

## Guidelines for self-care and self-application of insulin to patients with diabetes mellitus by medical students

### Orientações de autocuidado e autoaplicação insulínica a portadores de diabetes mellitus por estudantes de medicina

### Orientaciones sobre autocuidado y autoadministración de insulina a pacientes con diabetes mellitus por estudiantes de medicina

Received: 20/06/2020

Approved: 06/04/2021

Published: 21/06/2021

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This study aims to report the experience of medical undergraduates in self-care education actions for patients on insulin therapy, from an extension project, carried out during the 2019 academic semesters, in an outpatient clinic for people care with diabetes, at the Hospital de Clínicas of the Universidade Federal de Uberlândia, after training the students involved. Triggering questions were considered: Questions such as "Could you tell how you keep insulin in your house?", "Can you show me how you apply insulin?", "Where do you inject insulin, exactly?" and, "To dispose of the needle, how do you do it?". An audience of 260 children, teenagers and adults was estimated. The waiting period was used, before the consultation, with individual interviews. With the difficulties found for each patient, self-care in the application of insulin was guided. The experience of health education made it possible to reinforce the step-by-step process of insulin therapy, encourage adherence to treatment and contribute to improving the quality of life, strengthening the teaching-service-community axis, in which the patient develops the necessary skills for self-care, and students, experience practical for their professional future.

**Descriptors:** Diabetes mellitus; Insulin; Medication therapy management; Health education.

O presente estudo tem como objetivo relatar a experiência de graduandos do curso de Medicina em ações de educação no autocuidado a pacientes em uso de insulino terapia a partir de um projeto de extensão, realizado durante os semestres letivos de 2019, em ambulatório para atendimento a pessoas com diabetes, no Hospital de Clínicas da Universidade Federal de Uberlândia, após capacitação dos acadêmicos envolvidos. Considerou-se as perguntas disparadoras: Perguntas como "Poderia contar como você guarda a insulina na sua casa?", "Pode mostrar como você aplica a insulina?", "Onde você injeta a insulina, exatamente?" e, "Para descartar a agulha, como você faz?". Foi estimado um público de 260 crianças, adolescentes e adultos. Utilizou-se o período de espera, antes da consulta, com entrevistas individuais. Com as dificuldades encontradas para cada paciente, se orientava o autocuidado na aplicação da insulina. A experiência de educação em saúde possibilitou reforçar o passo-a-passo da insulino terapia, incentivar a adesão ao tratamento e contribuir na melhoria da qualidade de vida, fortalecendo o eixo ensino-serviço-comunidade, no qual o paciente desenvolve habilidades necessárias para o autocuidado, e os alunos vivenciam práticas para seu futuro profissional.

**Descritores:** Diabetes mellitus; Insulina; Conduta do tratamento medicamentoso; Educação em saúde.

Este estudio tiene como objetivo reportar la experiencia de los estudiantes de pregrado en medicina en las acciones de educación sobre el autocuidado a los pacientes que utilizan la terapia de insulina a partir de un proyecto de extensión, llevado a cabo durante los semestres académicos de 2019, en una clínica ambulatoria para las personas con diabetes, en el Hospital de Clínicas de la Universidad Federal de Uberlândia, después de la formación de los estudiantes involucrados. Se consideraron las siguientes preguntas desencadenantes: Preguntas como "¿Puede decirnos cómo guarda la insulina en su casa?", "¿Puede mostrarnos cómo aplica la insulina?", "¿Dónde se inyecta exactamente la insulina?" y "Para deshacerse de la aguja, ¿cómo lo hace?". Se estimó un público de 260 personas entre niños, adolescentes y adultos. Se utilizó el periodo de espera antes de la cita, con entrevistas individuales. Las dificultades encontradas por cada paciente se utilizaron para guiar el autocuidado en la aplicación de la insulina. La experiencia de educación en salud permitió reforzar el paso a paso de la terapia con insulina, fomentar la adherencia al tratamiento y contribuir a la mejora de la calidad de vida, fortaleciendo el eje enseñanza-servicio-comunidad, en el que los pacientes desarrollan las habilidades necesarias para el autocuidado y los estudiantes experimentan prácticas para su futuro profesional.

**Descriptores:** Diabetes mellitus; Insulina; Administración del tratamiento farmacológico; Educación en salud.

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## INTRODUCTION

The term “diabetes mellitus” (DM) describes a group of metabolic disorders characterized by chronic hyperglycemia in the absence of treatment, and there may be several etiologies for this defect in the regulation of blood glucose in the body<sup>1-4</sup>. The classification is: Type 1, resulting from the autoimmune destruction of pancreatic cells; Type 2, due to increased insulin resistance (with or without associated insulin secretion deficiency); Gestational diabetes, characterized by altered blood glucose first diagnosed during pregnancy; among other types<sup>1</sup>.

DM is found in all over the world, with an estimate that there were 422 million adults in the world with diabetes in 2014, reaching 629 million by 2045<sup>1</sup>. In Brazil, the number of people with diabetes was 12, 5 million in 2017, and the projection for 2045 reaches 20.3 million<sup>5</sup>. The expectation is for an increase in prevalence from 4.6% in 2000 to 11.3% in 2030, due to the population's eating habits and lifestyle<sup>6</sup>.

The main concern in DM, as well as in several other Chronic Noncommunicable Diseases, is the chronicity of the disease without treatment, in this case, characterized by persistent hyperglycemia, which generates several complications, such as heart and cerebrovascular diseases, in addition to retinopathy, nephropathy, neuropathy and obesity, being some of these conditions of high morbidity and mortality and/or generating high costs for the Brazilian health system. Therefore, therapeutic measures for good glycemic and, consequently, metabolic control are essential for the good management of these patients<sup>1-2,4-7</sup>.

In addition to nutrition and physical activity, the use of insulin is the foundation for the treatment of insulin-dependent DM<sup>5</sup>. Type 1 DM is characterized by insufficient insulin production and, therefore, treatment is based on the replacement of this hormone<sup>5</sup>. In patients with type 2 DM, the use of insulin therapy increases as the duration of the disease is prolonged, but it may enter the therapeutic scheme soon after diagnosis due to metabolic decompensations<sup>5</sup>.

Several studies have shown obstacles to the correct treatment in insulin therapy and, consequently, to an adequate metabolic control, particularly due to errors and inaccuracies regarding the technique of handling, administration, storage, injection site, rotation of injection sites and disposal of materials<sup>2,4,7</sup>. This is explained by the complex involvement of multiple key factors for the proper use of insulin, encompassing the procedures themselves, the characteristics of the individual (psychological status, comorbidities, cognitive and physical skills, discipline, interest and availability for learning and practical application), the insulin regimen (type of insulin, dose and number of daily applications) and the social determinants of health, such as the degree of financial stress and the provision of resources by the health system and the community<sup>2,4,7-8</sup>.

In Brazil, adherence to the correct technique is still insufficient due to factors such as: syringes with larger needles; less use of pens; reuse of needles; not rotating the application site; occurrence of lipohypertrophy; error in the crease technique<sup>9</sup>.

Given the potential failures in this web of factors and the negative impact they can cause, it is necessary to implement interventions to mitigate and prevent problems arising from this scenario, in addition to helping diabetic patients in their adherence to treatment. With the multiple technological, therapeutic, social and psychological aspects of DM, in addition to evidence showing a deficit of knowledge and skills in managing the disease in 50 to 80% of patients, it is understood that educational actions are protagonists in the movement of improvement in self-care and, consequently, in the health of patients<sup>2-3,5,6</sup>.

In this context, the present study aims to report the experience of medical undergraduates in self-care education actions for patients using insulin therapy.

## METHODS

This is a descriptive study of the experience report type, linked to an extension project carried out by medical students at the Universidade Federal de Uberlândia (UFU) linked to the Academic League of Endocrinology. The experience, coordinated by an endocrinologist and approved by UFU, promoted the provision of guidelines related to the treatment of DM, which included self-care measures and, mainly, the correct use and management of insulin.

The action took place during the term of the university's academic semesters in 2019 in outpatient clinics at the UFU Hospital de Clínicas (HC) with care for diabetic patients and under the responsibility of the endocrinologist involved in the project. A schedule was organized according to the functioning of these clinics and the students' schedule, with one day of action being in charge of a pair of undergraduates.

The action was performed once or twice week, with a daily duration ranging from thirty minutes to one hour, depending on the arrival time of the target patients. These consisted of patients with outpatient follow-up for the management of DM using insulin or in need of insulin therapy.

To carry out the action, students were trained from two classes taught by the project's teaching coordinator, with themes about the approach and guidance of diabetic patients on self-care and insulin therapy, including correct application, storage at home and proper disposal materials.

Psychosocial aspects were also addressed, with a view to preparing students when faced with financial limitations regarding the acquisition of new needles and resistance to changing habits.

During the waiting period, before the outpatient consultation, the target patients were individually invited to enter a service room for an interview with the students, who conducted the interviews individually. Children and adolescents were interviewed with their companions.

The guidelines were offered as the student perceived the participant's demands and were related to: preparation and rotation in the self-application of insulin; injection sites; insulin storage; distribution, reuse and disposal of syringes and needles; general care with diet and exercise; encouraging adherence to treatment. At the beginning of the interview, the participant was asked to simulate the application of insulin, often with the instrument used in their daily lives, for subsequent corrections, if necessary.

At the end of the interviews, for those who used syringes, an information manual was provided based on the initial classes on insulin procedures and care, aiming to reinforce important aspects and resolve possible future doubts.

## RESULTS

An audience of 260 patients, adults, children and adolescents was estimated. At the beginning and throughout the project, the offer of classes related to biomedical and psychosocial factors of DM, such as a comprehensive look at the relationship of patients with the proposed treatment, were important in preparing students for the subsequent outpatient activity and had the distinction of showing aspects that are normally omitted in conventional medicine classes and curricular practices, which are generally focused only on the biomedical side of diseases.

The approaches were carried out both in children and adolescents, accompanied by their guardians, and in adults. Both groups showed specificities and plurality, especially with regard to insulin use and adherence to treatment, which often require changes for better health habits.

Questions like *"Could you tell how you keep insulin in your house?"*, *"Can you show me how you apply insulin?"*, *"Where do you inject insulin, exactly?"* and *"To dispose of the needle, how do*

*you do it?*” were systematically asked in order to give the participant space to express and explain themselves with their own words, gestures and understanding.

In general, respondents were open to answering questions and receiving guidance from students. Even in the children's group, the children soon showed interest in the questions on several occasions; initially directed to the companion, and, as the interview progressed, the child actively participated.

With the approach following principles of attentive observation and active listening, to address the needs, concerns and experiences of patients related to insulin application and self-care required by diabetes, the following mistakes were identified: inattention to hand washing and/or regarding disinfection of the cap of the insulin bottle; homogenization of the bottle with sudden movements; not using the syringe to aspirate air in the corresponding amount of insulin prescribed and to inject this same air into the bottle before aspirating the insulin; maintenance of air bubbles inside the syringe after aspiration of insulin; incorrect preparation of the mixture of two insulins in the same syringe; divergent doses of the therapeutic proposal; lack of checks on the functioning of insulin pens; not performing skinfolds when necessary; application to lipodystrophy sites; application right after removing from the refrigerator; needle removal soon after injection; needle withdrawal without keeping the dose trigger button pressed; failures in rotation of application sites; inaccuracies regarding the distance between the injection points; storage of sealed insulin in an incorrect place inside the refrigerator.

In addition to the problems identified in the preparation, application and garnishing techniques, the repetitive use of needles and inappropriate disposal of syringes and needles in containers with risk of perforation were noted. Mistakes were carefully corrected through in-class clarifications.

## DISCUSSION

Given the high prevalence of DM and the potential complications of hyperglycemia in the absence of treatment, the importance of therapeutic measures for the management of patients emerges<sup>1-2,4-7</sup>. Diabetes control comes from patient follow-up and is not limited to the classic and historical triad consisting of blood glucose control with insulin, food and physical activity, but also monitoring and education, including incentives for treatment adherence and development of self-care, seeking to contribute to improving the quality of life<sup>2-7</sup>.

Insulin is a drug that needs surveillance. It is evaluated and classified as potentially dangerous, as it presents risks inherent to failures in its use<sup>5</sup>. As millions of people apply insulin one or more times a day, the challenge of managing insulin treatment arises<sup>5</sup>. Thus, health professionals must educate and train users in the management of insulin therapy considering the unique characteristics of each individual<sup>2,5,7</sup>.

“Diabetes education” comprises the process of developing skills necessary for self-care, both for health professionals and for diabetic patients and their families<sup>2,5</sup>. Among its proposals, the empowerment of patients for self-care, improvement of clinical results, prevention and delay of complications stand out<sup>5</sup>.

Diabetes education must be conducted in primary health care, in primary care units and in the hospital environment<sup>5</sup>. A study carried out in Malaysia points to evidence that this practice promotes positive impacts on the acquisition of necessary skills and on the realization of self-care practices. Consequently, there is improvement in diabetic control<sup>10</sup>. Adequate qualification of the team involved is important, and even reinforced in Brazil by Federal Law 11.347/2006, which establishes free distribution of medicines and materials necessary for their application and for monitoring capillary blood glucose<sup>11</sup>.

Diabetes education programs can shift from an educator-centered approach, based only on providing information, to models of empowerment in which patients adopt self-care behaviors and actively cooperate with the medical team<sup>2,3,12</sup>. Sharing knowledge helps to better manage the disease and improve the effectiveness of glycemetic control, in addition to placing the

patient at the center of decisions regarding their own treatment and reducing the length of hospital stay<sup>2,3,5,13</sup>.

In the experience presented, the Person-Centered Clinical Method was used, which proposes a person-centered approach and seeks positive results such as improved adherence to treatments, decreased use of health services and reduced concerns<sup>14</sup>. Among its components, the experience of the person with the disease was explored, when patients were asked to simulate the application of insulin, at which time it was possible to notice errors in the procedure, with a view to developing a common management project by through guidance and knowledge sharing, taking into account the context of the activities, carried out in the form of individual care and within an opportune moment of waiting for an outpatient appointment.

During the initiative, communication skills were worked on, such as eye contact and non-verbal behavior, body posture and gestures, to facilitate interaction<sup>15</sup>. Also, attentive listening was valued, through which it was possible to individually understand different physical, psychic and social dimensions of the patient<sup>15</sup>.

The guidelines offered were aimed at correcting or minimizing errors presented by patients and also strategies to reduce risk of discomfort or local bleeding, such as removing insulin from the refrigerator between 15 and 30 minutes before application, ensuring that the skin is dry after application of the alcohol (when performed), insert and remove needle with a smooth and single movement<sup>5-7</sup>. Other points were also addressed: physical exercise, fever, hot bath and massage at the application site, increase insulin absorption<sup>5</sup>.

In the insulin preparation, the homogenization of insulin was scored, so that the insulin crystals went into suspension, in which 20 gentle movements were recommended (rolling between the palms of the hands or making pendulum movements)<sup>5,7</sup>.

Regarding conservation, insulins should be kept in a cool place, protected from light and sudden temperature fluctuations<sup>7</sup>. The sealed insulin bottle must be stored at 2 to 8°C, while insulin in use can be kept at 2 to 8°C or at room temperature (15 to 30°C)<sup>5-7</sup>. In favor of a temperature in the range of 2 to 8°C, a practical tip was valued: to store the insuline on the middle or bottom shelves of the refrigerator, or in the vegetable drawer<sup>5</sup>, avoiding the refrigerator door, as it exposes the insulin to temperature variations<sup>5</sup>. As for expiration date, it is important to note the initial date of use to keep track of it<sup>5</sup>.

The recommended sites for application are healthy tissue, without inflammation, lipohypertrophy and scars<sup>5</sup>. Arms, buttocks, thighs and abdomen are the most common<sup>5-7</sup>. Lipohypertrophy is an alteration in the subcutaneous tissue that can cause hyperglycemia and/or hypoglycemia and is related to the time of insulin use, the frequency of rotation and the reuse of needles<sup>5,7</sup>. To prevent lipodystrophy, it is important to plan the rotation of application points, always with a minimum distance of 1 cm between doses and wait about 14 days for the recovery of a given application point<sup>5</sup>. In addition, it is important to keep the needle in the subcutaneous tissue for a few seconds (10 and 5 seconds for pens and syringes, respectively) to avoid insulin reflux at the application site<sup>5,7</sup>.

A synthesis of the correct application of insulin with the pen follows the following steps: hand hygiene; homogenize insulin; perform asepsis with alcohol in the place where the needle will be attached; thread the needle; check the insulin flow; select dose; asepsis at the application site when necessary; make subcutaneous fold; insert needle and inject the insulin; remove after 10 seconds, keeping the activation button pressed until the skin is completely removed; undo the subcutaneous fold; withdraw needle and remove it from the syringe with the outer shield; and discard the needle in a proper container<sup>5,6</sup>. In Figure 1, the information manual given to respondents summarizes the application with the syringe.

**Figure 1:** Informational and synthetic manual on maintenance care and insulin application with the syringe. Uberlândia, 2019.

# Orientations for self-application of insulin

Extension project by the Liga Acadêmica de Endocrinologia UFU - 2019

**Where to store insulin:**

- Sealed insulin must be kept in the refrigerator; never let it freeze. Insulin that has already been used can be left at room temperature.
- Leave it on the shelf close to the vegetable drawer (do not store it in the refrigerator door).
- Apply insulin at room temperature; if it is being kept in the refrigerator, remove it 30 minutes before use.

Pay attention to the type of syringe: always make sure that each distance between the dashes is equal to 1 unit or 2 units.

**Important precautions:** apply insulin every day, following the recommended dosage. Check your blood glucose regularly and watch for symptoms of hypoglycaemia.

**Insulin preparation**

- 1 - Separate all the material: insulin, syringe, needle, cotton and rubbing alcohol
- 2 - Wash your hands
- 3 - Gently roll the vial between your hands, 20 times.
- 4 - Remove the cap of the insulin vial. Clean the top part with cotton and rubbing alcohol.
- 5 - Aspirate air into the syringe according to the prescribed amount of insulin.
- 6 - Inject the air inside the syringe into the vial.
- 7 - Turn the vial upside down. Slowly draw the insulin into the syringe according to the prescribed dosage. If there are any air bubbles, lightly tap the syringe (upright), and then push the plunger
- 8 - Verify once again if the dosage is correct

*Observation: use the same syringe 3 at most; avoid applying insulin in scarred regions, wounds and lypodistrophy*

**How to apply insulin**

Choose the body part for the application. Make a fold of skin with your fingertips. Take the syringe, insert the needle into the skin at a 45-degree angle and inject all the insulin in the syringe. Keep the needle under the skin for another 5 seconds. Remove the needle at the same angle and release the skin fold. Rotate application locations.

**Prepare a mixture of 2 insulin vials**

Go to step 4 in the board above.

- Then aspirate air into the syringe at the prescribed dosage of longer-acting insulin.
- Insert the needle through the rubber cap of the longer-acting insulin bottle and inject the air in the syringe into the vial.
- Remove the needle from the vial. Aspirate air into the syringe at the prescribed dosage of the shortest-acting insulin.
- Insert the needle through the cap into the shorter-acting vial and inject the air that was in the syringe.
- Turn the bottle upside down and draw the prescribed dosage for this shorter-acting insulin.
- Set the prescribed dose.
- Remove air bubbles, if there are any, and check the dosage again.
- Remove the needle from the vial and insert the needle through the cap into the longer-acting insulin vial.

**Where to apply insulin**



The use of the subcutaneous fold is not necessary in needles with a length of less than or equal to 5mm, except for children under 6 years of age, and the use of alcohol on the skin is recommended mainly in institutional settings, such as day care centers and health services<sup>5</sup>. Disposal must be carried out in specific collectors and not in plastic bottles as shown in Figure 2.

**Figure 2:** Disposal not recommended in PET bottles.

A box for sharp and perforating materials must be provided by a competent institution, or in a rigid, resistant, unbreakable container, with a wide opening and lid<sup>4,6</sup>. Disposal in plastic bottles (Figure 2), identified by students, should be avoided due to the fragility of this material<sup>4,6</sup>. Once completed, the collector must be delivered to a qualified health service for proper treatment and destination<sup>4,6</sup>. Incorrect disposal of sharp and perforating materials from insulin therapy can cause accidents and thus transmit infectious diseases (especially HIV/AIDS, hepatitis B and C) among family members, the community and garbage collectors<sup>4</sup>.

Reusing materials is a reflection of an economic issue, in which cost interferes with the decision to use a new needle for each injection<sup>7</sup>. However, the reuse of syringes and needles is not recommended and can cause damage such as loss of sharpness and changes in the cannula bevel, blockage of insulin flow, pain, lipohypertrophy, uncontrolled glycemic control and risk of needle breakage. In addition, the reuse of syringes can favor the disappearance of the grading scale, which can cause errors in volume<sup>5</sup>. The Primary Care Notebook No. 366 brings the possibility of reusing syringes and needles according to criteria to avoid complications, as long as they have not been contaminated and are used individually.

The nutritional guidelines were mainly based on making the patient aware of the importance of a balanced diet, with a variety of food groups and balancing the consumption of industrialized foods, especially ultra-processed ones, and those *in natura* or minimally processed, such as vegetables, legumes, fruits, cereals, poultry and fish<sup>5</sup>.

Give preference to grilled, roasted, steamed foods and consume foods rich in saturated fat, alcohol and added salt/sugar in moderation<sup>5</sup>. Physical exercise, with nutrition that favors maintenance or weight loss, are strategies that improve glycemic control<sup>5</sup>.

In addition, precautions related to insulin use, such as avoiding long periods of fasting, eating before exercising, avoiding the coincidence of peak insulin action with the exercise period and signs of hypoglycemia, such as tremor, palpitation and hunger<sup>5</sup>, were approached when questioned by patients.

## CONCLUSION

The experience presented was able to show the contributions of (supervised) medical academics to the community, as well as the identification of mistakes and inaccuracies during several interviews. In addition to alerting for the development of research and educational actions involving diabetic patients, students and health professionals in an approach that encompasses the pathophysiology and the individual's social and environmental interaction, that is, the disease itself and the patient's relationship with the environment in which you live.

For the students involved in the project, the experience provided a better understanding of the health-disease process related to DM, so that, in addition to detecting factors that influence therapeutic failure and acting in an attempt to correct them, they also understood the importance of active listening and exercising the profession in a more humanized way for the

success of these actions. In addition, educational practice in an outpatient setting developed technical and communicative skills that are important in building the doctor-patient bond.

This study presented certain limitations detected during execution. The arrival time of patients, due to proximity or even delay in relation to the consultation time, made it difficult to approach target patients and, consequently, the completion of the interview and the appropriate guidelines on some occasions - particularly at the beginning of the extension. They were asked to arrive earlier, and this solved that issue. Additionally, there was a lack of standardization and constructive feedback regarding the conduct of the meeting and the guidelines, so that the students involved could value certain points more at the expense of others, which tends to generate greater variability in terms of method and results.

The absence of proper material for explanation was also a limiting factor, especially regarding the preparation of a mixture of two insulins, in which the insulin ampoules would facilitate mutual understanding. Another factor to be considered was the non-follow-up of the interviewed patients, which prevents a more comprehensive approach to needs and concerns and greater detailing of the results of the action.

This experience suggests carrying out research to delineate the clinical and sociodemographic profile of participants and compare their conduct before and after the action to assess the impact of the action and help in planning new interventions.

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**Editora Associada:** Estefânia Maria Soares Pereira

#### CONTRIBUIÇÕES

Alice Mirane Malta Carrijo, Isabela Milagres Guimarães, Jairo Fernandes Marques and Kaio Saramago Mendonça contributed to the design, data collection, analysis and writing. Marília Rodrigues Moreira participated in the analysis, writing and review.

#### How to cite this article (Vancouver)

Mendonça KS, Carrijo AMM, Marques JF, Guimarães IM, Moreira MR. Guidelines for self-care and self-application of insulin to patients with diabetes mellitus by medical students. REFACS [Internet]. 2021 [cited in *insert day, month and year of access*]; 9(3):682-690. Available from: *insert access link*. DOI: *insert DOI link*

#### How to cite this article (ABNT)

MENDONÇA, K. S.; CARRIJO, A. M. M.; MARQUES, J. F.; GUIMARÃES, I. M.; MOREIRA, M. R. Guidelines for self-care and self-application of insulin to patients with diabetes mellitus by medical students. REFACS, Uberaba, MG, v. 9, n. 3, p. 682-690, 2021. DOI: *insert DOI link*. Available from: *insert access link*. Access in: *insert day, month and year of access*.

#### How to cite this article (APA)

Mendonça, K.S., Carrijo, A.M.M., Marques, J.F., Guimarães, I.M., & Moreira, M.R. (2021). Guidelines for self-care and self-application of insulin to patients with diabetes mellitus by medical students. REFACS, 9(3), 682-690. Retrieved in *insert day, month and year of access* from *insert access link*. DOI: *insert DOI link*.

