

Educational intervention on insulin knowledge and management at home

Intervenção educativa sobre o conhecimento e manejo de insulina no domicílio
Intervención educativa sobre el conocimiento y manejo de insulina en el domicilio

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How to cite:

Reis P, Marcon SS, Teston EF, Nass EM, Ruiz AG, Francisqueti V, et al. Educational intervention on insulin knowledge and management at home. Acta Paul Enferm. 2020; eAPE20190241.

DOI

<http://dx.doi.org/10.37689/acta-ape/2020A00241>

**Keywords**

Diabetes *mellitus*; Insulin; Health education; Self care

Descritores

Diabetes *mellitus*; Insulina; Educação em saúde; Autocuidado

Descriptores

Diabetes *mellitus*; Insulina; Educación en salud; Autocuidado

Submitted

August 16, 2019

Accepted

November 25, 2019

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Abstract

Objective: To analyze the effect of an educational intervention on insulin knowledge and management at home.

Methods: Quantitative, before and after study. Participation of 61 people with diabetes mellitus on insulin therapy in a medium-sized municipality in southern Brazil between January and August 2017. For data collection, were used a questionnaire addressing sociodemographic and clinical variables, another questionnaire addressing knowledge about insulin use/management, and a checklist for observation of insulin preparation and administration. The intervention consisted of verbal guidance, insulin management demonstration, supervision of the application technique and delivery of a folder. Data were collected before the intervention and three months after its completion. The MacNemar's test was applied to evaluate the effect of the intervention.

Results: The intervention was effective in acquisition of knowledge related to the storage, preparation and use of insulin. There was a difference in the frequency of correct answers on the knowledge and administration of insulin before and after intervention and 31 questions were subject to intervention, which was efficient in 96.77% of cases and statistically significant in 80.64%.

Conclusion: There was a significant improvement in knowledge and use/management of insulin after the educational intervention.

Resumo

Objetivo: Analisar o efeito de intervenção educativa no conhecimento e manejo da insulina no domicílio.

Métodos: Estudo quantitativo do tipo antes e depois. Participaram 61 pessoas com Diabetes Mellitus em uso de insulina, em município de médio porte, da região sul do Brasil, de janeiro a agosto de 2017. Para coleta dos dados foi utilizado um questionário, abordando variáveis sociodemográficas e clínicas, e outro abordando o conhecimento sobre o uso/manejo da insulina e *checklist* para observação do preparo e administração da mesma. A intervenção foi constituída por orientação verbal, demonstração do manejo da insulina, supervisão da técnica de aplicação e entrega de folder. Os dados foram coletados antes da intervenção e três meses após o seu término. Na avaliação do efeito da intervenção foi aplicado o teste de MacNemar.

Resultados: A intervenção foi eficaz na aquisição de conhecimentos relacionados ao armazenamento, preparo e uso da insulina. Houve diferença nas frequências de acertos sobre o conhecimento e administração de insulina antes e após intervenção e, de 31 questões passíveis de intervenção, esta se mostrou eficiente em 96,77%, e em 80,64% foi estatisticamente significativa.

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Conflicts of interest: none to declare.

Conclusão: Houve melhora significativa no conhecimento e uso/manejo da insulina no domicílio após a intervenção educativa.

Resumen

Objetivo: Analizar el efecto de una intervención educativa sobre el conocimiento y manejo de la insulina en el domicilio.

Métodos: Estudio cuantitativo tipo antes y después. Participaron 61 personas con diabetes mellitus que utilizan insulina, de un municipio de tamaño medio en la región sur de Brasil, de enero a agosto de 2017. Para la recolección de datos se utilizó un cuestionario que abordaba variables sociodemográficas y clínicas, y otro que abordaba el conocimiento sobre el uso/manejo de la insulina y *checklist* para observar su preparación y administración. La intervención se realizó mediante instrucción verbal, demostración de manejo de la insulina, supervisión de la técnica de aplicación y entrega de folleto. Los datos se recolectaron antes de la intervención y tres meses después de su finalización. Para evaluar el efecto de la intervención se aplicó la prueba de McNemar.

Resultados: La intervención fue eficaz en la adquisición de conocimientos relacionados con el almacenamiento, preparación y uso de la insulina. Hubo diferencia en las frecuencias de aciertos sobre el conocimiento y administración de insulina antes y después de la intervención y, de 31 preguntas susceptibles de intervención, esta demostró ser eficiente en un 96,77% y en un 80,64% fue estadísticamente significativa.

Conclusión: Hubo una mejora significativa en el conocimiento y uso/manejo de la insulina en el domicilio después de la intervención educativa.

Introduction

Noncommunicable chronic diseases (NCDs) are one of the biggest health problems nowadays.⁽¹⁾ Among them, Diabetes Mellitus (DM) stands out with an estimated prevalence of 425 million people worldwide.⁽²⁾ In Brazil, DM has a prevalence of 19% in the elderly population and contributes to their disability in the basic activities of daily living.⁽³⁾

The control of DM requires complex care and self-care activities, especially for people on insulin therapy,⁽⁴⁾ which is a classic and essential indication in type 1 diabetes mellitus (T1DM), whereas in type 2 diabetes mellitus (T2DM) it is instituted only when other treatments are not effective or contraindicated.⁽⁵⁾

People on insulin therapy commonly have errors in storage, transport and administration.⁽⁶⁾ The most common are needle reuse, needle removal too quickly after injection and lack of rotation of application site.⁽⁷⁾

In a study conducted in Italy, insulin administration errors were correlated with negative results, such as a prevalence of 42.9% of lipodystrophy, which in turn was associated with glycemic instability, need for higher drug doses and higher risk of severe hypoglycemic episodes.⁽⁸⁾ In India, a study of 1011 insulin users found that 80.5% of syringes users misused the needle, which was related to bleeding, bruising, inaccuracy of dosage and lipodystrophy.⁽⁹⁾ In this sense, a bacteriological analysis of reused needles for administration of insulin by 12 people in Paraíba found 45% contamination by *Staphylococcus*, which can result in infectious pro-

cesses with damage to skin integrity and tissue damage.⁽¹⁰⁾ Thus, guidance, support and supervision by health professionals are essential components in the care of this public.⁽⁶⁾

In order to be successful in the treatment of DM and insulin therapy, patients' empowerment to self-care is key.⁽⁷⁾ Thus, health education is a crucial tool for disease control, reduction of acute and chronic complications, and self-care stimulation.^(4,11) In this context, the aim of diabetes education is to promote autonomy for disease management, improve clinical outcomes and consequently, the quality of life.^(12,13)

In this regard, individuals' behavior of self-care and chronic disease management should be the main focuses of health care. In the meantime, intervention studies with individual and/or collective approaches using different strategies, such as nursing consultations, motivational consultations and follow-up telephone calls have contributed to the care of diabetic people and offered subsidies for a better quality of care.^(14,15) Care provision that incorporates what is known about effective interventions in diabetes management is still a poorly explored area of nursing research, and the difficulty with glycemic control in this population shows an important gap in health care.⁽¹⁶⁾ Both of these aspects justify this study.

Diabetes education for people on insulin therapy may reduce the occurrence of errors and reflect positively on treatment. Thus, the aim of this study was to analyze the effect of an educational intervention on insulin knowledge and use/management at home.

Methods

This is a quantitative, intervention, before and after study conducted with people who used insulin, residents of a medium-sized municipality in the metropolitan region of Porto Alegre/RS. This municipality has eight Health Centers and ten Family Health Strategy (FHS) teams.

Assistance to people with DM in the municipality is provided through pre-scheduled medical appointments and user embracement of spontaneous demand by the nursing staff. Three Health Centers hold monthly meetings of health education groups (under nurses' responsibility) for people with hypertension and DM without specific approach to insulin therapy. The distribution of medicines and supplies for insulin application (syringe and needle) in the public network is performed exclusively by the municipal pharmacy.

The study population was initially composed of people diagnosed with type 1 and 2 DM who used insulin. The insulin dispensation report provided by the Municipal Pharmacy was used. It contained the name, age and address of 286 people.

Users aged 18 years or older were considered eligible for the study. Inclusion criteria were follow-up in the Health Center of the city and use of insulin. Those who used injector pens were excluded because the instrument used in data collection focuses on application with syringe, as recommended by the Brazilian Society of Diabetes.⁽¹²⁾

In the definition of sample size, were considered the following: 279 eligible individuals, 5% estimation error, 95% confidence level and 50% proportion plus 20% for possible losses. The probabilistic sample consisted of 194 individuals stratified by age group (18-59 years; 60 years or older) and by reference Health Center. Of these, four individuals were excluded because they used injection pens for insulin administration. Losses occurred due to refusal (13), death (5), and change of municipality (4), totaling 168 participants.

The main researcher visited the eight Health Centers during health teams' weekly meetings for participant recruiting. On such occasions, were presented the project and a list of randomly selected

people belonging to the respective coverage area. This allowed the organization of the initial approach to participants that often occurred during home visits with Community Health Agents. When there was no FHS coverage, the nurse of the Health Center where the user was registered made contact by telephone requesting authorization for a visit by the researcher.

Phase I of data collection occurred through home interviews using two instruments. The first was a questionnaire addressing sociodemographic variables (age, sex, marital status, schooling and occupation) and clinical variables (time since diagnosis of DM, type of DM and time of insulin use). The second instrument had two parts, namely: one with closed questions addressing insulin knowledge and management by users (or family members responsible for administration in cases of dependent people); and another part with a checklist on insulin preparation and administration.⁽¹⁷⁾ This phase of data collection lasted approximately one hour and 15 minutes.

The aim of the instrument on insulin knowledge and use/management was to analyze the competence to perform the procedure and it was originally designed for a telephone survey.⁽¹⁷⁾ In the preparation, the author considered competence as the individual's ability to apply knowledge for the mastery of concrete situations, which requires theoretical knowledge before the "know-how".⁽¹⁸⁾

For this study, the instrument was adapted for face-to-face application at home after the author's prior authorization. The adaptation was not validated by field experts because the content of questions did not change. Only the record of participants' report in the preparation and administration of insulin was replaced by observation of the procedure (real or simulated). The instrument used (like the original one) consists of 31 questions, of which 15 questions related to insulin therapy knowledge with multiple answer options, and 16 questions about the insulin administration technique with yes or no answers (performs/does not perform). This last part was changed to a checklist format for completion by the researcher upon observation of the procedure.

All participants in Phase I, regardless of the number of errors, received guidance on the correct insulin application technique, and reinforcement in relation to mistakes made, according to the Brazilian Diabetes Society guidelines.⁽¹²⁾

In Phase II, the 61 people who gave wrong answers to 50% (15) of questions or more were approached. All aspects addressed in the instrument were the theme of the intervention; correct answers were reinforced and special attention was given to items in which answers were wrong or technique was performed incorrectly, according to guidelines of the Brazilian Diabetes Society.⁽¹²⁾ The selection of participants is represented in figure 1.

The second meeting for the educational intervention was also previously scheduled by telephone and held at home 45 days after the first meeting. The intervention lasted an average of one hour and 30 minutes. It included the provision of guidelines on the correct insulin administration technique, using an individual and illustrated booklet as a script with fields for specific notes about the individual and his/her treatment, prepared by the researcher based on the Brazilian

Diabetes Society guidelines.⁽¹²⁾ The booklet contained the steps of insulin preparation and administration, guidance on materials used (type of syringe/needle, syringe graduation scale), packaging and validity of insulin and supplies, application sites and possible adverse effects. After verbal orientation, insulin preparation and administration were demonstrated, followed by assistance to participants with supervision of their performance and clarification of doubts related to the disease and its treatment.

Finally, 60 days after the second meeting, the instrument on insulin knowledge and use/management was reapplied at home. These meetings lasted an average of 50 minutes and on this occasion, the researcher clarified remaining doubts again and talked about persistent errors.

For data analysis, answers of the instrument on insulin knowledge and use/management were decoded as right/wrong according to the Brazilian Diabetes Society recommendations.⁽¹²⁾ In the analysis of performance, the number of errors per participant were taken into account. Data are presented in simple and bivariate frequency

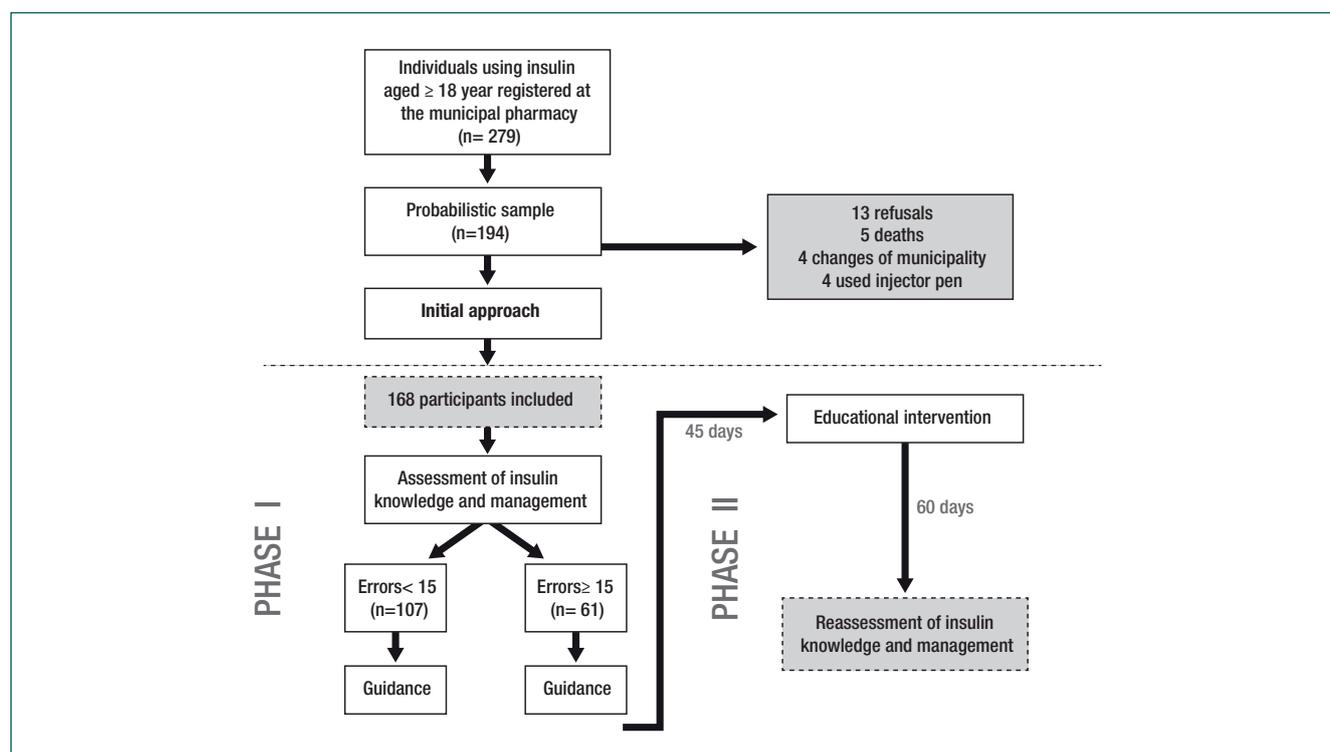


Figure 1. Study flowchart

tables. To evaluate the difference between Initial Performance and Final Performance, was applied the MacNemar's test, and each individual was his/her own control. A 95% ($\alpha=0.05$) confidence level was considered. Data were analyzed using the Statistical Analysis Software (version 9.4) from a database built in Excel.

The ethical principles in Resolution 466/12 of the National Health Council were respected in the study development. The project was approved by the Research Ethics Committee under number 1.889.132.

Results

The mean age of the 61 intervention participants was 61 (± 12.1) years (minimum 23 and maximum 86). Most were female (37 - 60.6%); married (39 - 63.9%); had incomplete primary education (54 - 88.5%); were retired (38 - 62.3%) and had T2DM (96.8%).

Of the total participants, 30 were under 60 years of age and of these, 33.3% (10) performed paid activity (work). The mean time of DM diagnosis was 13.7 (± 8.2) years (minimum of one and maximum of 40 years) and of insulin use was 5.52 (± 5.5) years (minimum of one and a maximum of 30 years).

Most participants, 45 (73.8%), performed insulin self-application and 16 (26.2%) relied on family members for this care. Of those responsible for insulin application (patient or family member), 37.7% (23) reported they had not received guidance from health professionals about this activity. Of the 38 people who said they had received guidance, 73.7% (28) reported having been instructed by nursing staff. Other professionals mentioned were physicians and pharmacists.

The frequency of correct answers regarding insulin knowledge and administration before and after intervention are presented in tables 1 and 2. The educational intervention was effective in the acquisition of knowledge related to insulin storage, preparation and use (Table 1).

Table 1. Knowledge of patients with diabetes mellitus on insulin storage, preparation and use before and after the intervention.

Question	Performance		p-value ^a
	Initial n(%)	Final n(%)	
Is able to correctly inform the type of insulin used			
Right	32(52.5)	57(93.4)	0.0001*
Wrong	29(47.5)	4(6.6)	
Is able to say the type of syringe used			
Right	57(93.4)	60(98.4)	0.0833
Wrong	4(6.6)	1(1.6)	
Is able to inform the size of syringe used			
Right	8(13.1)	49(80.3)	0.0001*
Wrong	53(86.9)	12(19.7)	
Is able to say how many units correspond to each needle line			
Right	9(14.8)	53(86.9)	0.0001*
Wrong	52(85.2)	8(13.1)	
Is able to say the needle size			
Right	2(3.3)	28(46.0)	0.0001*
Wrong	59(96.7)	33(54.0)	
Application sites			
Right	61(100)	61(100)	**
Wrong	0(0)	0(0)	
Rotates application sites			
Right	46(75.4)	60(98.4)	0.0002*
Wrong	15(24.6)	1(1.6)	
Observes local reaction at application			
Right	49(80.3)	54(88.5)	0.0253*
Wrong	12(19.7)	7(11.5)	
Place of insulin storage			
Right	7(11.5)	44(72.1)	0.0001*
Wrong	54(88.5)	17(27.9)	
Insulin transport			
Right	17(27.9)	42(68.9)	0.0001*
Wrong	44(72.1)	19(31.1)	
Validity of insulin open vial			
Right	4(6.6)	50(82.0)	0.0001*
Wrong	57(93.4)	11(18.0)	
What is done with the needle before disposal			
Right	59(96.7)	61(100)	**
Wrong	2(3.3)	0(0)	
Reuses the needle			
Right	2(3.3)	9(14.7)	0.0082*
Wrong	59(96.7)	52(85.3)	
Material disposal location			
Right	20(32.8)	51(83.6)	0.0001*
Wrong	41(67.2)	10(16.4)	
Suitable container for carrying needles/sharp objects to the Health Center ^{##}			
Right	16(80.0)	50(98.0)	0.0455*
Wrong	4(20.0)	1(2.0)	

^ap-value for McNemar's test; ^{##}Only the responses of participants who took materials to the Health Center for disposal were considered. * Significant difference at 95% confidence level ($\alpha=0.05$); ** Could not perform McNemar's test due to 100% hits in Final Performance

Table 2 shows the significant improvement in the performance of actions involved in the process of insulin application after the intervention.

Table 2. Performance of patients with diabetes mellitus in the process of insulin application (checklist) before and after the intervention.

Question	Performance		p-value [#]
	Initial n(%)	Final n(%)	
Handwashing			
Right	36(59.0)	56(91.8)	0.0001*
Wrong	25(41.0)	5(8.2)	
Leaves Insulin out of the fridge before application			
Right	3(4.9)	52(85.2)	0.0001*
Wrong	58(95.1)	9(14.8)	
Observes the liquid			
Right	13(21.3)	35(57.4)	0.0001*
Wrong	48(78.7)	26(42.6)	
Shakes the vial to mix contents			
Right	50(82.0)	61(100)	**
Wrong	11(18.0)	0(0)	
Cleans the rubber of the vial with alcohol			
Right	1(1.6)	40(65.6)	0.0001*
Wrong	60(98.4)	21(34.4)	
Injects air into vial before aspirating			
Right	1(1.6)	34(55.7)	0.0001*
Wrong	60(98.4)	27(44.3)	
Positions the vial upside down			
Right	57(93.4)	61(100)	**
Wrong	4(6.6)	0(0)	
Insulin NPH and insulin regular aspiration sequence ^{**}			
Right	3(33.3)	8(88.9)	0.0253*
Wrong	6(66.7)	1(11.1)	
Draws air bubbles from syringe			
Right	51(83.6)	59(96.7)	0.0047*
Wrong	10(16.4)	2(3.3)	
Sets the dose after removing air bubbles			
Right	49(80.3)	56(91.8)	0.0082*
Wrong	12(19.7)	5(8.2)	
Recaps needle until application			
Right	13(21.3)	32(52.5)	0.0001*
Wrong	48(78.7)	29(47.5)	
Cleans skin with alcohol			
Right	14(22.9)	59(96.7)	0.0001*
Wrong	47(77.1)	2(3.3)	
Pinches the skin adequately			
Right	29(47.5)	58(95.1)	0.0001*
Wrong	32(52.5)	3(4.9)	
Inserts the needle at a straight angle (90°)			
Right	54(88.5)	61(100)	**
Wrong	7(11.5)	0(0)	
Waits 5 seconds after injection with syringe plunger pressed to remove needle from skin			
Right	1(1.6)	50(82.0)	0.0001*
Wrong	60(98.4)	11(18.0)	
Does not rub the skin after application			
Right	43(70.5)	59(96.7)	0.0001*
Wrong	18(29.5)	2(3.3)	

[#]p-value for McNemar's test; ^{**}Only patients using both types of insulin were considered; *Significant difference at 95% confidence level (=0.05); **Could not perform McNemar's test because of 100% hits in Final Performance

Discussion

Insulin therapy is widely used and known, although health service users on this type of treatment still lack information and guidance.⁽⁸⁾ In recent years, the technique of insulin application has been the object of national and international studies, mostly in descriptive studies through self-report or simulation in the health service setting.^(6,8,13,19-29)

In the present study, empirical observation of how users apply the technique at home allowed the approximation with their daily life and identification of errors in the procedure. In addition, after guidance offered during the intervention, the specific needs of each case could be met based on the observed difficulties, and there was greater possibility of understanding, learning and fixation of information from the demonstration of the correct technique and support for its execution.

The current increase in chronic diseases demonstrates the importance of actions for self-care promotion and treatment adherence. Inadequate adherence to treatment is one of the major problems in chronic disease control and occurs for several reasons.

A study of 52 people with chronic diseases at the FHS in Minas Gerais showed lack of adherence to pharmacological treatment in almost half of cases investigated and difficulty with understanding the medical prescription in 22%.⁽³⁰⁾ In people with DM, poor glycemic control is mainly a result of partial adherence to pharmacological and non-pharmacological measures, and a frequent cause of complications and visits to the emergency department.⁽³¹⁾

The low educational level of the sample in this study may compromise adherence and lead to possible errors related to drug treatment. Individuals with low educational level have greater difficulty with understanding medical prescriptions and the importance of treatment for the control of chronic diseases.⁽³⁰⁾ This was also observed during data collection, when the same orientation had to be provided two or three times for achieving even a minimal understanding.

In addition to medical prescription, the use of insulin demands understanding the importance of

adequate storage and the ability to handle and develop the application technique. Despite these relevant aspects, proper guidance to patients is rare,⁽⁸⁾ a reality corroborated by the results of this study. Our findings showed that 37.7% of health service users reported they had not received guidance from a health professional about aspects involved in insulin therapy at home. Although disagreement with reality may be possible because information was self-reported hence, subject to forgetfulness, users lacked the necessary knowledge. This may be a result of the manner and time spent with guidance, besides users' own difficulties with retaining information. Deficient orientation increases the chance of errors in drug use, which in turn, can trigger complications such as hypoglycemia.⁽⁶⁾

The use of insulin revolutionized DM treatment and provided quality of life for people with this disease. However, simply prescribing and dispensing the drug is insufficient for effective treatment. People with DM often need systematic guidance and should be encouraged to adhere to treatment properly. In addition, they lack access to regular follow-up with health professionals and to essential supplies for treatment implementation.

Health professionals should know and evaluate how treatment has been instituted in the routine, as the complexity of insulin application and potential risks arising from errors are a reality.⁽¹⁷⁾ This shows the relevance of nurses' role. They should take advantage of opportunities such as home visits, nursing consultations and group activities for investigations of how and under what conditions treatment has been instituted in patients' routine.

In a study at a multidisciplinary clinic in the United States with 60 people, approximately 20% of participants did not administer insulin correctly, although health education was recognized by all professionals. The authors recommended, in addition to asking patients how they are administering insulin, also asking them to demonstrate the technique used.⁽⁶⁾

Despite technological advances that allowed the development of different types of insulin and application devices, errors in the administration technique are the main reason for the high prevalence of

lipodystrophy.⁽⁸⁾ A study conducted in India with 145 people who used insulin at home identified the presence of lipodystrophy in most participants. Lipodystrophy was related to lack/deficient rotation of the needle application site, needle reuse and higher risk of severe hypoglycemia.⁽²³⁾ In the same vein, a study conducted in Italy found that the training and monitoring of the application technique performed by health professionals was crucial for promoting blood glucose stabilization and reducing by 30% the insulin dose prescribed for patients with unstable blood glucose levels and areas of lipodystrophy in the abdomen.⁽²⁴⁾

Similarly, in a randomized study of 132 people in France, the intervention group underwent DM education performed exclusively by nurses. After three months, patients had a mean reduction of 3.90 IU in insulin dose, and of 5.02 IU at six months. These figures reinforce the importance of the proper technique for glycemic levels and the effectiveness of DM education by nurses.⁽²⁵⁾

Positive results of educational interventions were also pointed out in a study conducted with 50 people in Iraq. The effectiveness of an educational program on the knowledge and practice of insulin self-administration was evaluated. This study showed a significant difference in insulin self-administration performance before and after the intervention by nurses.⁽²⁶⁾ In a study conducted in India with 91 insulin-dependent individuals, injection pads were used as a tool for self-application education. The steps of preparation, administration and disposal of materials were addressed and in the end, there was a significant improvement of the technique among participants when comparing before and after.⁽²⁰⁾

The face-to-face approach used in the present study proved to be more effective than that performed by telephone with 26 people with DM enrolled in a self-monitoring capillary blood glucose program in São Paulo, where the intervention was statistically significant in 50% of the questions,⁽¹⁷⁾ while in our findings it was significant in 80.64%. This reinforces the importance of face-to-face guidance together with observation and support for insulin administration. However, telephone fol-

low-up is certainly useful for complementing care and follow-up.⁽¹⁷⁾

Knowledge on the disease and its treatment is the first step towards the development of self-care actions that contribute to the individual's confidence in their ability to manage the treatment.⁽³²⁾ Thus, nurses must identify the specific learning needs related to health/disease care of individuals with chronic diseases for a greater effectiveness of the planned and implemented health education and promotion strategies.⁽³³⁾

Although the results showed errors in insulin administration, participants were sensitive to DM education actions performed by nurses in the intervention phase. This result indicates that low-cost and replicable education actions in the routine of primary care professionals are effective care tools. However, in the case of elderly people with low education, the need for periodic reinforcements must be considered. A study indicated the need for continuous evaluation of the insulin therapy technique used at home for education reinforcement and identification and correction of errors.⁽²⁷⁾

A limitation of the study was performing the intervention only with participants who had worse performance in the initial application of the instrument for evaluation of insulin knowledge and use/management. However, the results confirmed that individualized intervention, involving verbal guidance, demonstration, assistance and supervision of performance and clarification of doubts is an effective strategy for the promotion of insulin knowledge and management at home, especially in individuals with similar characteristics to participants of this study, i.e., elderly with low educational level.

Conclusion

The results showed a significant improvement in 80.64% of aspects related to insulin knowledge and use/management before and after the educational intervention performed by nurses, which shows the competence and responsibility of these professionals in the care of this population.

Collaborations

Reis P and Marcon SS contributed to the conception and design, analysis and interpretation of data, article writing, critical review, final approval of the version to be published. Teston EF and Silva ES collaborated with data analysis and interpretation, article writing and critical review. Ruiz AGB, Nass EMA, Otero LM and Francisqueti V collaborated with the critical review of intellectual content.

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