi-square test ($p \leq 0.05$) and odds ratio were performed.

Results: the main errors identified were: not knowing the correct time to administer insulin before meals (51.9%), not removing insulin from the refrigerator before administration (61.3%), not disinfecting rubber stoppers of vials or pens (55.7%), not removing air bubbles from syringes (51.9%) and reusing needles (77.4%). People aged >60 years, with comorbidities, dyslipidemia, hypertension and using human insulin showed a significant association ($p \leq 0.05$) with unsatisfactory performance.

Conclusion: the identified errors were: lack of knowledge about the correct timing for insulin administration, not taking insulin out of the refrigerator before application, not disinfecting the rubber stoppers of vials, not removing air bubbles from syringes, and reusing needles.

Descriptors: Diabetes mellitus; Insulin; Self-administration; Medication therapy administration.

RESUMO

Objetivo: identificar os erros relacionados à administração de insulina relatados por pessoas com diabetes *mellitus* no domicílio.

Método: estudo transversal realizado em um serviço de endocrinologia em Fortaleza, de agosto de 2022 a fevereiro de 2023. Participaram 106 pessoas com diabetes *mellitus* usuárias de insulina. Utilizou-se um formulário com 52 itens com dados sociodemográficos, clínicos e sobre a autoadministração de insulina no domicílio, preenchido por meio de entrevista. Para testar a associação entre as variáveis com o desempenho (desfecho), realizou-se o teste do qui-quadrado de Pearson ($p \leq 0,05$) e odds ratio.

Resultados: os principais erros identificados foram: não saber o tempo correto de administrar insulinas antes das refeições (51,9%), não retirar as insulinas da geladeira antes da administração (61,3%), não realizar desinfecção da borracha dos frascos ou canetas (55,7%), não retirar as bolhas das seringas (51,9%) e reutilizar agulhas (77,4%). Pessoas com idade >60 anos, com comorbidade, dislipidemia, hipertensão e em uso de insulinas humanas apresentam associação significativa ($p \leq 0,05$) com o desempenho insatisfatório.

Conclusão: identificaram-se como erros: desconhecimento sobre tempo correto de administração de insulinas, não retirar a insulina da geladeira antes da aplicação, não realizar a desinfecção da borracha dos frascos, não retirar as bolhas das seringas e reutilizar agulhas.

Descritores: Diabetes *mellitus*; Insulina; Autoadministração; Administração de terapia medicamentosa.

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RESUMEN

Objetivo: identificar los errores relacionados con la administración de insulina reportados por personas con diabetes *mellitus* en el hogar.

Método: estudio transversal realizado en un servicio de endocrinología en Fortaleza, de agosto de 2022 a febrero de 2023. Participaron 106 personas con diabetes *mellitus* que utilizaban insulina. Se utilizó un formulario con 52 ítems que recogía datos sociodemográficos, clínicos y sobre la autoadministración de insulina en el hogar, completado mediante entrevista. Para probar la asociación entre las variables y el desempeño (resultado), se realizó la prueba de chi-cuadrado de Pearson ($p \leq 0,05$) y odds ratio.

Resultados: los principales errores identificados fueron: no saber el momento correcto para administrar insulina antes de las comidas (51,9%), no sacar la insulina del refrigerador antes de la administración (61,3%), no desinfectar el tapón de goma de los frascos o lápices (55,7%), no retirar las burbujas de las jeringas (51,9%) y reutilizar agujas (77,4%). Las personas mayores de 60 años, con comorbilidades, dislipidemia, hipertensión y en uso de insulinas humanas mostraron una asociación significativa ($p \leq 0,05$) con un desempeño insatisfactorio.

Conclusión: se identificaron como errores: desconocimiento sobre el tiempo correcto de administración de insulina, no sacar la insulina del refrigerador antes de la aplicación, no desinfectar el tapón de goma de los frascos, no retirar las burbujas de las jeringas y reutilizar agujas.

Descriptores: Diabetes *mellitus*; Insulina; Autoadministración; Administración de terapia con medicamentos.

■ INTRODUCTION

Insulin self-administration is the process of regularly applying insulin autonomously, without the assistance of healthcare professionals, to manage diabetes mellitus (DM)⁽¹⁾. This procedure requires a set of safe practices in the storage, preparation, administration and disposal of insulin and supplies, to prevent, avoid and/or minimize errors and adverse events (AE). Therefore, it is a complex procedure that involves knowledge and skills to perform a safe and effective procedure⁽²⁾.

The care in insulin administration includes the handling of the various devices used, the application technique and observation of results. The occurrence of tissue trauma due to the reuse of disposable material or lack of rotation between application sites are frequent errors, which compromise the safety of the self-administration process⁽³⁾. Authors have pointed out that insulin is the first medication with the highest frequency of recorded errors⁽⁴⁾.

Previous studies in Jordan⁽⁵⁾, Iran⁽⁶⁾ and Brazil^(7,3) identified that the technique for preparing, administering insulin, and disposing of waste is often inadequate, and reported complications arising from these issues.

The incorrect technique of insulin self-administration can negatively influence metabolic control, accelerate the progression of diabetes complications, and hinder adherence to treatment⁽⁸⁾. The occurrence of errors is harmful to the patient, having a negative impact on the safety and health outcomes of people with DM⁽⁹⁾.

Given the issue of potential errors in insulin preparation and administration and their negative impact

on patient safety, it is evident that understanding the vulnerabilities involved in this process is necessary.

Understanding the weaknesses involved in this process is important to identify the chain of failures and the associated reasons, recognize the behaviors of people with DM, and support individualized interventions to prevent complications and improve health outcomes.

Considering the errors and adverse events inherent in insulin administration, the objective was to identify errors related to insulin administration at home, as reported by people with diabetes mellitus.

■ METHOD

This is a cross-sectional study, guided by the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), developed to promote the quality and transparency of observational studies⁽¹⁰⁾.

Study conducted in an endocrinology service of a public university hospital in the city of Fortaleza, Ceará, Northeast region of Brazil. The Diabetes Outpatient Clinic offers specialized care to people with DM on Fridays, operating from 7:00 a.m. to 5:00 p.m. Patients who require specialized care are referred to primary health care. The multidisciplinary team is composed of an endocrinologist, nurse, nutritionist, physical therapist, and social worker, in addition to the support of medical Residencies and the Multiprofessional Diabetes Residency of the institution.

The study population consisted of people with diabetes mellitus registered within the service. Individuals over 18 years of age and insulin users were included.

Those using a continuous insulin infusion system and/or with any type of disability evidenced in their medical records were excluded, since the presence of these characteristics requires specific adaptations in the preparation and self-administration of insulin that require a particular approach than the one proposed in this study. The total population was 1,204 individuals, according to the latest survey conducted in 2021. Non-probabilistic sampling method was chosen for convenience based on the availability of the research team, totaling 106 participants. No participants were excluded because they did not meet the exclusion criteria.

The data were collected from August 2022 to February 2023, using an instrument and conducted by a trained data collection team, composed of undergraduate and graduate students. The training was performed by the main researcher, a diabetes educator and a postgraduate nursing student, in three meetings, during which discussions addressed the pathophysiology of DM, complications of DM and insulin administration, so that the researchers had the necessary knowledge to implement the instrument. To avoid bias in data collection, the researchers were trained by a professional diabetes educator, and a pilot test was conducted to assess whether the questions were understandable and whether needed any adjustments. After the pilot test, the items about the needle size and angle used were removed, as the patients were unable to report such information.

The invitation to participate in the research and the data collection took place in the waiting room of the endocrinology service before or after the consultation with the multiprofessional team and lasted an average of 20 minutes. Participants who agreed to participate in the study signed the Informed Consent Form and answered the questionnaire through an interview. The interview was conducted individually and in a private location, respecting the participants' privacy.

The data collection instrument was developed based on the Guidelines of the Brazilian Diabetes Society⁽¹¹⁾ and consisted of two parts. The first part included sociodemographic and clinical data (sex, age group, marital status, education level, paid work, family income, dependents, type of DM, time since diagnosis, comorbidities, complications, result of the last capillary blood glucose routinely measured by the

outpatient team before the appointment, blood glucose self-monitoring, types of insulin and devices used); and the second part consisted of a checklist with 22 items about insulin administration, with response options "correct" and "incorrect". The checklist was divided into three domains: 1 - necessary information for the procedure (three questions); 2 - care in preparation (12 questions) and 3 - care in administration (eight questions). The questionnaires were completed by the researcher based on the participant's self-report.

The quantitative data was organized and tabulated in Excel software, version 2010, and analyzed in the Statistical Package for the Social Sciences (SPSS) version 20.0. In the exploratory analysis, normality was assessed using the Kolmogorov-Smirnov test and absolute and percentage frequencies were calculated for nominal variables, while mean and standard deviation for quantitative variables.

The authors empirically considered a cutoff of 70% of correct answers to define satisfactory performance in the participants' self-report on the studied practice. To test the association of performance variables on insulin administration (outcome variable) and sociodemographic and clinical data (independent variables), Pearson's chi-square test was performed, considering $p \leq 0.05$ as significant, and the strength of this association was measured using the odds ratio and its 95% confidence intervals.

The study received a favorable opinion from the institution's National Research Ethics Commission under number 5,498,417/2022 and CAAE 58805022.7.0000.5534 and complied with the standards and guidelines for conducting research involving human beings, according to Resolution 466/12, of December 12, 2012.

■ RESULTS

A total of 106 people participated in the study, of which the majority were women ($n=71;67\%$), under 60 years of age ($n=55;51.9\%$), with incomplete elementary education ($n=34;32.1\%$), without paid work ($n=67;63.2\%$), family income of up to one minimum wage ($n=54;50.9\%$), living with a partner ($n=64;60.4\%$) and with up to three dependents ($n=67;63.2\%$), and having a refrigerator at home ($n=98;92.5\%$) and with reports that the treatment negatively affected the family income ($n=74;69.8\%$) (Table 1).

Table 1. Sociodemographic data of people with diabetes. Fortaleza, Ceará, Brazil, 2024. (n= 106).

Variables	n	%	Other statistics
Sex			
Female	71	67.0	
Male	35	33.0	
Age group			
≥ 60 years	51	48.1	Min.= 21 years; Max.= 78 years; Md (p25-75) = 58 (40.0-66.0)
< 60 years	55	51.9	
Has a partner			
Yes	64	60.4	
No	41	38.7	
Not informed	1	0.9	
Education level			
Illiterate	08	7.5	
Incomplete elementary school	34	32.1	
Complete elementary school	10	9.4	
Incomplete high school	06	5.7	
Complete high school	30	28.3	
Incomplete higher education	06	5.7	
Complete higher education	08	7.5	
Postgraduate	04	3.8	
Engaged in Paid Work			
Yes	37	34.9	
No	67	63.2	
Not informed	02	1.8	

Tabela 1. Cont.

Variables	n	%	Other statistics
Family income (minimum wage)			
Up to one minimum wage	54	50.9	
Two to three minimum wages	43	40.6	
Four to six minimum wages	8	7.5	
Dependents			Min.= 01; Max.= 08; Mean = 03(SD = 1.5)
Up to three dependents	67	63.2	
More than three dependents	37	34.8	
Has a refrigerator			
Yes	98	92.5	
No	06	5.7	
Not informed	01	0.9	
Does treatment affect family income?			
Yes	74	69.8	
No	31	29.2	

n = absolute frequency; % = relative frequency; min.= minimum; max.= maximum; Md = median; p25-75 = percentiles 25 e 75; SD = standard deviation.
Source: prepared by the authors.

Regarding the clinical profile, the majority had a diagnosis of DM2 (n=73; 68.9%), followed by DM1 (n=23; 21.7%), the average time since diagnosis was 16.4+9.6 years, ranging from 1 to 47 years. The average of the last capillary blood glucose (self-reported after routine measurement by the outpatient care team) of the participants was 195+88 mg/dl. Comorbidities were present in 78.5% of the participants, with systemic arterial hypertension (68.9%), dyslipidemia (57.9%), and depression (22.4%) being the most prevalent. The majority had diabetes complications (57%), with retinopathy (40.6%) and neuropathy (27.1%) being the most prevalent. Approximately 59.4% reported not following the diet plan, and 51.9% did not engage in physical activity.

Regarding insulin use, 63.1% of participants used NPH insulin, 74.5% used regular insulin and 21.7% used rapid-acting insulin analogues, with the pen being the most commonly used application device (67.3%), followed by syringes (29%). The majority (79.4%) performed self-administration and self-monitoring of blood glucose (86.8%) with an average of 3.6+2.1 times per day.

Approximately 92.5% received guidance on insulin administration, which was made by nurses most of the time (74.5%). Regarding local complications, 13.2% reported having already experienced lipodystrophy and 8.5% hyperchromic spots at the injection site, which were associated with repeated applications in the same site because they reported less discomfort.

Regarding the responses to the questionnaire on insulin self-administration practices, in domain 1 (information necessary for the procedure), most participants knew how to differentiate insulins (74.5%), however, more than half of the participants (51.9%) did not know the correct time to administer insulin before meals (Table 2).

Regarding care in preparing insulin (domain 2), the vast majority wash their hands (89.6%), invert the vial to withdraw the insulin (76.1%) and check the flow when using pens (74.6%). Less than half (38.7%) remove the insulin from the refrigerator for 15 minutes. In domain 2, 60.4% of the participants had an unsatisfactory performance.

Table 2. Practices in self-administration of insulin among research participants. Fortaleza, Ceará, Brazil, 2023.

Questions	Yes (n)	%
Domain 1 - Necessary information for the procedure		
Knows the correct time to administer insulin before meals.	51	48.1
Can differentiate types of insulin.	79	74.5
Knows the expiration date of insulin in use after opening.	63	59.4
Domain 2- Care in preparation		
Proper storage	72	67.9
Removes insulin from refrigeration for 15 minutes	41	38.7
Washes hands	95	89.6
Gathers material	86	81.1
Performs NPH homogenization (N=79)	37	52.1
Disinfects the rubber of vials or pens	47	44.3
Draw air corresponding to the dose and inject it into the vial (N=42)	22	52.3
When there is association, first draws the correct one (regular) (N=31)	20	71.4
Inverts the vial to withdraw the insulin (N=42)	32	76.1
Draws/prepares the correct dose	67	63.2
Removes air bubbles	51	48.1
Checks the flow when using pens (N=72)	59	74.6

Tabela 2. Cont.

Questions	Yes (n)	%
Domain 3- Care in administration		
Cleans the skin with 70% alcohol or washes with soap and water (n=105)	74	69.8
Applies in the correct site (n=106)	98	92.5
Rotates the application sites (n=105)	78	73.6
Performs subcutaneous fold (n=104)	77	72.6
Does not apply	14	13.2
Waits 5 seconds for the syringe and 10 seconds for the pen (n=106)	77	72.6
Disposes of the material correctly (n=106)	53	50
Reuses needles (n=106)	82	77.4
Min.= 01 time; Max.=120 times; Md (p25-p75) = 3.0 (2.0-4.0)		
Not informed	17	15.9

n = absolute frequency; % = relative frequency; min.= minimum; max.= maximum; Md = median; p25-75 = 25th and 75th percentiles; CI= confidence interval
Source: prepared by the authors.

Regarding domain 3, care in administration, the majority (92.5%) apply the insulin in the correct site. However, more than half (77.5%) reuse needles and (77.4%) clean the skin with 70% alcohol or wash the skin with soap and water. In domain 3, 67.9% of participants had an unsatisfactory performance.

The participants with a number (n) lower than the sample (n=106) in domain 2 were the subgroups of insulin users in vials or pens, in which care is specific and different from each other. The participants with a lower number than the sample in domain 3 did not respond to the question.

Based on the cutoff point of 70% correct answers for satisfactory performance, considering all domains, 67.9% of the participants showed unsatisfactory performance in the safe administration of insulin.

The domain with the highest number of errors in participants' responses was domain 1, which corresponds

to the necessary information to the procedure, with 70.8% indicating unsatisfactory performance.

Regarding the bivariate analysis, the variables "having a refrigerator" (p=0.027), age 60 years or older (p=0.008), having comorbidities (p=0.008), having a diagnosis of dyslipidemia (p=0.001), being hypertensive (p=0.047), as well as using regular insulin (p=0.001) and NPH insulin (p=0.011) showed a significant association with unsatisfactory performance on insulin administration (Table 3). However, no statistical significance was found in the logistic regression models.

A participant with hypertension had twice the chance, and an elderly participant had three times the chance of obtaining an unsatisfactory score. Regarding the types of insulin, those who used NPH or regular insulin had three times more chances to obtain an unsatisfactory score and the fact that the individual had a refrigerator was a protective factor for the outcome (Table 3).

Table 3. Association between sociodemographic and clinical data and self-administration of insulin. Fortaleza, Ceará, Brazil, 2023.

Variables	Performance in self-administration of insulin		p	OR (95% CI)
	Satisfactory n(%)	Unsatisfactory n(%)		
Sex			0.587	
Female	24 (33.8)	47 (66.2)		-
Male	10 (28.6)	25 (71.4)		
Age group			0.008	
Over 60 years old	10 (19.6)	41 (80.4)		3.17 (1.32-7.59)
Under 60 years old	24 (43.6)	31 (56.4)		
Marital status			0.461	
With partner	19 (29.7)	45 (70.3)		-
Without partner	15 (36.6)	26 (63.4)		
Education level			0.763*	
Illiterate	01 (12.5)	07 (87.5)		-
Incomplete elementary school	10 (29.4)	24 (70.6)		
Complete elementary school	02 (20.0)	08 (80.0)		
Incomplete high school	02 (33.3)	04 (66.7)		
Complete high school	12 (40.0)	18 (60.0)		
Incomplete higher education	03 (50.0)	03 (50.0)		
Complete higher education	03 (37.5)	05 (62.5)		
Postgraduate	01 (25.0)	03 (75.0)		
Family income			0.901	
Up to 1 salary	18 (33.3)	36 (66.7)		
02 to 03 salaries	13 (30.2)	30 (69.8)		
04 to 06 salaries	3 (37.5)	5 (62.5)		

Tabela 3. Cont.

Variables	Performance in self-administration of insulin		p	OR (95% CI)
	Satisfactory n(%)	Unsatisfactory n(%)		
Has refrigerator			0.027[†]	
Yes	34 (34.3)	65 (65.7)		0.65 (0.56-0.75)
No	-	06 (100.0)		1
Comorbidity			0.008	
Yes	21 (25.6)	61 (74.4)		3.43 (1.33-8.82)
No	13 (54.2)	11 (45.8)		1
Dyslipidemia			0.001	
Yes	12 (19.7)	49 (80.3)		3.90 (1.65-9.23)
No	22 (48.9)	23 (51.1)		1
Heart disease			0.158	
Yes	05 (20.0)	20 (80.0)		
No	28 (35.0)	52 (65.0)		
Depression			0.180	
Yes	05 (20.8)	19 (79.2)		
No	29 (35.4)	53 (64.6)		
Has hypertension			0.047	2.3 (1-5.6)
Yes	19 (26.0)	54 (74.0)		
No	15 (45.5)	18 (54.5)		
DM complications			0.686	
Yes	19 (32.8)	39 (67.2)		
No	15 (31.3)	33 (68.8)		
Diabetic foot or Amputation			0.345	
Yes	03 (21.4)	11 (78.6)		
No	31 (33.7)	61 (66.3)		

Tabela 3. Cont.

Variables	Performance in self-administration of insulin		p	OR (95% CI)
	Satisfactory n(%)	Unsatisfactory n(%)		
Neuropathy			0.543	
Yes	08 (27.6)	21 (72.4)		
No	26 (33.8)	51 (66.2)		
Kidney disease			0.069	
Yes	02 (12.5)	14 (87.5)		
No	32 (35.6)	58 (64.4)		
Retinopathy			0.237	
Yes	11 (25.6)	32 (74.4)		
No	23 (36.5)	40 (63.5)		
Uses regular insulin			0.001	
Yes	14 (20.9)	53 (79.1)		3.98 (1.68-9.42)
No	20 (51.3)	19 (48.7)		1
Uses NPH insulin			0.011	
Yes	20 (25.3)	59 (74.7)		3.17 (1.28-7.88)
No	14 (51.9)	13 (48.1)		
Device: pen			0.666	
Yes	25 (33.3)	50 (66.7)		
No	09 (29.0)	22 (71.0)		
Device: syringe			0.396	
Yes	09 (26.5)	25 (73.5)		
No	25 (34.7)	47 (65.3)		
Performs self-monitoring of blood glucose			0.899	
Yes	29 (31.5)	63 (63.0)		-

Tabela 3. Cont.

Variables	Performance in self-administration of insulin		p	OR (95% CI)
	Satisfactory n(%)	Unsatisfactory n(%)		
No	04 (33.3)	08 (66.7)		
Received guidance from a nurse			0.085	
Yes	30 (38.0)	49 (62.0)		-
No	03 (16.7)	15 (83.3)		

n = absolute frequency; % = relative frequency; p = Chi-Square; * = Likelihood Ratio; † = Fisher's Exact Test; OR (CI95) odds ratio with 95% confidence interval.
Source: prepared by the authors.

■ DISCUSSION

The main errors identified were not knowing the correct time to administer insulin before meals, not disinfecting the rubber stoppers of vials or pens, not removing air bubbles from syringes and reusing needles. People aged >60 years old, with comorbidities, dyslipidemia, hypertension and using human insulin have a significant association with unsatisfactory performance in self-administration of insulin.

Monitoring the application technique performed by people with DM by healthcare professionals is important for good glycemic management, protection against AE and reduction of the dose of insulin prescribed for patients with unstable glycemia⁽¹²⁾. Insulin administration is a process that requires intensive and shared education between the educator and the person with DM to ensure diabetes management.

In the present study, women and people over 60 years of age were the ones who most reported using insulin, a result similar to a cross-sectional study conducted on the medical records of 113 people with type 2 Diabetes Mellitus using NPH or regular insulin from a diabetes outpatient clinic⁽¹³⁾.

Currently, the elderly people represent a heterogeneous group. There are functionally independent elderly individuals without frailties who respond to the treatment recommended for young adults with DM. However, there are particularities in the treatment of DM in elderly people with comorbidities, varying

degrees of sarcopenia and frailty, cognitive changes, use of polypharmacy, which increases the risk of drug interactions and hypoglycemia. DM is associated with a higher risk of functional disability, which can impair activities of daily living and self-care, thus influencing insulin administration⁽¹⁴⁾.

Additionally, elderly people with DM have a higher incidence of cognitive changes, depression and dementia, especially in the presence of obesity. These changes directly influence the understanding of the guidelines for insulin administration. There is also a decrease in the threshold for perceiving hypoglycemia, which increases the risk of severe episodes, generating fear, anxiety and influencing treatment adherence⁽¹⁴⁾. In view of this, analyzing difficulties and barriers related to the use of insulin helps healthcare professionals to pay attention to particularities and promote comprehensive care.

Hypertensive individuals with DM have a high cardiovascular risk, especially when the disease is associated with dyslipidemia. It is estimated that individuals with type 2 diabetes have a two to four times higher incidence of coronary heart disease or ischemic stroke. Furthermore, DM increases the risk of heart failure, peripheral arterial disease and microvascular complications, serious circumstances that hinder functional capacity⁽¹⁵⁾.

It is suggested that the presence of complications and comorbidities affects quality of life and leads to polypharmacy, which can compromise self-care practices and diabetes management, including

self-administration of insulin, the practice of which involves complex and multifactorial aspects.

As a strategy for preventing chronic complications of DM, the role of nurses in diabetes education stands out, which consists of instructing and guiding individuals, family members and potential caregivers, aiming to promote behavioral changes that ensure a better quality of life and lower morbidity⁽¹⁶⁾.

O Nurses are responsible for DM early detection, identifying risk factors and assisting patients in the management process to reduce hospitalizations⁽¹⁷⁾. A study showed that insulin administration is a complex process involving the knowledge, attitude and behavior of nurses. Because of this, it pointed out that professionals working in specialized units receive more training and have greater knowledge on the subject when compared to those who do not. The study suggested standardized training and mentoring to optimize diabetes education at all levels of health care and, consequently, improve the performance of insulin users⁽¹⁸⁾.

The results about the predominance of people who used regular and NPH insulin pens differ from an analytical epidemiological study on perception, whose findings showed that glargine and NPH were the most used insulins in the basal regimen, and syringes were the predominant device. Pens are easier to handle, offer shorter needles, and better storage conditions, improving users' quality of life⁽¹⁶⁾.

NPH and regular insulins, which were significantly associated with unsatisfactory performance, may be presented in vials, which requires specific care in preparation and administration, unlike pens, which are more practical devices to handle. These specificities may contribute to difficulties in self-administration of insulin.

Regarding the procedure, the present study showed slightly better results than a cross-sectional study, aiming at describing the care with the use of insulins provided by the SUS. The authors identified that only 12.5% knew the correct time for administration; 11.3% removed insulin from the refrigerator 15 minutes before application⁽¹³⁾. These practices are important for the medication to start working simultaneously with food absorption, avoiding glycemic peaks, and avoiding pain and discomfort during application.

The homogenization of cloudy insulins, such as NPH, is an important specific care. The literature shows that

inadequate homogenization can lead to variable insulin concentrations and unpredictable clinical outcomes, resulting in inadequate medication effect and loss of glycemic control⁽¹⁹⁾.

Regarding the reuse of needles and their correct disposal, our data presents weaknesses, as observed in the literature⁽²⁰⁻²²⁾. The study associates the reuse of needles with bruising at the injection site, lipohypertrophy, and pain during application⁽²³⁾. Therefore, it is necessary to raise awareness among insulin users about disposal of supplies in resistant plastic containers for dispensing at the nearest health unit. Improper disposal may expose family members and waste collection workers to accidents and disease transmission, in addition to environmental contamination^(20,22).

The habit of reusing needles mainly occurs due to their cost and lack of knowledge about complications. An analytical and descriptive research reports that the main reasons for reusing sharps include the lack of single-use material provided by the SUS, financial conditions and material savings⁽³⁾. However, this practice causes needle deformities and clogging, loss of lubrication and sharpness, and breakdown of sterility, resulting in inaccuracy in imprecise dosing, pain and discomfort, bleeding, lipohypertrophy, local infection, and unsatisfactory clinical outcomes⁽²⁴⁾.

A study that evaluated the insulin injection technique in Brazilian patients showed that in Brazil, the reuse of pen needles is greater than that of syringes, since the SUS only distributed syringes⁽²⁴⁾. This may explain the high frequency of needle reuse, since most participants used the pen as the application device.

Unlike the findings of the present study (67.9%), the research that assessed knowledge, attitude and practice in the self-administration of insulin in people with DM showed that less than half (46.1%) presented unsatisfactory knowledge. Furthermore, men, not married, urban residents, with elementary or higher education presented greater knowledge than their comparators⁽²⁵⁾.

A study that assessed the knowledge and practice of people with DM regarding the safe disposal of insulin injection devices also showed that illiteracy and unemployment were not significantly associated with knowledge about insulin administration practices⁽²⁰⁾, as was the present research. Another cross-sectional study showed that the highest proportion of inadequate care occurred in women, young people, those with eleven

or more years of education, those with less than 10 years of illness, and those who inject insulin once or twice a day⁽¹³⁾. The differences in these findings can be explained by differences between research population, sampling techniques, culture, and settings.

The importance of educational actions for teaching the appropriate injection technique is emphasized. In the present study, 92.5% of participants reported having received guidance on the topic, and 74.5% mentioned that it was provided by nurses. However, most participants presented unsatisfactory performance, which raises concern about the effectiveness of such educational actions, which may be negatively influenced by the alleged use of technical terms, insufficient time for learning, or the lack of confirmation that the patient understood the topic. It is worth noting that the research field is a specialized unit, the only one in Brazil that offers Multiprofessional Residency in Diabetes, unlike the reality of most healthcare units that, hypothetically have less qualified professionals for diabetes education.

A randomized clinical trial conducted with 158 patients with type 2 DM provided evidence that people with diabetes treated with insulin require intensive educational refresher courses at intervals of at least three months, suggesting a strategy of continuous and cyclical education to optimize learning. Thus, it suggested that healthcare professionals should be more attentive to structured therapeutic education on best injection practices⁽²⁶⁾.

It is noteworthy that the complexity of insulin therapy involves physical, psychological, social and economic aspects of the population with DM. Insulin administration is not just a technical procedure, as it involves several factors that healthcare professionals need to understand to implement comprehensive and effective diabetes education.

As a limitation of the study, the use of self-reported data stands out, as it can generate biased responses by memory and social desirability factors. It is also worth mentioning the difficulty in obtaining information about the size of the needle used at home and the use of convenience sampling, which is likely to introduce biases into the sample, since it can result in generalizations and inaccurate conclusions in the process of external validation of the findings. To mitigate this bias,

some strategies were adopted, such as: establishing a trustful relationship with the participant, ensuring data confidentiality and the preservation of the anonymity and confidentiality of the information; absence of judgment and/or researcher reactions to responses; and guaranteeing privacy and an appropriate environment for data collection⁽²⁷⁾.

Despite the data were obtained by self-report, which was considered a limitation of the present research, it was found that 67.9% of the participants showed unsatisfactory performance regarding the self-administration of insulin.

This study is important because it allows people to understand inadequate practices in the self-administration of insulin by people with DM. These data will serve as a foundation for optimizing care actions with a view to reducing errors in the self-administration of insulin by people with diabetes mellitus, in order to achieve better practices and health outcomes.

■ CONCLUSION

This study identified errors related to insulin administration as reported by people with diabetes mellitus at home, such as lack of knowledge about the correct time to administer insulin before meals, failure to remove insulin from the refrigerator 15 minutes before, failure to disinfecting the rubber stopper on vials or pens, failure to remove air bubbles from syringes, and reuse of needles. The following variables showed a significant association with unsatisfactory performance: older age, comorbidity, dyslipidemia, hypertension, and use of human insulin.

The main contribution and advancement of this investigation lies in identifying the health education needs of people with diabetes. Based on these results, it is possible to establish more effective and patient-centered strategies, aiming at better health outcomes. Thus, this study not only broadens the knowledge about the reality of this population but also guides nursing practices more targeted at individual needs.

Further studies are suggested to broaden the understanding of factors related to the multifaceted treatment of diabetes, especially the use of insulin, as well as to implement and evaluate educational strategies.

■ REFERENCES

1. American Diabetes Association (ADA). Standards of Medical Care in Diabetes. *Diabetes Care*. 2022;45(Suppl 1):S17-S38. <https://doi.org/10.2337/cd22-as01>
2. Krolow MR, Machado KP, Oliveira AT, Soares MU, Volz PM, Thumé E. Quality and safety in the use of insulin therapy by the aged population. *Rev Enferm UFSM* [Internet]. 2021[cited 2024 Dec 20];11:e38. Available from: https://periodicos.ufsm.br/reufsm/article/view/48098/pdf_1
3. Dunes CAT, Sousa JK, Oliveira MTA. Reutilização de perfurocortantes na insulinoterapia e sua associação com infecções estafilocócicas. *Rev Epidemiol Controle Infecç*. 2019;9(1):15-20. <https://doi.org/10.17058/reci.v9i1.12243>
4. Almeida A, Nogueira C, Souto I, Serra M, Pinto N, Coelho A. Avaliação da técnica de administração de insulina em utentes com Diabetes *Mellitus* tipo 2 nos cuidados de saúde primários. *Rev Port Diabetes* [Internet]. 2018 [cited 2024 Dec 20];13(3):95-100. Available from: <https://www.revportdiabetes.com/wp-content/uploads/2018/10/RPD-Setembro-2018-Artigo-Original-p%C3%A1gs-95-100.pdf>
5. Abujbara M, Khreisat EA, Khader Y, Ajlouni KM. Effect of insulin injection techniques on glycemic control among patients with diabetes. *Int J Gen Med*. 2022;15:8593-602. <https://doi.org/10.2147/IJGM.S393597>
6. Mehrabbeik A, Namiranian N, Azizi R, Aghaee Meybody M, Shariati M, Mahmoudi Kohani HA. Investigation of association between insulin injection technique and blood glucose control in patients with type 2 diabetes. *Int J Endocrinol Metab*. 2022;20(4):e128392. <https://doi.org/10.5812/ijem-128392>
7. Reis P, Marcon SS, Nass EMA, Arruda GO, Back IR, Lino IGT, Francisqueti V. Performance of people with diabetes *mellitus* under insulin therapy. *Rev Cogitare Enferm*. 2020;20(1):1-12. <https://doi.org/10.5380/ce.v25i0.66006>
8. Vianna MS, Silva PAB, Nascimento CVD, Soares SM. Self-care competence in the administration of insulin in older people aged 70 or over. *Rev Latino-Am Enfermagem*. 2017; 25:e2943. <https://doi.org/10.1590/1518-8345.2080.2943>
9. Dezena RCA, Oliveira FS, Oliveira LS. Erros de medicação e implicações na assistência de enfermagem. *Cuid Enferm* [Internet]. 2021[cited 2024 Dec 20];15(2):274-80. Available from: <https://www.webfipa.net/facfipa/ner/sumarios/cuidarte/2021v2/p.274-280.pdf>
10. Cheng A, Kessler D, MacKinnon R, Chang TP, Nadkarni VM, Hunt EA, et al. Reporting guidelines for health care simulation research: extensions to the CONSORT and STROBE statements. *Simul Healthc*. 2016;11(4):238-48. <https://doi.org/10.1097/SIH.0000000000000150>
11. Banca R, Marroni M, Oliveria M, Sparapani V, Pascali P, Oliveira S, et al. Técnicas de aplicação de insulina: Diretriz Oficial da Sociedade Brasileira de Diabetes [Internet]. 2023[cited 2024 Dec 20]. <https://doi.org/10.29327/557753.2022-4>
12. Gentile S, Strollo F, Corte TD, Marino G, Guarino G; Italian Study Group on Injection Techniques. Skin complications of insulin injections: a case presentation and a possible explanation of hypoglycaemia. *Diabetes Res Clin Pract*. 2018;138:284-7. <https://doi.org/10.1016/j.diabres.2018.02.005>
13. Barros DG, Santos KF, Lima JOR, Malaquias SR, Sousa ALL, Silveira EA, et al. Management of insulin available by sus: support to control diabetes *mellitus*. *Ciênc, Cuid Saúde*. 2021;20:2-8. <http://dx.doi.org/10.4025/ciencucuidsaude.v20i0.50524>
14. Moura F, Salles JEN, Valente F, Almeida-Pititto B, Fonseca RMC, Cavalcanti S. Abordagem do paciente idoso com diabetes *mellitus*: Diretriz Oficial da Sociedade Brasileira de Diabetes. 2023. <https://doi.org/10.29327/5238993.2023-3>
15. Izar M, Fonseca F, Faludi A, Araújo D, Valente F, Bertoluci M. Manejo do risco cardiovascular: dislipidemia: Diretriz Oficial da Sociedade Brasileira de Diabetes. 2023. <https://doi.org/10.29327/557753.2022-19>
16. Brandão GL, Werner LA, Magalhães BABM, Campanati SSE, Juliatti FC, Simões TM, et al. Analysis of type 1 diabetes patients' perception of insulin therapy at the service of care and support to diabetics and their family. *Rev Soc Bras Clin Med* [Internet]. 2020[cited 2024 Dec 20];18(2):104-7. Available from: <https://docs.bvsalud.org/biblioref/2022/03/1361464/104-107-1.pdf>
17. Gadot T, Azuri J. Diabetes control in the community, under the management of a diabetes-clinic nurse specialist, and the effect of a parallel diabetologist advice. *J Prim Care Community Health*. 2023;14:21501319231162310. <https://doi.org/10.1177/21501319231162310>
18. Liao Y, Liu X, Huang J, Chen Q, Li N, Zhou P. Insulin injection knowledge, attitude and behaviour of nurses: a cross-sectional study in Guangdong Province. *Nurs Open*. 2023;10(6):3754-3765. <https://doi.org/10.1002/nop2.1633>

19. Sousa Z, Neves MC, Carvalho D. Técnica de Administração de Insulina: uma prática sustentada em evidência científica. Rev Port Diabetes [Internet]. 2019[cited 2024 Dec 20];14(3):120-8. Available from: <https://www.revportdiabetes.com/wp-content/uploads/2019/11/RPD-Set-2019-Artigo-de-Revis%C3%A3o-p%C3%A1gs-120-128.pdf>
20. Hassan NM, Safynaz ESS, Asmaa OA, Eman AY. Toward safe environment: injection device disposal among diabetic patients attending tertiary care academic clinic in Middle Delta, Egypt. Environ Sci Pollut Res Int. 2021;28(18):23192-203. <https://doi.org/10.1007/s11356-021-12393-z>
21. Moura TVC, Silva AFR, Machado ALG, Carvalho GCN, Silva ARV. Educational intervention on description of the insulin delivery technique: randomized clinical trial. Rev Rene. 2020;21:1-7. <https://doi.org/10.15253/2175-6783.20202144230>
22. Gupta S, Ramteke H, Gupta S, Gupta S, Gupta KS. Are people with type 1 Diabetes *Mellitus* appropriately following insulin injection technique practices: a review of literature. Cureus. 2024;16(1):e51494. <https://doi.org/10.7759/cureus.51494>
23. Zhou T, Zheng Y, Li J, Zou X. Insulin injection technique and related complications in patients with diabetes in a northwest City of China. J Eval Clin Pract. 2024. <https://doi.org/10.1111/jep.14226>
24. Calliari LE, Tschiedel B, Pedrosa HC, Rea R, Pima-Zoni-Netto A, Hirsch L, et al. Insulin Injection Technique Questionnaire: results of an international study comparing Brazil, Latin America and World data. Diabetol Metab Syndr. 2017;10(85):1-7. <https://doi.org/10.1186/s13098-018-0389-3>
25. Nasir BB, Buseir MS, Muhammed OS. Knowledge, attitude and practice towards insulin self-administration and associated factors among diabetic patients at Zewditu Memorial Hospital, Ethiopia. PLoS One. 2021;16(2):1-10. <https://doi.org/10.1371/journal.pone.0246741>
26. Gentile S, Guarino G, Della Corte T, Marino G, Satta E, Pasquarella M, et al. The durability of an intensive, structured education-based rehabilitation protocol for best insulin injection practice: the ISTERP-2 study. Diabetes Ther. 2021;12:2557-69. <https://doi.org/10.1007/s13300-021-01108-9>
27. Bispo Júnior JP. Social desirability bias in qualitative health research. Rev Saude Publica. 2022;56:101. <https://doi.org/10.11606/s1518-8787.2022056004164>

■ Data and material availability

The data and research materials are available at the following link:
<https://doi.org/10.48331/scielodata.BHUKZL>

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Received: 10.24.2024

Approved: 01.13.2025

Associate editor:

Carlise Rigon Dalla Nora

Editor-in-chief:

João Lucas Campos de Oliveira

