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ORIGINAL ARTICLE

# EDUCATIONAL TECHNOLOGY FOR CARE AND PREVENTION OF DIABETIC FOOT ULCERS

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## ABSTRACT

**Objective:** to outline the methodological path of designing an educational technology for the prevention of diabetic foot ulcers. **Method:** methodological research that used a systematic way to design an educational technology for the prevention of diabetic foot ulcers, taking the following steps: 1) Gathering of contents created by the Laboratory of Research and Technology in Nursing and Health for People with Chronic Condition; 2) Literature review; 3) Dialogue between researchers and nurses at a hospital; 4) Definition of technical content and pedagogical approach; 5) Description of the educational process step by step, the necessary materials and the pedagogical approach;6) Training of the research team to carry out educational technology; 7) Pilot test with people with diabetes, admitted to the medical-surgical inpatient unit of a hospital. **Results:** the educational technology designed was based on the systematization of the actions "HEAR-SEE-DO", including the guidance and demonstration of foot care by the health professional, using materials that allow the simulation of this care on a mannequin dummy foot andthen, the imitation of care by the person with diabetes. **Conclusion:** the educational technology, built from a problematic pedagogical perspective, is a low-cost and simple carry-out-assistance tool that can contribute to the prevention of diabetic footulcers.

**Palavras-chave:** Educational technology. Health education. Diabetes mellitus. Diabetic foot. Nursing.

## INTRODUCTION

One of the most common complications of diabetes mellitus (DM) and which brings major losses to people who have this chronic condition, with an impact on health services and society in general, istrouble in the feet, known by the term "diabetic foot". This complication results mainly from diabetic neuropathies and peripheral arterial disease that cause foot ulcers in people with DM, which may lead toamputations[1-3].

The annual incidence of diabetic foot ulcers reaches up to 6.3% and up to 10% of prevalence in countries with poor socioeconomic status. Yearly, it is also estimated that one million people with DM go through an amputation worldwide, that is, three per minute. Current evidence suggests that the incidence of foot ulcers throughout life is between 19% and 34%[2,4].

Researches carried out in different countries have shown that health education programs for people with DM may decrease thedevelopment of diabetic foot ulcers, since educational interventions properly implemented improve the level of understanding and self-care of people with DM [5-10].

Health education for the prevention of diabetic foot ulcerscomprises, mainly, the assessment of risk factors and their proper management; of deformities in the feet, loss of protective sensitivity in the feet and acknowledgement of peripheral artery disease; appropriate foot care and the relevance of daily foot monitoring[11]. Even the teaching of easymeasures, such as choosing the right shoes and proper foot hygiene, promotes themanagement to avoid complications[4].

Despite the acknowledgement of the advances that health education promotes, the

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existence of policies instituted by Brazilian government agencies and the consensus of scientific societies, which establish guidelines for the care of the feet to prevent complications in people with DM, there are still many disparities with reality. This situation is expressed by the persistent lack of knowledge of people with DM about the importance of foot care and inefficiencies in the care received [1, 12-15].

Further, it is understood that there are many educational proposals and protocols for the care and prevention of diabetic foot ulcers, but not many educational proposals have been converted into technologies that are low cost and easy to access[16]. An educational technology needs to foster, in addition to knowledge, the person's autonomy, which is one of the main goals of health education.

The following research questionwas elaborated: how should an educational technology aimed at people with DM and their families aim at the care and prevention of diabetic foot ulcersbe designed?

Given the severity of complications in the feet of people with DM and the need to figure out new strategies for health education that consider the reality of the living and health conditions of these people, a study was carried out to outline the methodological pathof designing an educational technology for the prevention of diabetic foot ulcers.

## METHOD

This is a methodological research that used a systematic path to design an educational technology for the prevention of diabetic foot ulcers. It is a process technology that produces an immaterial product, that is, a technique that combines one or more steps of the work process. Process technology involves theoretical and methodological proposals to innovate and qualify care for individuals, groups, or communities, offering original and different ways of producing health care[17].

At first, the group of researchers held five biweekly meetings, in which themes on "educational technologies", "foot care of people with DM" and "prevention of complications" were investigated and deepened. From these discussions, a systematic path was established for the process of creating educational technology, which comprised seven steps:

1) Gathering of contents created by the Laboratory of Research and Technology in Nursing and Health for People with Chronic Condition(NUCRON), in its 30 years of existence, about the themes of interest, producing theoretical and practical subsidies the development of educational technology;

2) Literature review, including scientific journals, guidelines from the Ministry of Health of Brazil, guidelines from the *SociedadeBrasileira de Diabetes* (SBD) (Brazilian Diabetes Society) and the American Diabetes Association (ADA). The content was systematized in a table with the main indications of foot care to be performed to assist the team in making decisions about the content that should comprise the educational technology;

3) Dialogue with nurses from the endocrinology outpatient clinic and nursing assistants from the adult inpatient units of the University Hospital where the study was carried out, with a discussion on the creation of educational technology, possibilities of its insertion in practice and detection of service needs;

4) Definitions on the technical content and pedagogical approach of the educational proposal. The "Nursing care model for hospitalized people with diabetes mellitus" was used as a theoretical framework[18], besides the perspective of problematizing pedagogy [19];

5) Description of educational technology for the prevention of diabetic foot ulcers, which included the educational process (step by step), the necessary materials and the pedagogical approach;

6) Training of the research team to carry out educational technology in a standardized manner, focusedon avoiding inaccuracies or mistakes to carry it out. The training included the discussion of all steps to carry it outand consolidation of the pedagogical approach;

In this step, it was possible to improve the language/communication, the techniques for performing foot care, the organization of the necessary material and to manage the time spent;

7) Pilot test with four people with DM, admitted to one of the medical-surgical inpatient units of a University Hospital in southern Brazil, in November 2016.

In step 7, the participants were found with the help of the assisting nurse in each medical-surgical inpatient unit and, afterward, were invited to participate in the research.

The following inclusion criteria were considered: being admitted to a medical-surgical clinic; be over 18 years old; having a medical diagnosis of type 1 or type 2 DM; knowing about the diagnosis of DM; having no previous amputation; not having foot ulcers at the time of assessment and educational intervention; and the participant consents to take part in the research by reading, understanding, and signing the Informed Consent Form (ICF). Difficulties in speech, communication and/or interaction were considered as exclusion criteria.

Right after carrying out the educational technology in practice, notes were taken reflecting the lived experience and, subsequently, a round of discussion was carried out among the researchers to share the experiences and analyze the data. This moment allowedimprovements in the development of technology to better adapt content, language, materials and time for execution.

The research was approved by the Ethics Committee on Research with Human Beings at UFSC, under protocol number 1,932,640, following all the precepts established by the CNS Resolution 466/2012. As foreseen in the educational technology development process, it is worth noting that the validation stepof the educational technology designed through the nursing care practice to people with DM is in progress.

## RESULTS AND DISCUSSION

The path taken to accomplish the research objective produced technical and pedagogical subsidies for the development of a singular dynamic of health education that established an educational technology for the care and prevention of diabetic foot ulcers.

The theoretical framework employed conducted the construction of educational technology with an expanded view of nursing care to people with DM in a comprehensive, interdisciplinary, humanized way and with an appreciation of the care approach focused on people with DM and his/her family. It was also considered that the moment of hospitalization is a goodtime for health education and understood as a potential to improve self-care[18].

**Figure 1.** Model foot used tocarry out the educational technology

The educational technology designed was named"*Cuidados com os pés para a prevenção de complicações: OUVIR-VER-FAZER*" ("Foot care for the prevention of complications: HEAR-SEE-DO"). The technology has eight guiding questions and materials that support the development of the educational activity, namely: a model foot simulating the human foot (synthetic material) (Figure 1); a 20 cm by 15 cm framed mirror; different types of soaps

(glycerin and/or neutral and scented soaps usually found in pharmacies and grocery stores); a small towel; a bottle with moisturizer; different nail clipping instruments (scissors, nail clippers and pliers); fake nails and double-sided adhesive tape; different types of socks (seamless and without elastic, with seam and elastic, cotton and nylon); different types of shoes (open, closed, with heels and without heels); and pictures of feet with deformities and calluses. All materials were stored in a backpack for easy storage and transportation to carry out the educational activity.

Carrying out the built-in educational technology (Chart 1) aims to enable people with DM and their families to **hear** how care is performed, to **watch** the care being performed on a model foot and to **perform/do** the care on their own feet with the supervision and assistance from a health professional.

**Chart 1 -** Foot care to prevent complications: HEAR-SEE-DO

| GUIDING QUESTIONS | DEVELOPMENT |
|---|---|
| 1. How to perform self-assessment of feet? | **HEAR:**provide strategies for self-assessment of the feet and aspects that must be observed:<br>- Suggest that the feet evaluation should be done daily;<br>- Carefully observe the feet'smoisturizing conditions, if there are injures, calluses, cracks, blisters on the skin of the back of the foot, sole, heel and between the toes;<br>- Look at the length and shape of the nails;<br>- Emphasize the importance of using the mirror to assess the soles of the feet and the back of the feet, if you are unable to look at them properly because of some mobility impairment;<br>- Ask the family member/caregiver to check the feet of the person with DM, if they have visual or mobility difficulties, for example.<br>**SEE:**show how to evaluate the feet, observing the skin on the back of the foot, sole, heel and between the toes. This evaluation is carried out on the model foot, in which calluses, cracks or other often found conditions can be seen.<br>Evaluate the moisturizing conditions of the feet, check for injuries, calluses, cracks, and blisters. Also observe the length and shape of the nails.<br>Show how to use the mirror for the assessment if the person has a mobility impairment.<br>**DO**: ask the person to carry out the self-assessment on their feet or, if necessary, ask the family member to do it. The professional observes carefully, talks about how the self-assessment is being carried out and suggests adjustments in this care, if necessary. |
| 2. Whatwashing product to use on the feet and the appropriate water temperature? | **HEAR:**suggest the ideal products for foot hygiene and adequate water temperature:<br>- Bar or liquid soaps that are neutral, such as unscented ones or glycerin-based;<br>- Avoid strongly scented soaps;<br>- Suggest that the water must be lukewarm;<br>-Avoid very hot water, as it dries out the skin, causing cracks/fissures/ flaking, and can cause burns or blisters, which may be even worse for people with DM whose sensitivity may be reduced.<br>**SEE:**choose, among the many products available, the appropriate soap and simulate the washing on the model foot.<br>**DO**: ask the person to choose the product, among the given choices, simulating the care on the foot itself or, if necessary, ask the family member to do it. The professional observes carefully, talks about the choice made by the person, and suggests the adjustments in this action, if necessary. |
| 3. How to dry the feet? | **HEAR:**guide the correct way to dry the feet after bathing/washing:<br>- Emphasize the needfor drying between the toes, because if it stays moist between the toes, it will favor excessive humidity and proliferation of fungi and bacteria.<br>**SEE:**perform the care, simulating the drying, of the model foot with a towel.<br>**DO**: ask the person to simulate drying the foot with the towel or, if necessary, ask the family member/caregiver to do it. The professional observes carefully, talks about how the person performed this care and suggests adjustments, if necessary. |
| 4.How to put on a moisturizer? | **HEAR:**guide the needfor using moisturizers and how to apply:<br>- Emphasize that moisturizerskeep adequate skin moisture, preventing dryness, cracks and fissures;<br>- Suggest that it should be applied after washing the feet and whenever necessary (at least twice a day);<br>- Show the areas where the moisturizer should be applied (on the foot, soles, heel, on the toes), emphasizing that it should not be applied between the toes, as it favors excessive humidity and proliferation of fungi and bacteria.<br>**SEE:**carry out the care by applying a moisturizer on the model foot gently, in round movements, including the back of the feet, soles, heels and over the toes.<br>**DO:**ask the person to apply the moisturizer on the foot or, if necessary, ask the family member to do it.<br>The professional observes carefully, talks about the care provided and suggests adjustments, if necessary. |

To be continued.

| GUIDING QUESTIONS | DEVELOPMENT |
|---|---|
| 5. How and how often to cut the nails? | **HEAR:**guide the correct way to cut the nails and ideal frequency:<br>- Emphasize the appropriate instruments: scissors, nail clippers and pliers;<br>- Suggest that the nails should be cut in a straight line and never in the rounded shape to prevent them from becoming "stuck"; cut to medium size (on the finger line); and do not let them grow too much;<br>- Emphasize that the frequency of the cut is decided by the person him/herself in his/her daily assessment.<br>**SEE:** carry out the care by cutting the model's nails with scissors, nail clippers, or pliers (fake nails glued to the model's toes).<br>**DO**: ask the person to cut the nail on the model foot or the nail itself (if necessary). If necessary, ask the family member to do so.<br>The professional observes carefully, talks about the care provided and suggests adjustments, if necessary. |
| 6. How to care for the feet in case of calluses and cuticles? Is it possible to do"foot-soakings"? | **HEAR:**guide on the need of consulting a podiatrist if you have calluses or cuticle problems:<br>- Emphasize the importance of never leaving your feet soaking and never removing calluses and cuticles at home;<br>- To advise on the use of callus protectors, if necessary, and the use of shoes that do not hurt or worsen callus;<br>- Emphasize the risk of injury and possible difficulty in healing any foot wound, as a person with DM.<br>**SEE:** show the callus on the model foot pointing to its most frequent areas. Show figures of different types of calluses and areas.<br>**DO**: ask the person to observe and identify the callus/calluses on his/her feet. The professional observes carefully, talks about the care provided and suggests adjustments, if necessary. |
| 7. What kind of socks should I wear? | **HEAR:**guide on the features of the appropriate socks:<br>- Wear cotton (soft) socks, not nylon ones;<br>- Wear socks without elastic, as the elastic can tighten/constrict the ankle and compromise blood circulation in the feet;<br>- Wear seamless socks, as the seams can cause skin damage;<br>- Prefer light-colored socks, because if there is any injury and bleeding, they will be easily seen in the sock.<br>**SEE:**choose, among the several socks available, the most suitable to dress the model foot.<br>**DO**: ask the person to choose the socks among those presented or, if necessary, ask the family member to do it.<br>The professional observes carefully, talks about the care performed and suggests adjustments, if necessary. |
| 8. What types of shoes are suitable? | **HEAR:**guide on the attributes of the appropriate shoes:<br>- Never wear tight shoes, they must be soft and comfortable;<br>- The tip of the shoe should have a rounded or square shape, and not a "pointed toe";<br>- They must be seamless, as the internal seams can hurt or calluses;<br>- Prefer closed-toe shoes to protect your feet, since open toe shoes, such as flip flops and sandals, expose your feet, causing a greater risk of injury;<br>- Avoid walking barefoot or wearing high-heels.<br>**SEE:**choose among the various shoes available, the most suitable to put on the model foot.<br>**DO**: ask the person to point out the most suitable type of shoes among those presented or, if necessary, ask the family member to do so. The professional observes carefully, talks about the care provided and suggests adjustments, if necessary. |

**Source:** prepared by the authors based on the literature review carried out, 2019.

The carrying out process of educational technology should include the following steps to be taken by the health professional who will perform it: a) Show the objective of the activity and the time required, emphasizing the importance of the participation of the family member of the person with DM, when possible; b) Start a conversation about how the person with DM perceives his/her chronic condition and how self-care is being carried out, using a comprehensive perspective that seeks to develop integral, non-fragmented and humanized health care; c) Place the necessary materials on a flat, clean surface, organized by type of material and in the order they will be addressed according to Table 1; d) Expose the guiding question, followed by health guidance (according to Chart 1). The guiding questions work as a guide about the topics to be addressed. Thus, during the dialogue, this order can be altered if the person with DM questions about some care action that does not follow the sequenceshown; e) Guide care through verbalization by the professional. In this action, the person with DM and his/her relative will HEAR; f) Perform care tothe model foot using the materials previously selected for

this action. At this moment, the person with DM and the family member will SEE, and this stepmay take place simultaneously with the HEAR step; g) Encourage the care on the foot of the person with DM or the model foot by the person with DM and/or his/her relative, carrying out care that was previously guided and observed. This action constitutes DO. The health professional, on this occasion, monitors, analyzes and stimulates the care provided properly or suggests the necessary adjustments if difficulties in understanding and/or performing it are observed; h) Give feedback to the person with DM and family member for the performance of care as a form of encouragement, recognizing the person's commitment to correctly perform the care; i) Finish with the clarification of doubts and the hand outof printed material summarizing the main care actions (folder, for example).

The use of learning strategies that involve kinesthetic, visual, and hearing resources has shown effective results [20,21]. Multiple educational tools were used, as support of verbalized guidelines, to promote a greater understanding of these people and promote behavior change [5, 20, 22, 23].

The educational technology for the prevention of diabetic foot ulcerswas designed to be carried out briefly, requiring about 30 minutes of interaction between nurses and people with DM and their family members, making health education dynamically inserted in the nurse's work process. This characteristic is essential for its applicability since the lack of time and prioritizing other activities (other than health education) are usual in many health care environments. Health education, developed interactively, increases the understanding of diabetic footulcer prevention measures. Also, just as long-term educational programs can bring benefits, those carried out more briefly can be successful, once they are well planned [5,20].

This educational technology is in line with other studies that point out that programs should include practical demonstrations and consider the level of education of people, promoting their motivation and their families to be involved in educational programs, benefiting individuals with DM [5,20].

It is suggested that combined with educational technology, physical examination of the feet should also be carried out, in associationwith general clinical assessment, neurological tests, vascular tests, and risk classification with the use of specific instruments from the health institution for proper registration and monitoring according to the possibilities of each health service.

The risk classification of ulceration is crucialin assisting people with DM with a view to comprehensive care and self-care guidelines for the feet as a routine of care for these people to contribute to the prevention of foot ulceration [24].

The use of educational technologies in nursing care allows the understanding of people with DM about the need for changing their lifestyle and self-care, toprevent, postpone and/or control the complications resulting from the disease. Nursing and health professionals must support the development or strengthening of skills for self-care, act as facilitators and motivators for the behavioral changes necessary in adhering to treatment, in an individualized, creative, and innovative educational process [25].

As study limitations, it is highlighted that the educational technology was designed considering only the reality of a particular health service. Further, the educational material for the prevention of diabetic foot ulcersrepresents only one element of the educational process for people with DM and cannot be considered outside this broad context of care.

## FINAL CONSIDERATIONS

The use of the educational technology "Foot care for the prevention of complications: HEAR-SEE-DO"in the nurse's care practice may foster the prevention of complications and the continuous assessment for the risk of developing diabetic foot ulcers. It is a low-cost educational technology, simple to be carried out and combined with the nurse's care activities with the potential to promote comprehensive health care and the empowerment of people with DM for self-care.

The proposed educational technology was motivated by the needs of nursing care for people with DM, attended in the hospital environment, specificallyin medical-surgical inpatient units, emergency rest, and outpatient

areas. Nevertheless, it may be carried out in primary health care services if the person's clinical condition and the dynamics of the services are considered.

## TECNOLOGIA EDUCATIVA PARA CUIDADOS E PREVENÇÃO DO PÉ DIABÉTICO


## RESUMO

**Objetivo**: delinear o percurso metodológico da criação de uma tecnologia educativa para a prevenção do pé diabético. **Método**: pesquisa metodológica que utilizou um caminho sistematizado para criar uma tecnologia educativa para a prevenção do pé diabético, seguindo as seguintes etapas: 1) Reunião de conteúdos produzidos pelo Laboratório de Pesquisa e Tecnologia em Enfermagem e Saúde a Pessoas em Condição Crônica; 2) Revisão bibliográfica; 3) Diálogo entre pesquisadoras e enfermeiras de um hospital; 4) Definição do conteúdo técnico e abordagem pedagógica; 5) Descrição do passo a passo do processo educativo, os materiais necessários e a abordagem pedagógica; 6) Treinamento da equipe de pesquisadoras para a realização da tecnologia educativa; 7) Teste piloto com pessoas com diabetes, internadas em unidades médico-cirúrgicas de um hospital. **Resultados**: a tecnologia educativa criada pautou-se na sistematização das ações "OUVIR-VER-FAZER", incluindo a orientação e demonstração dos cuidados com os pés pelo profissional de saúde, usando materiais que permitem a simulação desses cuidados em um pé modelo e, em seguida, a reprodução dos cuidados pela pessoa com diabetes. **Conclusão**: a tecnologia educativa, construída sob uma perspectiva pedagógica problematizadora, é uma ferramenta assistencial de baixo custo e simples aplicação que pode contribuir para a prevenção do pé diabético.


**Palavras-chave:** Tecnologia Educacional. Educação em Saúde. Diabetes Mellitus. Pé Diabético. Enfermagem.

## TECNOLOGÍA EDUCATIVA PARA EL CUIDADO Y LA PREVENCIÓN DEL PIE DIABÉTICO


## RESUMEN

**Objetivo**: definir elrecorrido metodológico de la creación de una tecnología educativa para la prevención del pie diabético. **Método**: investigación metodológica que utilizó un camino sistematizado para crear una tecnología educativa para la prevención del pie diabético, siguiendo las siguientes etapas: 1) Reunión de contenidos producidos por el Laboratorio de Investigación y Tecnología en Enfermeríay Salud a Personas en Condición Crónica; 2) Revisión bibliográfica; 3) Diálogo entre investigadoras y enfermeras de un hospital; 4) Definición del contenido técnico y abordaje pedagógico; 5) Descripción de las etapas del proceso educativo, los materiales necesarios yel abordaje pedagógico; 6) Entrenamiento del equipo de investigadoras para la realización de la tecnología educativa; 7) Prueba piloto con personas con diabetes, ingresadas en unidades médico-quirúrgicas de un hospital. **Resultados**: la tecnología educativa creada se basó en la sistematización de las acciones "OÍR-VER-HACER", incluyendo la orientacióny demonstración de los cuidados conlos pies por el profesional de salud, usando materiales que permiten la simulación de estos cuidados en un pie modelo y, posteriormente, la reproducción de los cuidados por la persona con diabetes. **Conclusión**: la tecnología educativa, construida bajo una perspectiva pedagógica problematizadora, es una herramienta asistencial de bajo costeyaplicaciónsimple que puede colaborar para la prevención del pie diabético.


**Palabras clave**: Tecnología Educacional. Educación para la salud. Diabetes mellitus. Pie diabético. Enfermería.

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