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Insulin: from acquisition to disposal — a cross-sectional study of people with diabetes mellitus followed by Family Health Strategy teams in Santa Luzia, Paraíba, Brazil

Insulina: da aquisição ao descarte — estudo transversal com pessoas com diabetes mellitus acompanhadas pelas Estratégias de Saúde da Família de Santa Luzia-PB

Insulina: de la adquisición a la eliminación — estudio transversal con personas con diabetes mellitus seguido por las Estrategias de Salud de la Familia de Santa Luzia-PB

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Abstract:
Diabetes Mellitus (DM) is an important public health problem, and the effectiveness of insulin therapy depends on appropriate care at every stage of insulin use, from transportation to the disposal of materials. Objective: To describe practices related to insulin transportation, storage, preparation, administration, and disposal among users of the Family Health Strategy (FHS) units in Santa Luzia, Paraíba, Brazil, as well as the receipt of professional guidance and the professionals identified as responsible for providing it. Methods: A cross-sectional, descriptive study with a quantitative approach was conducted with 40 adults with DM who used insulin dispensed by the municipal Basic Pharmacy between August 2026 and October 2026. Data were collected using a structured questionnaire and analyzed through descriptive statistics. Results: Half of the participants (50.0%) transported insulin in direct contact with ice, 57.5% stored it in the refrigerator door or near the freezer compartment, and 55.0% reused needles or syringes. Regarding disposal, 37.5% did not use rigid containers to store sharps. Professional guidance was reported by 92.5% of participants regarding transportation, storage, and administration, but by only 47.5% regarding disposal. Pharmacists were the most frequently mentioned professionals providing guidance on transportation (60.0%), storage (55.0%), and disposal (30.0%), whereas nurses were most frequently mentioned regarding administration (47.5%). Conclusion: Despite the high coverage of professional guidance, inadequate practices persist, particularly regarding transportation, storage, reuse of supplies, and disposal. These findings indicate the need for continuous educational interventions, including verification of users' understanding and greater emphasis on safe disposal practices.

Keywords:
Diabetes Mellitus; Insulin; Primary Health Care; Pharmaceutical Services; Health Education.

Resumo:
O Diabetes Mellitus (DM) é um importante problema de saúde pública, e a efetividade da insulinoterapia depende de cuidados adequados em todas as etapas do uso da insulina, do transporte ao descarte dos materiais. Objetivo: descrever as práticas relacionadas ao transporte, armazenamento, preparo, aplicação e descarte da insulina entre usuários das Estratégias de Saúde da Família (ESF) de Santa Luzia-PB, bem como o recebimento de orientações profissionais e os profissionais referidos como responsáveis por elas. Método: estudo transversal, descritivo, de abordagem quantitativa, realizado com 40 adultos com DM em uso de insulina dispensada pela Farmácia Básica municipal, no período de agosto/2026 a outubro/2026. Os dados foram coletados por meio de questionário estruturado e analisados por estatística descritiva. Resultados: metade dos participantes (50,0%) transportava a insulina em contato direto com o gelo, 57,5% a armazenavam na porta da geladeira ou próximo ao congelador e 55,0% reutilizavam agulhas ou seringas. Quanto ao descarte, 37,5% não utilizavam recipiente rígido para acondicionar os perfurocortantes. A orientação profissional foi referida por 92,5% nas etapas de transporte, armazenamento e aplicação, mas por apenas 47,5% no descarte. O farmacêutico foi o profissional mais citado nas orientações sobre transporte (60,0%), armazenamento (55,0%) e descarte (30,0%), e o enfermeiro, nas orientações sobre aplicação (47,5%). Conclusão: apesar da elevada cobertura de orientação,

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persistem práticas inadequadas, sobretudo no transporte, no armazenamento, na reutilização de insumos e no descarte, o que indica a necessidade de ações educativas contínuas, com verificação da compreensão do usuário e maior ênfase no descarte seguro.

Palavras-chave:
Diabetes Mellitus, Insulina, Profissionais, Usuários, Insulinodependentes.

Resumen:
La diabetes mellitus (DM) es un importante problema de salud pública y la eficacia de la terapia con insulina depende de la atención adecuada en todas las etapas del uso de la insulina, desde el transporte hasta la eliminación de los materiales. Objetivo: describir las prácticas relacionadas con el transporte, almacenamiento, preparación, aplicación y eliminación de insulina entre los usuarios de las Estrategias de Salud de la Familia (ESF) de Santa Luzia-PB, así como la recepción de orientaciones profesionales y los profesionales señalados como responsables de ellas. Método: estudio descriptivo transversal, con enfoque cuantitativo, realizado con 40 adultos con DM usuarios de insulina dispensada por la Farmacia Básica municipal, de agosto/2026 a octubre/2026. Los datos se recogieron mediante un cuestionario estructurado y se analizaron mediante estadística descriptiva. Resultados: la mitad de los participantes (50,0%) llevaba insulina en contacto directo con el hielo, el 57,5% la guardaba en la puerta del frigorífico o cerca del congelador y el 55,0% reutilizaba agujas o jeringas. En cuanto a la disposición, el 37,5% no utilizó un contenedor rígido para almacenar objetos punzocortantes. La orientación profesional fue mencionada por el 92,5% en las etapas de transporte, almacenamiento y aplicación, pero sólo por el 47,5% en la etapa de eliminación. El farmacéutico fue el profesional más citado en las directrices sobre transporte (60,0%), almacenamiento (55,0%) y eliminación (30,0%), y la enfermera, en las directrices sobre aplicación (47,5%). Conclusión: a pesar de la alta cobertura de orientaciones, persisten prácticas inadecuadas, especialmente en transporte, almacenamiento, reutilización de insumos y disposición, lo que indica la necesidad de acciones educativas continuas, con verificación de la comprensión de los usuarios y mayor énfasis en la disposición segura.

Palabras clave:
Diabetes Mellitus, Insulina, Profesionales, Usuarios, Insulinodependientes.

1. Introduction

Chronic Noncommunicable Diseases (NCDs) are among the main public health challenges today. Among these conditions, Diabetes Mellitus (DM) stands out, due to its high prevalence and negative impacts on the population's quality of life (Muzy et al., 2021). According to data from the World Health Organization (2026), globally, in 2022, more than one in six adults aged 30 or over had diabetes. Furthermore, an estimated 45.1 deaths occurred per 100,000 inhabitants in 2023, with mortality rates being higher in low- and lower-middle-income countries.

According to the 11th edition of the Diabetes Atlas of the International Diabetes Federation (IDF), Brazil ranks sixth among the countries with the highest absolute number of adults with DM, with an estimated 16.6 million people in 2024 and a projection of approximately 24 million in 2050 (Genitsaridi et al., 2026). These numbers are related, among other factors, to changes in lifestyle, such as the reduction in physical activity and the adoption of inadequate eating habits, characterized by insufficient consumption of fruits and vegetables

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(Peres et al., 2023). Other risk factors associated with diabetes, such as high blood pressure, obesity and excess weight, also show an increasing trend in the country (BRASIL, 2022).

According to the Brazilian Diabetes Society, DM is classified into four main categories: type 1 DM (DM1), characterized by insulin deficiency resulting, in most cases, from the autoimmune destruction of pancreatic β cells (type 1A) or idiopathic causes (type 1B); Type 2 DM (DM2), marked by resistance to the action of insulin associated with a progressive deficit in its secretion; Gestational DM, diagnosed during pregnancy in women without a previous diagnosis of DM; and other specific, less frequent types, such as monogenic forms, drug-induced diabetes and exocrine pancreas diseases (Sociedade Brasileira de Diabetes, 2025). Insulin is mandatory in DM1, but it is also frequently necessary in DM2 throughout the course of the disease. Therefore, in this study, the expression "people with DM using insulin" is adopted, which is more accurate than the term "insulin dependent", which refers to the old classification of DM1.

In DM1, insulin is essential, usually in multiple daily doses (Silva Júnior; Gabbay; Lamounier, 2023). In DM2, insulin therapy is indicated when glycemic goals are not achieved with other agents, in the face of marked and symptomatic hyperglycemia, contraindication or intolerance to other antidiabetics — such as in severe kidney or liver disease — and with progressive loss of β-cell function (Cahn et al., 2015). In severe insulin deficiency, there is a risk of diabetic ketoacidosis, an acute complication resulting from a lack of insulin associated with an increase in counter-regulatory hormones (catecholamines, glucagon and cortisol) (Silva Júnior; Gabbay; Lamounier, 2023). However, the benefits of insulin therapy depend on the correct use of the medication: failures in storage, preparation, application and disposal can compromise effectiveness, cause hypo or hyperglycemia, lipohypertrophy and accidents with sharps (Truong et al., 2017; Reis et al., 2020).

In general, every person with diabetes mellitus should receive guidance on self-care and have this process continuously monitored. This education and support should be person-centered and can be offered in a group or individually (American Diabetes Association, 2026). This support is not restricted to doctors: health professionals such as pharmacists, nurses and nutritionists also act as supporting agents for people with DM (Powers et al., 2020).

Continuous support from healthcare professionals is vital for quality insulin therapy, as cases of inadequate management tend to be frequent. In a cross-sectional study carried out in Fortaleza-CE with 150 people with DM followed in Primary Health Care, 93.3% performed some of the stages of insulin therapy inadequately; Among vial and syringe users, 83.1% stored syringes and needles and 93.8% stored vials in use incorrectly, and more than 80% disposed of sharps inappropriately (Cunha et al., 2020).

In this context, monitoring by the pharmacist in insulin therapy, within the scope of Primary Health Care (PHC), assumes a strategic role, since this level of care constitutes the

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gateway to comprehensive and continuous care. The pharmacist participates from the acquisition of insulin to the specialized monitoring of the patient (Costa; Pinto, 2026). In a clinical trial conducted in 15 public primary care clinics, with 139 people with DM2 who completed the follow-up, monthly re-education on the application technique, conducted by pharmacists for four months, reduced glycated hemoglobin (HbA1c) by 1.19% in the intervention group, a reduction 0.63 percentage points greater than that observed in the control group ($p = 0.008$). This result indicates that systematic monitoring of the application technique can improve glycemic control (Selvadurai et al., 2021).

In view of the above, this study aimed to describe practices related to the transportation, storage, preparation, application and disposal of insulin among people with DM using insulin monitored by the ESF of Santa Luzia-PB, as well as verifying the receipt of professional guidance on each stage and identifying the professionals referred to as responsible for this guidance. The aim is, therefore, to identify flaws in the care process that could compromise the safety and effectiveness of treatment and support educational actions within the scope of PHC.

2 Theoretical framework

2.1 Diabetes mellitus in Brazil.

In addition to the diagnosed cases, it is estimated that, in 2024, around 5.3 million Brazilians were living with DM without knowing it, which indicates that the real magnitude of the disease in the country is even greater (Genitsaridi et al., 2026).

Considering by region, from 2019 to 2023, data from the Hospital Information System (SIH) of the Department of Informatics of the Unified Health System (DATASUS), the Southeast region appears with 36.6% in the proportion of Diabetes Mellitus hospitalizations, followed by the Northeast region with 31.9% of hospitalizations, with the two regions accounting for over 60% of hospitalizations. Higher frequency among males (52%) compared to females (48%). Regarding race/color, there was a predominance of mixed-race people (46.1%), followed by white people (27.6%), showing differences in the epidemiological profile of hospitalizations for this condition (Silva et al., 2024).

Diabetes has a high potential to trigger several associated complications. In Brazil, for every 100 thousand inhabitants, it is estimated that 2,990.3 have neuropathy, 1,798.5 retinopathy, 23.3 cases of blindness and 282.6 amputations related to the disease. The Southeast and Northeast regions stand out as those with the highest prevalence of these complications (Muzy et al., 2021). Regarding the economic impact, hospitalizations for DM in Brazil had, in 2024, an average length of stay of 6.77 days and an average cost of R$1,109.87

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per hospitalization, of which R$940.20 corresponded to hospital services and R$168.99 to professional services (Rodrigues et al., 2025).

2.2 Importance of insulin in the treatment of diabetes mellitus.

Diabetes constitutes a set of complex metabolic diseases, characterized by different pathophysiological mechanisms, such as the autoimmune destruction of pancreatic β-cells and resistance to the action of insulin, and may also involve multiple associated factors. These processes result in chronic hyperglycemia which, when accentuated, causes manifestations such as polyuria, polydipsia, weight loss, blurred vision and greater predisposition to infections. As the disease progresses, more serious complications may arise, such as retinopathy with a risk of visual impairment, peripheral neuropathy associated with the development of foot ulcers and autonomic neuropathy, which triggers gastrointestinal, genitourinary and cardiovascular changes (American Diabetes Association, 2026).

DM can be classified into several categories, including DM1, DM2, gestational diabetes and specific types, such as MODY (maturity-onset diabetes of the young), a monogenic form that generally manifests itself in young people. DM2 is the most common form, responsible for around 90% to 95% of cases, and DM1, for 5% to 10% (Sociedade Brasileira de Diabetes, 2025; Sapra; Bhandari, 2023).

DM1 is characterized by the destruction, generally autoimmune, of the β cells of the pancreatic islets, responsible for the production of insulin, which results in an absolute deficiency of this hormone (Sapra; Bhandari, 2023). In DM2, resistance to the action of insulin in peripheral tissues and progressive dysfunction of β cells predominate, which reduces the effectiveness of the hormone in glycemic control. This form is more prevalent after the age of 45, although it is increasingly diagnosed in young people (Goyal; Singhal; Jialal, 2023).

Insulin is the body's main anabolic hormone and regulates the metabolism of carbohydrates, lipids and proteins: it stimulates glucose uptake by skeletal muscle and adipose tissue, promotes glycogen storage and inhibits hepatic glucose production and lipolysis (Rahman et al., 2021). Its discovery, in 1921, and the beginning of its therapeutic use, the following year, represented one of the greatest medical advances of the 20th century and transformed the prognosis of people with diabetes, especially DM1 (Vasiljević et al., 2020).

According to data from Vigitel Brasil 2023, in Brazilian capitals and the Federal District, 13.6% of adults who reported a medical diagnosis of diabetes reported using insulin, while 86.4% did not use this therapeutic modality (BRASIL, 2024). In a study carried out from 2012 to 2016 with data that considered free access to pharmacies from the SUS and the Brazilian Popular Pharmacy Program, between 88.9% and 90% of people with DM obtained insulin free of charge, which highlights the importance of the Unified Health System (SUS) programs (Francisco et al. 2019).

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Despite the wide availability of insulin in the SUS, treatment difficulties persist, such as fear of hypoglycemia, resistance to injections, low adherence and difficulties related to the application technique (Daher et al., 2025). In a study with 255 users of five Brazilian public health centers, 75% of them with DM2, 48% reported missing doses, 57% reused syringes, 80% reused pen needles and 27% showed lipohypertrophy on physical examination (Calliari et al., 2018). These results highlight the importance of precise guidance and continuous monitoring of people using insulin, for a better clinical response.

2.3 Professional guidance in the management of diabetes mellitus

Care for people with Diabetes Mellitus should not be understood as the exclusive responsibility of the individual, since the prevention of complications and control of the disease also depend on family and social support and health services. In this context, the role of Primary Health Care professionals stands out, who play a fundamental role in diagnosis, longitudinal monitoring, health education and development of strategies that promote self-care and prevention of complications (BRASIL, 2013)." (Li et al., 2020). When monitoring patients with chronic conditions, there are still many barriers between health professionals and users, family and community, creating distance in care, highlighting the need for better monitoring in primary care (Salci; Meirelles; Silva, 2017).

Health care in the territory requires qualified teams, capable of offering an appropriate care experience to the user (Bodenheimer; Sinsky, 2014). This care must be individualized and consider the social context, preferences and needs of each person (American Diabetes Association, 2026). The guidance provided by the professional is a valuable tool to encourage self-care and adherence to treatment (BRASIL, 2021).

Correct insulin management is essential for the effectiveness of the treatment, and health professionals have a central role in providing guidance to prevent complications related to the application technique (Frid et al., 2016). Some people have greater difficulty in this process, such as those with low visual acuity, often due to DM itself, low health literacy, polypharmacy or difficulty understanding the action of insulin, which requires an individualized approach (Freitas; Costa; Nunes, 2019).

3. Material and method

This is a cross-sectional, descriptive study with a quantitative approach. The cross-sectional design allows describing the characteristics and practices of a population at a single moment (Hulley et al., 2015; Rouquayrol; Gurgel, 2018).

The study was carried out in the municipality of Santa Luzia-PB, located in the backlands of Paraíba, a region with a semi-arid climate, with an estimated population of

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15,447 people (IBGE, 2026). The municipality's PHC network has 6 ESF teams, and the dispensing of insulin and supplies is centralized in the municipal Basic Pharmacy. Data collection took place between August 2026 and October of the same year.

The study population consisted of people with type 1 or type 2 Diabetes Mellitus (DM), using insulin therapy, living in the city of Santa Luzia-PB, monitored by the Family Health Strategies (ESF) and registered at the municipal Basic Pharmacy to collect insulin and supplies. According to data from the Municipal Health Department, in 2026, the municipality had 1,249 people diagnosed with diabetes. However, in the Basic Pharmacy registry, 134 users of NPH (Neutral Protamine Hagedorn) insulin and 56 users of Regular insulin were identified, considering that some of the patients used both types of insulin. The sample, non-probabilistic and selected for convenience, consisted of 40 participants, recruited after collecting insulin at the municipal Basic Pharmacy.

People aged 18 or over, with a clinical diagnosis of DM, using insulin obtained from the municipal Basic Pharmacy, residing in Santa Luzia-PB and able to respond to the questionnaire were included. Individuals under 18 years of age, people diagnosed with Diabetes Mellitus who did not use insulin, who did not collect insulin at the municipal Basic Pharmacy, non-residents in the municipality of Santa Luzia-PB, unable to respond to the questionnaire independently, as well as those who did not agree to participate in the research or who submitted incomplete questionnaires were excluded.

A structured questionnaire was used, prepared by the researcher based on the work of Sparapani et al., 2026; BRAZIL, 2025; Cunha et al., 2020, consisting of 32 objective questions: 5 on sociodemographic data, 4 on clinical variables, 7 on transportation, 5 on storage and preparation, 7 on application and 4 on disposal of materials and supplies. The instrument was applied via face-to-face interview by the researcher. The reported practices were compared to the recommendations of the Ministry of Health and the Brazilian Diabetes Society (BRASIL, 2013; Sparapani et al., 2026).

The data were tabulated in Microsoft Excel and subjected to descriptive statistical analysis, using absolute and relative frequencies. The 95% confidence intervals of the proportions were calculated using the Wilson method.

The study was approved by the Research Ethics Committee of the Centro Universitário de Patos (UNIFIP), under registration nº 5181, CAAE nº 98487726.3.0000.5181 and Opinion nº 8.523.182, in accordance with CNS Resolution nº 466/2012. All participants were instructed on the research objectives and procedures and signed the Free and Informed Consent Form (TCLE). In the case of illiterate participants, the document was read in full by the researcher. When the participant did not know how to sign their own name, consent would be formalized by means of a fingerprint, in the presence of a witness. However, all non-literate participants were able to write at least their first name, meaning that it was not necessary to resort to fingerprinting.

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4. Results and discussion

40 insulin users attended by the Basic Pharmacy in the city of Santa Luzia-PB participated in the study. The sample provided for in the project was fully achieved, and no missing data were recorded in the analyzed variables. The presentation of the results was organized according to the stages investigated by the questionnaire: characterization of participants, transportation, storage and preparation, application and disposal of materials used in insulin therapy. The sociodemographic characteristics of the participants are presented in Table 1.

Table 1 – Sociodemographic characterization of participants (n = 40)

Variable	Category	n	%
Sex	Female	22	55.0
	Male	18	45.0
Age range	18 to 29 years old	1	2.5
	30 to 39 years old	4	10.0
	40 to 49 years old	5	12.5
	50 years or more	30	75.0
Color/race	White	18	45.0
	Brown	14	35.0
	Black	8	20.0
Number of people in the household	Lives alone	5	12.5
	Two people	17	42.5
	Three people	9	22.5
	More than three people	9	22.5
Years of study	Did not attend school/illiterate	6	15.0
	1 to 8 years	26	65.0
	9 years or more	8	20.0

Source: Research data.

There was a slight predominance of female participants, corresponding to 55.0% of the sample (n = 22). The majority were 50 years old or over (75.0%; n = 30), while only one participant was between 18 and 29 years old. This profile is consistent with the epidemiology of DM in the country. The Vigitel Brasil study, from 2023, with data collected in Brazilian

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capitals and the Federal District, demonstrated a higher prevalence of diabetes among women (11.1%) compared to men (9.1%) and an increase in prevalence with age in both sexes (BRASIL, 2024). Similarly, analysis of the 2019 National Health Survey (PNS) with 32,111 adults living in Brazilian capitals identified a prevalence of 7.2% among men and 8.0% among women (Faria; Sena; Guimarães, 2026). The greater female participation may also reflect the greater use of PHC services by women, which favors diagnosis and monitoring (IBGE, 2020).

Regarding color or race, 45.0% (n = 18) declared themselves white, 35.0% (n = 14) mixed race and 20.0% (n = 8) black. Data from the 2019 National Health Survey, carried out with 60,202 adult individuals nationwide, indicated a prevalence of diabetes mellitus of 8.0% among white people, 7.3% among black people and 7.8% among mixed-race people (Malta et al., 2022). As these prevalence differences are small, the predominance of self-declared white people in the sample does not seem to be explained by them and must be interpreted in light of the racial composition of the local population and possible self-declaration bias. The analysis of individuals' color or race is important in studies related to health practices, since issues associated with racial discrimination in health services can compromise access and quality of care provided (Carvalho; Louvison, 2026).

Regarding household composition, 42.5% (n = 17) lived in households with two people (the participant and one other resident), while 12.5% □□(n = 5) lived alone. The sample was characterized by low education, since 65.0% (n = 26) had between one and eight years of study and 15.0% (n = 6) had not attended school or were illiterate. Thus, 80.0% of participants had a maximum of eight years of schooling. Education is an important sociodemographic factor in the analysis of health practices, as it may be related to the ability to understand information and guidance from health professionals. In this sense, lower levels of education can represent challenges for understanding and adopting practices favorable to treatment (Paes et al., 2025). As an example, a study carried out with 82 patients treated at the Intermunicipal Health Consortium of Western Paraná (CISOP) observed differences in the average levels of glycated hemoglobin (HbA1c) according to education. Patients with completed higher education or postgraduate studies had an average of 7.9%, while those who were illiterate or had primary education had an average of 8.9% (Fontenele; Andrade; Pescador, 2024). Regarding the assistance received by people with diabetes, the study by Neves et al. (2022), carried out with data from the 2019 National Health Survey (PNS) and which included 6,317 individuals with diabetes, demonstrated that people with higher education were more than twice as likely to undergo eye and foot exams. Furthermore, this group presented higher indicators of service in terms of requesting tests, with percentages 39% higher for glycated hemoglobin, 31.4% for glycemic curve and 29.7% for ophthalmological examination carried out in the previous year. This aspect is particularly relevant in this study, in which 80.0% of participants had up to eight years of education, and reinforces the need for educational strategies adapted to health literacy, such as simple language, practical

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demonstration and verification of understanding using the teach-back method (Brevidelli; Moura; De Domenico, 2024).

Next, the clinical and therapeutic characteristics related to diabetes and the use of insulin were analyzed.

Table 2 – Clinical and therapeutic characteristics of the participants (n = 40)

Variable	Category	n	%
Type of diabetes	Type 1 diabetes	2	5.0
	Type 2 diabetes	38	95.0
Diagnosis time	Less than 5 years	9	22.5
	5 to 10 years	7	17.5
	More than 10 years	24	60.0
Insulin therapy time	Less than 5 years	15	37.5
	5 to 10 years	11	27.5
	More than 10 years	14	35.0
Type of insulin	NPH	24	60.0
	Regular	1	2.5
	NPH and Regular	15	37.5

Source: Research data.

Regarding the clinical profile, it was found that 95.0% of the participants (n = 38) had type 2 diabetes mellitus. The majority had lived with the diagnosis for more than ten years (60.0%; n = 24). Regarding insulin therapy, 37.5% (n = 15) had been using insulin for up to five years, while 35.0% (n = 14) had been taking insulin for more than ten years.

The predominance of DM2 (95.0%) was expected, since this is the most frequent form of the disease, responsible for around 90% to 95% of cases (Sociedade Brasileira de Diabetes, 2025). As it is a progressive disease, with a gradual decline in β-cell function, many people with DM2 begin to require insulin throughout its course, especially in the face of severe hyperglycemia or failure of oral antidiabetic medications (BRASIL, 2024). This progressive nature is consistent with the finding that 60.0% of participants had lived with the diagnosis for more than ten years.

In DM1, insulin therapy is essential from diagnosis, due to absolute insulin deficiency, generally on a multiple daily dose schedule that seeks to mimic the physiological secretion of the hormone (Silva Júnior; Gabbay; Lamounier, 2023). The low proportion of people with DM1 in the sample (5.0%) is compatible with the lower prevalence of this form of the disease. Although it is less prevalent than type 2 diabetes mellitus, it is estimated that Brazil has

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approximately 564,249 people with DM1, of which around a fifth (109,827 people) are under the age of 20 (Gregory et al., 2022).

NPH insulin was used alone by 60.0% of participants (n = 24). The combined use of NPH and Regular insulin was identified in 37.5% of the sample (n = 15), while only one participant used Regular insulin exclusively.

According to Law No. 8,080/1990, one of the objectives of the SUS is to guarantee comprehensive health care, including therapeutic and pharmaceutical assistance (BRASIL, 1990). Law No. 11,347/2006 ensures the free distribution of medicines and supplies to people with diabetes enrolled in education programs, and Ordinance No. 2,583/2007 defines the supplies made available, such as syringes for administering insulin, reagent strips, lancets and glucometers (BRASIL, 2006; BRASIL, 2007). Subsequently, the incorporation of pens for the application of NPH human insulin and regular human insulin, both at a concentration of 100 IU/mL and presented in 3 mL cartridges, was established through SCTIE/MS Ordinance nº 11, of March 13, 2017 (BRASIL, 2017).

Regarding the action profile, NPH insulin is classified as an intermediate-acting insulin, used to provide basal coverage, with an onset of action between 2 and 4 hours and a duration of 10 to 18 hours. Regular insulin is classified as a short-acting insulin, used to control meal-related elevations in blood glucose levels, with an onset of action between 30 minutes and 1 hour and a duration of 5 to 8 hours (Silva Júnior; Gabbay; Lamounier, 2023).

The practices adopted by the participants during the transport of insulin, as well as the receipt of professional guidance on this stage, are presented in Table 3.

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Table 3 – Practices related to insulin transportation (n = 40)

Variable	Category	n	%
Container used	Thermal bag	4	10.0
	Styrofoam box	36	90.0
Uses refrigeration	Always	26	65.0
	Sometimes	1	2.5
	Never	13	32.5
Take it home immediately	Always	40	100.0
Prevents exposure to heat	Always	37	92.5
	Sometimes	1	2.5
	Never	2	5.0
Maintains direct contact with ice	Yes	20	50.0
	No	6	15.0
	Does not use ice	14	35.0
Received professional guidance	Yes	37	92.5
	No	3	7.5

Source: Research data.

The Styrofoam box was the most used container for transporting insulin, being mentioned by 90.0% of participants (n = 36). Refrigeration was always used by 65.0% (n = 26), while 32.5% (n = 13) reported never using any form of refrigeration during transport.

All participants stated that they took the insulin home immediately after receiving it. Furthermore, 92.5% (n = 37) stated that they always avoided exposing the medication to heat, such as the sun or staying in a closed vehicle. However, half of the sample (50.0%; n = 20) reported keeping the insulin in direct contact with ice during transport. Another 35.0% (n = 14) did not use ice and 15.0% (n = 6) used ice, but without direct contact with the medicine.

The majority reported having already received guidance from a health professional on the correct transportation of insulin (92.5%; n = 37). The pharmacist was the most mentioned professional, being indicated by 60.0% of the sample (n = 24), followed by the doctor, mentioned by 25.0% (n = 10). The nurse was mentioned by one participant, other professionals by two participants, and three reported not having received guidance.

Although favorable practices were observed, such as immediate transport to home and protection against heat, the results also highlighted behaviors that require attention, especially

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the direct contact of insulin with ice, reported by half of the participants, and the absence of any form of refrigeration during transport, reported by 32.5%.

According to the Ministry of Health, the transport of insulin from the Basic Pharmacy to the home can be done in common packaging, as long as the medicine is protected from direct sunlight and excessive heat, avoiding exposure to temperatures above 30 °C. In regions with a hot climate, such as the semi-arid region of Paraíba, it is recommended to use thermal bags or Styrofoam boxes, without direct contact between insulin and ice, which can cause it to freeze and lose activity (BRASIL, 2026). Therefore, the absence of refrigeration on short journeys is not, in itself, a mistake, but it becomes a risk on long journeys or in high temperatures. Contact with ice represents a relevant failure, as it compromises the integrity of the medicine. In Fortaleza-CE, 27.4% of participants transported insulin inappropriately (Cunha et al., 2020). The finding that half of the sample kept the insulin in contact with ice, although 92.5% reported guidance on transportation, suggests that the recommendation to use ice may be being transmitted without the caveat of avoiding direct contact, an aspect that should be emphasized in the Basic Pharmacy guidelines.

Practices related to storage and procedures carried out before application are presented in Table 4.

Table 4 – Insulin storage and preparation practices (n = 40)

Variable	Category	n	%
Storage location	Refrigerator door	18	45.0
	Inner shelf	17	42.5
	Next to the freezer	5	12.5
Apply immediately after removing from the refrigerator	Always	33	82.5
	Sometimes	3	7.5
	Never	4	10.0
Observe the appearance of insulin	Always	38	95.0
	Never	2	5.0
Received guidance on storage and preparation	Yes	37	92.5
	No	3	7.5

Source: Research data.

Regarding storage, 45.0% of participants (n = 18) reported storing insulin in the refrigerator door, 42.5% (n = 17) used an internal shelf and 12.5% (n = 5) stored the

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medication close to the freezer. Thus, 57.5% (n = 23) kept insulin in places subject to greater thermal fluctuations or risk of freezing.

After removing the insulin from the refrigerator, 82.5% of participants (n = 33) said they administered it immediately, 7.5% (n = 3) performed this practice occasionally and 10.0% (n = 4) never administered it immediately. Regarding the inspection of the medicine, 95.0% (n = 38) reported always observing its appearance, considering characteristics such as color, particles and turbidity.

Professional guidance on storage and preparation was reported by 92.5% of the sample (n = 37). The pharmacist was again the most cited professional (Table 7), being responsible for the guidance received by 55.0% of participants (n = 22). The doctor was mentioned by 25.0% (n = 10), the nurse by 7.5% (n = 3) and other professionals by 5.0% (n = 2). Three participants reported not having received guidance on this step.

The data revealed a high frequency of professional guidance and inspection of insulin appearance. However, they also showed that a significant portion stored the medication in the refrigerator door or close to the freezer, indicating the presence of practices that should be considered in educational activities aimed at managing insulin therapy.

Proper storage of insulin is essential to preserve its stability and effectiveness. According to the Ministry of Health, sealed NPH and Regular insulins must be kept refrigerated, between 2 °C and 8 °C, and, after starting use, they can remain at room temperature, below 30 °C, for the period indicated by the manufacturer (BRASIL, 2025). The application does not need to be immediate: the insulin can be removed from the refrigerator about 30 minutes in advance, which reduces the discomfort of application. Therefore, the item "administer immediately after removing from the refrigerator" does not, in itself, indicate inappropriate practice. It is recommended to store it on internal shelves, away from the freezer and avoiding the door, which is subject to greater temperature fluctuations, as temperatures below 2 °C can freeze the insulin and compromise its effectiveness (Sparapani et al., 2026). In a study that monitored the temperature of insulins stored in domestic refrigerators, periods outside the recommended range were frequent (Braune et al., 2019), which reinforces the importance of guidance on the storage location. In addition to taking care of temperature, visual inspection is essential: Regular insulin must be clear and colorless, and NPH, after homogenization, must be uniformly milky; the presence of lumps, crystals, flakes or color changes indicates that the product should not be used (BRASIL, 2025).

The procedures adopted during the preparation and application of insulin are presented in Table 5.

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Table 5 – Practices related to the preparation and application of insulin (n = 40)

Variable	Category	n	%
Sanitize your hands	Always	36	90.0
	Sometimes	3	7.5
	Never	1	2.5
Clean the injection site with alcohol	Always	27	67.5
	Sometimes	2	5.0
	Never	11	27.5
Performs clamping at a 90° angle	Always	35	87.5
	Never	5	12.5
Systematically change the injection site	Always	37	92.5
	Sometimes	1	2.5
	Never	2	5.0
Reuse needles or syringes	Always	12	30.0
	Sometimes	10	25.0
	Never	18	45.0
Received application guidance	Yes	37	92.5
	No	3	7.5

Source: Research data.

Hand hygiene before preparing insulin was always performed by 90.0% of participants (n = 36). Cleaning the injection site with alcohol was reported as a common practice by 67.5% (n = 27), while 27.5% (n = 11) said they never performed this procedure.

Pinching the skin at the injection site for administration at a 90° angle was reported by 87.5% of the sample (n = 35). The systematic rotation of injection sites was reported as a common practice by 92.5% (n = 37), while two participants stated that they never alternated the sites used.

The reuse of needles or syringes was significantly common. Among the participants, 30.0% (n = 12) reported always reusing them and 25.0% (n = 10) sometimes. Thus, 55.0% of the sample reused needles or syringes at some frequency, while 45.0% (n = 18) reported never carrying out this practice.

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Professional guidance (Table 7) on correct application was reported by 92.5% of participants (n = 37). At this stage, nurses were the most cited professionals, corresponding to 47.5% of the sample (n = 19). The doctor was mentioned by 25.0% (n = 10), the pharmacist by 17.5% (n = 7) and another professional by 2.5% (n = 1). Three participants had not received guidance on the application.

In general, there were high frequencies of hand hygiene, rotation of injection sites and receipt of professional guidance. On the other hand, the reuse of needles or syringes remained a frequent practice among participants.

Hand hygiene is recommended before preparing and administering insulin, as well as inspecting the injection site to identify skin changes, such as lipohypertrophy, bruises or signs of inflammation (Frid et al., 2016; Sparapani et al., 2026). Regarding antisepsis, international recommendations consider a clean injection site sufficient in the home setting, reserving disinfection for specific situations, while national guidelines recommend the use of 70% alcohol, waiting for it to dry completely before application (Frid et al., 2016; Sparapani et al., 2026). Therefore, the absence of alcohol antisepsis, reported by 27.5% of participants, should be interpreted with caution; in Fortaleza-CE, only 42.6% of users cleaned the place with alcohol (Cunha et al., 2020).

Regarding the subcutaneous fold, the procedure depends on the length of the needle: with 4 mm needles, most adults can apply at 90° without a fold, while with longer needles, such as the 8 mm needles in syringes, the skin fold is recommended and, in people with little subcutaneous tissue, a 45° angulation, in order to avoid intramuscular application (Frid et al., 2016; Sparapani et al., 2026). As the questionnaire jointly assessed the fold and the 90° angle, without identifying the needle length, it is not possible to say whether the reported technique was suitable for each participant. Finally, rotating injection sites is essential to prevent lipohypertrophy: it is recommended to maintain a distance of at least 1 cm between applications in the same region and alternate between the abdomen, thighs, buttocks and arms (Frid et al., 2016). The systematic rotation reported by 92.5% of the sample was similar to that observed in Fortaleza-CE (92.7%) and the proportion that formed the skin fold for administration at 90° (87.5%) was close to that of that study (94.0%) (Cunha et al., 2020).

Internationally, single use of syringes and pen needles is recommended (Frid et al., 2016; American Association of Diabetes Educators, 2017), as reuse is associated with lipohypertrophy, the risk of which increases significantly when the needle is used more than five times (Blanco et al., 2013). In a randomized clinical trial, training associated with providing sufficient needles for single use reduced the frequency of lipodystrophy and glycated hemoglobin within six months (Misnikova et al., 2017). The Brazilian Diabetes Society recommends limiting reuse to up to five applications per syringe, prohibiting reuse when two insulins are mixed in the same syringe (Almeida et al., 2026). Even so, a recent

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clinical trial observed an increase in lipohypertrophy even with reuse limited to five times, although without glycemic damage in the short term (Berlanda et al., 2024).

In a Brazilian multicenter study, 57% of users reused syringes and 80% reused pen needles (Calliari et al., 2018), proportions close to that observed in this study (55.0%). As the questionnaire did not distinguish the device used or the number of reuses, it is not possible to classify all reported reuse as inappropriate. Even so, the finding indicates the need to reinforce guidelines on the limit of reuse of syringes and the single use of pen needles, as well as to verify whether the quantity of inputs dispensed is sufficient.

The practices adopted for the packaging and disposal of needles, syringes and ampoules are presented in Table 6.

Table 6 – Practices related to the packaging and disposal of materials used (n = 40)

Variable	Category	n	%
Use specific container before disposal	Always	26	65.0
	Sometimes	1	2.5
	Never	13	32.5
Container used	ESF/Basic Pharmacy collection box	4	10.0
	PET bottle or rigid container	21	52.5
	Plastic bag	2	5.0
	Does not use specific container	13	32.5
Received guidance on disposal	Yes	19	47.5
	No	21	52.5

Source: Research data.

The habitual use of a specific container to hold needles, syringes or ampoules before disposal was reported by 65.0% of participants (n = 26). However, 32.5% (n = 13) said they never used a specific container, while one participant reported using it only occasionally.

Regarding the type of container, 52.5% of the sample (n = 21) used a PET bottle or other rigid container. Only 10.0% (n = 4) reported using an appropriate collection box provided by the ESF or Basic Pharmacy. Storage in plastic bags was mentioned by 5.0% (n = 2), while 32.5% (n = 13) declared not using any specific container. Considering only rigid containers (collection box, PET bottle or similar) to be suitable, 62.5% (n = 25) stored sharps appropriately, and 37.5% (n = 15) used plastic bags or no containers at all.

Unlike the transportation, storage and application stages, in which 92.5% of participants reported having received professional guidance, only 47.5% (n = 19) had been

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instructed on the correct disposal of materials. More than half of the sample (52.5%; n = 21) stated that they had not received guidance on this procedure.

Among the professionals mentioned (Table 7), the pharmacist was the most mentioned in the guidelines on disposal, corresponding to 30.0% of the sample (n = 12). The doctor was mentioned by 5.0% (n = 2), the nurse by 2.5% (n = 1) and other professionals by 10.0% (n = 4). In the item referring to the professional advisor, 52.5% of participants (n = 21) marked the alternative "I did not receive guidance".

It is recommended that the disposal of syringes, needles, lancets and disposable pens be carried out carefully, in resistant containers, capable of avoiding contact with contaminated and sharp materials, such as rigid plastic containers, such as PET bottles, or specific collection boxes. Disposal should not be carried out in domestic or public waste bins, as this practice can represent a public health problem, causing accidents with sharps and exposure to infectious agents, such as the human immunodeficiency virus (HIV) and hepatitis B and C viruses. Waste generated by insulin therapy must be sent to appropriate locations, such as Basic Health Units (UBS), according to the disposal flow established by the municipality (BRASIL, 2025; BRASIL, 2013; SOCIEDADE BRASILEIRA DE DIABETES, 2019; SOCIEDADE BRASILEIRA DE ENDOCRINOLOGIA E METABOLOGIA, 2019). The result of this study is more favorable than that observed in Fortaleza-CE, where 82.3% of users discarded syringes and needles inappropriately (Cunha et al., 2020), possibly due to the flow of sharps collection by the ESF and the Basic Pharmacy in the city. Even so, disposal was the stage with the lowest professional guidance coverage (47.5%), which highlights a gap to be prioritized by services.

To allow an integrated visualization of the professionals' performance, Table 7 presents the distribution of guidelines according to each stage of insulin management.

Table 7 – Professional responsible for providing guidance at each stage of insulin therapy (n = 40)

Professional	**Transport n (%)**	**Storage and preparation n (%)**	**Application n (%)**	**Discard n (%)**
Doctor	10 (25.0)	10 (25.0)	10 (25.0)	2 (5.0)
Nurse	1 (2.5)	3 (7.5)	19 (47.5)	1 (2.5)
Pharmacist	24 (60.0)	22 (55.0)	7 (17.5)	12 (30.0)
Other professional	2 (5.0)	2 (5.0)	1 (2.5)	4 (10.0)
Did not receive guidance	3 (7.5)	3 (7.5)	3 (7.5)	21 (52.5)

Source: Research data.

The pharmacist was more involved in providing guidance on transportation, storage, preparation and disposal. In relation to the application of insulin, the role of the nurse stood

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out, cited by 47.5% of the participants. The doctor was mentioned by 25.0% of the sample in the guidelines on transportation, storage and application, but was less frequent in the guidelines related to disposal.

The receipt of guidance was high in the transportation, storage, preparation and application stages, being reported by 92.5% of participants in each of these dimensions. On the other hand, guidance on disposal reached less than half of the sample, showing less educational coverage at this stage of insulin therapy management.

The guidelines provided by health professionals are fundamental to the safety of insulin therapy and, to be effective, they must be dynamic, interactive and continuous, involving trained professionals, users, family members and caregivers (BRASIL, 2022). The results of this study, however, reveal an apparent paradox: although 92.5% of participants reported having been instructed on transportation, storage and application, inadequate practices persisted in these same stages, such as insulin coming into contact with ice (50.0%), storage in the refrigerator door or close to the freezer (57.5%) and the reuse of inputs (55.0%). This suggests that receiving guidance alone does not guarantee its understanding and application, especially in an older population with low education, and reinforces the need for educational strategies that include practical demonstration, materials adapted to health literacy and verification of user understanding (Paes et al., 2025; Selvadurai et al., 2021).

The role of the pharmacist in the guidance on transportation, storage and disposal is consistent with his presence at the time of dispensing, and that of the nurse in the guidance on application, with his role in the administration technique. Within the scope of PHC, the clinical responsibilities of the pharmacist, regulated by CFF Resolution No. 585/2013, include health education and pharmacotherapeutic monitoring, which reinforces their strategic role in caring for people using insulin (CONSELHO FEDERAL DE FARMÁCIA, 2013). It is up to professionals to seek updates and base their guidelines on the best available evidence (Sparapani et al., 2026).

5. Final considerations

The present study made it possible to investigate the knowledge and practices of 40 insulin-dependent users monitored by the Family Health Strategies and the Basic Pharmacy in the city of Santa Luzia-PB, covering aspects related to the transport, storage, preparation, administration and disposal of materials used in insulin therapy.

Regarding the sociodemographic profile, there was a predominance of females (55.0%; n = 22) and participants aged 50 years or over (75.0%; n = 30). In relation to color/race, there was a higher frequency of self-declared white individuals (45.0%; n = 18), followed by mixed-race individuals (35.0%; n = 14). Regarding household composition, 42.5% (n = 17) lived with two people. Education was predominantly low, as 65.0% (n = 26) had between one

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and eight years of study and 15.0% (n = 6) had not attended school or were illiterate. In the clinical profile, the predominance of type 2 diabetes mellitus (95.0%; n = 38) stood out, with a diagnosis time of more than ten years in 60.0% of participants (n = 24). These results characterize a mostly adult population, with a greater concentration of individuals over 50 years of age and low education.

One of the data that deserves attention refers to that 50.0% (n = 20) kept the insulin in direct contact with the ice. This conduct may compromise the conservation of the medicine, since direct exposure to very low temperatures can cause the insulin to freeze and impair its quality.

Another relevant finding was the reuse of needles or syringes, reported by 55.0% of participants (n = 22), 30.0% (n = 12) habitually and 25.0% (n = 10) occasionally. Although 92.5% (n = 37) stated that they received guidance on application, the reuse of materials remained frequent. With regard to disposal, it was observed that 32.5% (n = 13) never used specific containers to store the materials before disposal.

Finally, it is highlighted that the findings of this study can contribute to the planning of health education actions within the scope of the Family Health Strategies and Pharmaceutical Services of Santa Luzia-PB, strengthening the monitoring of users and promoting greater safety in all stages of insulin therapy.

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