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NUTRITIONAL APPROACH IN ADULTS WITH INSULIN THERAPY: AN INTEGRATIVE REVIEW

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ABSTRACT

Introduction: Diabetes Mellitus (DM) is a chronic disease characterized by hyperglycemia due to severe deficiency in insulin secretion or resistance of the body to it. In 2021, it was estimated that 537 million people between the ages of 20 and 79 were living with diabetes, and that number could rise to 628.6 million by 2045. The ideal treatment is insulin therapy associated with a healthy and balanced diet, crucial for glycemic control and the prevention of complications. Objective: To describe current nutritional approaches for better management of care in adult patients on insulin therapy. Method: An integrative literature review was carried out, including publications from 2019 to 2024, in Portuguese and English, addressing MD I and/or MD II, covering review articles, scientific and technical notes, as well as guidelines from relevant institutions. Studies in other languages, articles that did not respond to the survey after reading the abstract, case reports, duplicates, not available in full, and those involving pregnant women and children were discarded. Results: The search in the databases resulted in 54 articles, reduced to 5 after applying the inclusion and exclusion criteria. All addressed individualized diets (100%), two highlighted the importance of physical activity (40%), and one article emphasized reducing carbohydrates and increasing fiber (20%). In addition, two articles (40%) mentioned the importance of decreasing sugars and refined foods, and increasing whole grains. Conclusion: The importance of a personalized nutritional approach in diabetes management, optimizing insulin use and improving glycemic control is highlighted. Continuing nutritional education by health professionals is essential for patients' autonomy and adherence to nutritional care.

Keywords: Diabetes Mellitus. Food. Diet and Nutrition. Nutritional Therapy. Insulin Resistance. Insulin. Glycemic Index.

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INTRODUCTION

The Brazilian Diabetes Society (SBD) defines Diabetes Mellitus (DM) as a disease caused by the destruction of pancreatic ß cells, resulting in severe deficiency of insulin secretion (type diabetes - DM 1) or by insulin resistance and partial deficiency of insulin secretion by ß cells, in addition to alterations in the secretion of incretins (type diabetes - DM 2). DM1 is more common in children and adolescents, usually autoimmune and abrupt in onset. DM 2, on the other hand, has an insidious onset, often associated with obesity and aging. (Rodacki *et al.*, 2023; SBD, 2022; SBD, 2019).

It is also known that in 2021, the International Diabetes Federation (IDF) presented an estimate that approximately 7% of the world's population aged between 20 and 79 years old (537 million people) lived with diabetes. Therefore, if inadequate habits persist, the number of people with diabetes will be approximately 628.6 million in 2045 (SBD, 2020; ADA, 2022a; IDF, 2021).

Therefore, the best treatment route for this disease is insulin therapy, associated with healthy behaviors, since the essential purpose is the quality of life of the individual affected by this chronic non-communicable disease (NCD), so that chronic hyperglycemia associated with carbohydrate metabolism disorders can be avoided (Evert *et al.,* 2019).

Within this context, the insulin formulations available in Brazil aim to mimic the physiological secretion of insulin that occurs in individuals without diabetes, with the bolus-basal scheme, which corresponds, respectively, to prandial effect and basal effect insulin. These insulins vary in terms of pharmacokinetics, cost, and availability to the patient by the Unified Health System (SUS). Insulins can be classified according to the duration of their action as: ultra-fast-acting analogues, which include inhaled insulin and fast-aspart; ultra-fast-acting analogues, lasting 3 to 5 hours, encompassing insulin aspart, lispro, and glulisine; fast-acting, which corresponds to rapid (regular) human insulin, lasting 5 to 8 hours; intermediate-acting human insulin, this being NPH (Hagedorn's Neutral Protamine), lasting from 10 to 18 hours; long-acting insulin analogue, such as glargine 100U/ml, lasting 20 to 24 hours, and ultra-long-acting insulin analogues, such as glargine 300 U/ml and degludec, which can last 36 to 42 hours (Ceriello; Monnier; Owens, 2019; CONITEC, 2019).

Basal insulin analogues, such as glargine and degludec, represent significant progress in the treatment of diabetes, mainly due to the convenience of being administered in most cases as a single daily dose. This feature helps reduce glycemic variations, avoiding sudden peaks and falls, which is crucial to minimize damage to the body. In

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addition, these analogues contribute to the stabilization of glucose levels throughout the day and interprandial period. However, a considerable challenge is the high cost associated with its use, which can limit its accessibility to the population (Ceriello; Monnier; Owens, 2019; Ewen *et al.,* 2019; Nally *et al.,* 2019; SBD, 2022).

The main goal of diabetes treatment is to reduce mortality and prevent damage to vital organs. According to the recommendation of the National Commission for the Incorporation of Technologies in the Unified Health System (CONITEC), the SUS prioritizes the use of rapid (regular) human insulin, with a prandial effect, and intermediate human insulin (NPH), with a basal effect, for most patients. The lack of broad incorporation of basal insulin analogues into the treatment regimen provided by the SUS is justified by the absence of a significant difference in their efficacy, except in specific situations, such as difficulty in glycemic control or episodes of nocturnal hypoglycemia. (CONITEC, 2020; SBD, 2022; Brazil, 2022).

Simultaneously with insulin therapy, the patient's nutritional approach should be carried out, and treatment planning should be individualized, taking into account the lifestyle and needs of each individual, main mechanisms of approach, risk of hypoglycemia, costs, adverse effects, tolerability, impacts of this approach, among others. A balanced and well-guided diet contributes significantly to the maintenance of autonomy, care management, and glycemic control in these patients. By adapting to individual needs, it is possible to define criteria and goals that promote healthy food choices, facilitating balance and reducing the occurrence of hyper and hypoglycemia. In addition, a healthy lifestyle, including regular physical activity, has a direct and positive impact on health. For individuals with diabetes, weight management is crucial to lower the risk of complications, such as cardiovascular disease. (Guimarães; Araújo, 2023; ADA, 2022a).

Thus, the relevance of nutritional strategies in the effective management of diabetes in adults who depend on insulin therapy is highlighted. The personalized and guided approach not only aims to improve glycemic control, but also encourages patients' independence and facilitates treatment compliance. The aim of this study is to investigate and compare different nutritional approaches used for the effective management of adults using insulin, aiming to improve glycemic control, promote patient autonomy and facilitate treatment adherence.

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MATERIALS AND METHODS

This is an integrative literature review, as proposed by Mendes, Silveira and Galvão (2008), which is divided into the following stages:

2.1 STEP 1: IDENTIFICATION OF THE THEME AND SELECTION OF THE HYPOTHESIS

The guiding question for this subject was: "What is the impact of the nutritional approach, including diet and nutritional monitoring, on the management of diabetes in adults who use insulin?". The bibliographic survey was carried out from January to March 2024, in the *Scientific Electronic Library* Online (SciELO), Latin American and Caribbean Literature in Health Sciences (LILACS) and *Medical Literature Analysis and Retrieval System* Online (MEDLINE) databases. The search for the material was carried out using the combination of the following descriptors in health sciences (DECs), in Portuguese and their counterparts in English, associated with the Boolean operators (and, or): Diabetes Mellitus (*Diabetes Mellitus*); Diet, *Food, and Nutrition*; Nutrition Therapy; Insulin Resistance; Insulin (*Insulin*); *Glycemic* Index.

STEP 2: ESTABLISHMENT OF CRITERIA FOR INCLUSION AND EXCLUSION OF STUDIES/SAMPLING OR LITERATURE SEARCH

The inclusion criteria were: year of publication (last five years – 2019 to 2024), language (Portuguese and English), articles that addressed DM I and/or MD II, with these review articles, original articles and scientific notes available in the databases mentioned above, without preferences for a particular country. The following exclusion criteria were adopted: duplicate articles, articles not available in full, articles that had pregnant women and/or children as the study population, articles that, after reading in full, did not answer the guiding question of the study.

STEP 3: DEFINITION OF THE INFORMATION TO BE EXTRACTED FROM THE SELECTED STUDIES/ CATEGORIZATION OF THE STUDIES

Initially, with the application of the health descriptors (DECs) and reading of the title, 54 articles were found that met the proposed subject. Of this total, 5 made up the study sample, considering the inclusion and exclusion criteria.

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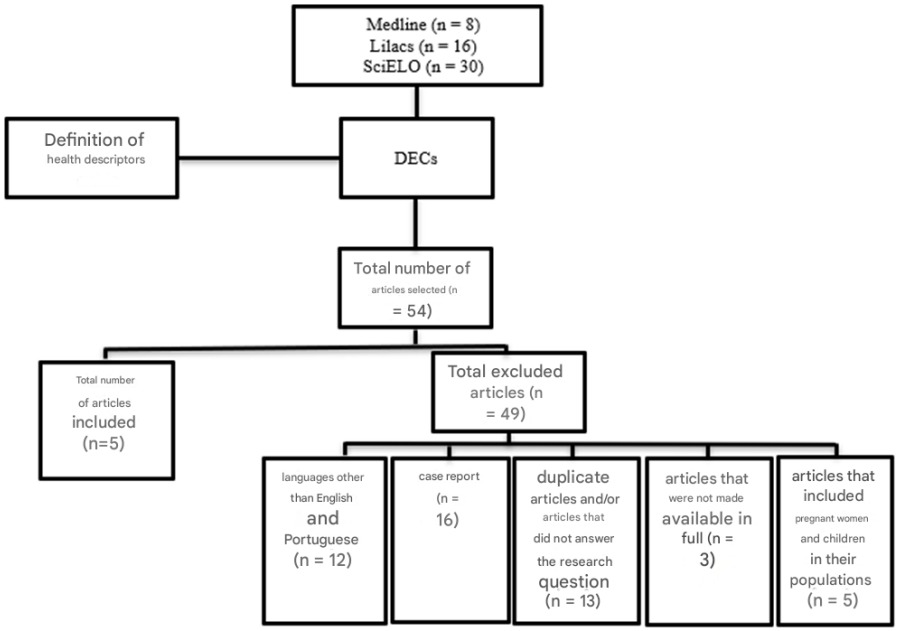
Figure 1: Stages of selection of articles for analysis regarding inclusion and exclusion criteria.



Source: Authors (2024)

STEP 4: EVALUATION OF THE STUDIES INCLUDED IN THE INTEGRATIVE REVIEW

After reading the full text of the articles, the following information was extracted: authorship, year of publication, country in which the study was conducted, title of the work, study methodology used, results and conclusion.

STEP 5: INTERPRETATION OF RESULTS

Initially, the articles were critically analyzed individually and in a later stage, we sought to compare the studies, identifying similarities and differences.

STEP 6: PRESENTATION OF THE REVIEW/SYNTHESIS OF KNOWLEDGE

In order to gather and synthesize the main results pertinent to the analysis of the articles, they were presented in a table, followed by a qualitative appraisal of the studies and a synthesis of the literature.

RESULTS

When searching the databases, 54 articles were found, which were reduced to 5 articles after applying the inclusion and exclusion criteria. It was observed that all the selected articles dealt with an individualized diet n=5 (100%), according to the needs of the patients, respecting cultural and personal preferences, in order to reduce fluctuations in

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blood glucose. In addition, two articles mentioned the importance of physical activity n=2 (40%) as fundamental, as well as reducing overall carbohydrate intake and increasing fiber intake n=1 (20%). In addition, mention was made of reducing the intake of sugars to less than 25g, in order to avoid the accumulation of glucose, and thus heart problems, in addition to the increase in the consumption of fresh grains n=2 (40%).

Chart 1 presents the information collected from the articles under study, which are in descending order in relation to the year of publication, including data on authorship, title, methodology, country of study and result/conclusion.

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Chart 1 – Articles evaluated according to compliance with inclusion and exclusion criteria. Palmas-TO, 2024.

Yes/Author	Title	Methodology	Country	Outcome/Conclusion
2023/ ALMEIDA, et. al	Nutritionists' knowledge about the management of type 1 diabetes mellitus regarding macronutrient count and insulin units	An exploratory and descriptive study was carried out in adults, through a questionnaire elaborated in *Google Forms*, containing questions for the general description of the evaluated and 10 questions to assess the level of knowledge. The data are presented in absolute and relative frequencies.	Brazil	Macronutrient counting is a highly effective approach to regulating blood sugar levels and determining the correct dosage of insulin before meals. Carbohydrate counting is a fundamental item for individuals with type 1 diabetes mellitus, and this fact contributes to reducing glycated hemoglobin (HbA1C) values. The most effective approach to controlling postprandial blood glucose is to adjust insulin doses according to the amount of hormone injected.
2022/ PORTELA, et. al.	Type 2 diabetes mellitus: factors related to adherence to self-care.	This is a quantitative, cross-sectional study conducted with 270 people with diabetes, between December 2019 and October 2020, in São Luís, Maranhão.	Brazil	There was more favorable adherence to self-care regarding the use of insulin and medication (Mean=7.0) and foot care (Mean= 6.0) and less desirable adherence to blood glucose monitoring (Mean=1.0), physical activity (Mean=2.0) and general diet (Mean=4.0). The identification of factors related to adherence to self-care proved to be essential for strengthening the line of care in chronic diseases and directing educational actions.
2020/ KATSARIDIS, et. al.	Low Reported Adherence to the 2019 American Diabetes Association Nutrition Recommendations among Patients with Type 2 Diabetes Mellitus, Indicating the Need for Improved Nutrition Education and Diet Care	This was a cross-sectional study. A total of 162 adults with T2DM (64.7 ± 10.6 years), of whom 41.4% were men, were recruited from the Sismanoglio Hospital and participated in the study.	Northern Greece	The present cross-sectional study demonstrated a low rate of adherence to dietary recommendations for DM among patients with DM2, indicating the need for better nutritional education and dietary care. Only 9.9% of patients followed an individualized eating plan to improve glycemic control, and 3.1% had specific energy goals set to reduce body weight. Among those on insulin therapy, only 1.2 percent were competent to count the carbohydrate content of their meals, and 3.7 percent received fixed doses of insulin combined with a consistent carbohydrate intake.
2019/ EVERT,	Nutrition therapy for adults with diabetes or	The search strategy is reported by	USA	The Consensus Report now includes information on prediabetes

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et. al.	prediabetes: A consensus report	supplementary data, emphasizing randomized controlled trials (RCTs), systematic reviews and meta-analyses of RCTs. The reviewed research was limited to studies conducted in adults diagnosed with prediabetes, type 1 and/or type 2 diabetes.		and the American Diabetes Association (ADA) nutrition position statements. A food plan must be built together with the patient so that he or she has autonomy. It is necessary to regularly adjust the individual's diet based on individual needs. Maintaining a healthy weight is crucial for effective management of diabetes and prediabetes. Carbohydrate intake should be individualized and distributed throughout the day to optimize glycemic control. It is important to choose high-quality carbohydrates such as whole grains, fruits, vegetables, and low-fat dairy products, and to regularly monitor blood glucose levels and adjust nutritional therapy as needed.
2019/ AHOLA, et. al.	Associations of dietary macronutrient and fibre intake with glycaemia in individuals with Type 1 diabetes.	Study carried out with a thousand adults, over two years, including people with insulin therapy treatment. The associations between these blood glucose measurements and food intake were investigated using generalized linear regression, with and without macronutrient substitution.	USA	They were all associated with lower variability in blood glucose measured values. After adjusting for fiber intake, no significant results were observed in the analyses of self-monitored mean blood glucose; It has been noted that dietary fiber plays an important role in the successful management of blood glucose in type 1 diabetes, in addition to reducing oscillations when used with protein to replace excess carbohydrates, fats.

Source: Authors (2024)

DISCUSSION

As found in the results, in an exploratory and descriptive study by Almeida, Miranda, and Cavicchia (2023), the Brazilian Diabetes Society (SBD, 2021-2022) and the *American Diabetes Association* (ADA, 2022a) recommend that the daily diet of patients with DM should be divided into macronutrients without fructose intake, with a maximum of 5 to 10% of the total energy value for sucrose; it should contain at least 14 g/1,000 kcal or 20 g/1,000 kcal/day dietary fiber; 20 to 35% of the total energy value being total fats, with a limitation of saturated fat by up to 10%, free of trans fats; and, 15 to 20% of the total energy value being proteins. As for micronutrients, such as vitamins and minerals, the intake recommendation is according to the non-diabetic population (SBD, 2019-2020).

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From this perspective, for Almeida, Miranda, and Cavicchia (2023), sugar levels, as well as carbohydrate counting, should be carried out rigorously for glycemic control, according to the findings of this research. In addition, it was mentioned that calculating carbohydrate intake is efficient because it allows greater flexibility and allows food choice for better blood glucose control. Thus, weighing food, counting its grams of carbohydrates and identifying preprandial blood glucose, allows the calculation of the dose of ultra-rapid or regular insulin (*bolus*), for example. Such a calculation generates the possibility of reducing blood glucose, if it rises, in addition to allowing the amount (grams) of carbohydrates to be ingested in the meal to be covered (SBD, 2021-2022; Portela *et al.*, 2021).

In this way, the reduction of sugars, refined grains, and ultra-processed foods shows an improvement in the glycemic index and allows the alternation between the patient's preferences, increasing their quality of life, within their treatment specificity (ADA, 2023a). From this perspective, ultra-processed foods are considered of poor quality, which causes a negative effect on the body by leading to weight gain, modifying the intestinal microbiome and directly interfering in the control of diabetes, also impairing the association with insulin (Ahola *et al.*, 2019).

Another factor mentioned in the studies refers to dietary fiber, which is relevant in the successful management of glycemic control in DM1 in addition to being able to reduce fluctuations in blood glucose, if it is used with protein in order to replace excess carbohydrates and fats. This is due to the fact that these foods rich in free and/or added sugars, fats and low levels of fiber, contribute directly to weight gain, which affects the health of diabetics (Evert *et al.*, 2019). These data corroborate those of Ahola *et al.* (2019), who state that adequate fiber consumption favors the reduction of blood glucose concentrations.

In the study by Evert *et al.* (2019), noticed that patients using insulin who were in excessive consumption of ultra-processed foods, unrelated to economic class, were overweight or obese, had low HDL levels and metabolic syndrome, in addition to depression, anxiety, and increased cardiovascular risk. With the evolution of technology, the foods produced began to have an increase in additives, being also rich in flavor, starch, sugars, and even more attractive, making their consumption greater and, consequently, impairing the maintenance of adequate blood glucose levels (De Almeida, Miranda, and Cavicchia, 2023).

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Another observation made by this study was regarding satisfactory adherence to self-care, where it was found that there was little adherence to blood glucose monitoring and the practice of physical activity, which appears to be detrimental to the strengthening of a healthy routine for DM patients (Evert *et al.*, 2019). Therefore, when the patient undergoes insulin therapy, it is important that they are encouraged to self-monitor their glycemic levels, namely, during fasting, before meals and snacks, after meals, at bedtime, after hypoglycemia, before and during exercise (De Almeida, Miranda and Cavicchia, 2023).

Thus, the control of blood glucose with the patient's autonomy favors the reduction of the risks of acute and chronic complications, in addition to allowing the understanding of the determinants of glycemic results, such as the intake of adequate foods and the practice of physical activity. Portela *et al.,* (2021) mention the significant interferences in the use of oral and injectable drugs, and it is possible to observe a reduction in their needs for the treatment of DM 2, and also an improvement in insulin sensitivity after physical exercise. In this study, it was reported that greater adherence to physical activity can be achieved with the institution of a goal plan, monitoring and supervision tools.

According to SBD (2022), aerobic exercise reduces oxidative stress levels by controlling blood glucose as well as hyperglycemia and thus inflammation, causing less damage to micro and macro circulation. Another important point was regarding a cross-sectional study conducted by Katsaridis *et al.* (2020), in which they mention low adherence to the dietary recommendations of patients with DM 2, and therefore, the combination of macronutrients should be individualized, observing how the patient is, their needs, metabolic goals, physical activity, and other particularities (Evert *et al.*, 2019)element.

From this point of view, a diet with an incorrect amount of macronutrients can significantly reduce the essential amount of potassium, magnesium, vitamin A, C, D, E, B12, zinc and others. Therefore, the ADA (2023b) proposes the construction of a food plan together with the patient, according to their needs, to optimize glycemic control. Therefore, an adequate diet with individualized nutritional guidance/counseling allows for a better quality of life and general improvement of the individual's health, in order to allow them to plan their daily meals (SBD, 2021-2022).

A healthy diet needs to include varied and nutrient-rich foods, in addition to presenting adequate proportions. Also in this context, a quality eating plan should involve properly selected carbohydrates (Evert *et al.*, 2019). Thus, it is necessary to observe cultural aspects and personal food preferences to minimize barriers to the change in the

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lifestyle of these individuals, since the accumulation of visceral fat is directly associated with the increase in inflammatory factors and insulin resistance (Katsaridis *et al.*, 2020; Evert *et al.*, 2019).

In addition, individuals with diabetes should consume more fiber, which can be acquired through vegetables, legumes (beans, peas, and lentils), fruits, and whole and intact grains, favoring the reduction of harmful glycemic indexes to the body (Evert *et al.*, 2019). Thus, among the findings, it was possible to notice that only 9.9% of the patients followed an individualized eating plan to improve the glycemic index and 3.1% had specific energy goals defined to reduce body weight.

It is also known that nutritional therapy has as its main purpose the treatment of a certain health condition, through changes in the consumption of nutrients or food, and although it is essential, it is sometimes neglected. Thus, it is essential that for the continuity of treatment, the patient is contemplated with food choices (Katsaridis *et al.*, 2020; Evert *et al.*, 2019). For this, it is important that nutritional education is carried out, however, according to the results of this research, only 1.2% of diabetics were competent to count the carbohydrate content of their meals.

This situation could also be seen by Katsaridis *et al.* (2020), who infer that nutritional education is considered fundamental for treatment, since the continuous guidance provided by health professionals, such as nutritionists, helps patients to make appropriate food choices and understand the importance of balancing diet and insulin therapy. This support facilitates the development of self-care and empowerment skills for managing their health. So, this approach improves not only clinical outcomes, but also contributes to the overall well-being of patients.

It is known that the dietary pattern is a modifiable risk factor, so it is an ally that favors blood glucose control. Thus, foods and their nutrients play a crucial role in nutrition and glycemic control, particularly in patients with diabetes mellitus. According to Evert *et al.* (2019), therapy with insulin analogues, such as those used in continuous infusion pumps, is effective in the management of T2DM by mimicking the physiological release of insulin and improving glycemic control. The choice of foods with a low glycemic index is essential to stabilize blood glucose, complementing treatment and promoting a better quality of life for patients (Katsaridis *et al.*, 2020).

Therefore, balanced diets that consider the distribution of macronutrients and fiber intake have shown positive results in controlling blood glucose levels. Another positive

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factor is the continuous monitoring and adjustments in the diet as necessary, as it allows a more precise response to insulin treatment, promoting greater glycemic stability (Evert *et al.*, 2019).

Thus, it is important that the team also provides adequate nutritional education to patients regarding nutrition, individually, without a generalist protocol, so that they understand and can make prudent choices, beneficial to their individual needs, in order to provide a better understanding of how their eating habits impact their health, highlighting the relevance of foods with a low glycemic index, to maintain stable glucose levels. Therefore, the nutritional approach is essential for patients who use insulin and its analogues, as it directly influences glycemic control and treatment efficacy.

CONCLUSION

From this research, it is noted that the proper nutritional approach plays a primary role in the effective management of diabetes and contributes significantly to the glycemic control, autonomy and adherence of patients. It is also inferred that the personalization of the diet is relevant, based on the individual needs and metabolic profile of each individual, in order to optimize the use of insulin and its analogues. Also, nutritional education is of paramount importance, given that the continuous guidance provided by health professionals, such as nutritionists, helps patients to make appropriate food choices, develop self-care skills and understand the importance of balancing diet and the use of insulin and its analogues.

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