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 and, then, 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 foot ulcers.


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, is trouble 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 to amputations[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].

Researchers carried out in different countries have shown that health education programs for people with DM may decrease the development 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 ulcers comprises, 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 easy measures, such as choosing the right shoes and proper foot hygiene, promotes the management to avoid complications[3].

Despite the acknowledgement of the advances that health education promotes, the
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 question was elaborated: how should an educational technology aimed at people with DM and their families aim at the care and prevention of diabetic foot ulcers be 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 path of 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 for the development of educational technology;
2) Literature review, including scientific journals, guidelines from the Ministry of Health of Brazil, guidelines from the Sociedade Brasileira 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, focused on avoiding inaccuracies or mistakes to carry it out. The training included the discussion of all steps to carry it out and consolidation of the pedagogical approach;
7) Training of the research team to carry out educational technology in a standardized manner, focused on avoiding inaccuracies or mistakes to carry it out. The training included the discussion of all steps to carry it out and consolidation of the pedagogical approach.
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 allowed improvements 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 step of 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 good time for health education and understood as a potential to improve self-care\textsuperscript{(18)}.

Figure 1. Model foot used to carry 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
different types of shoes (open, closed, with heels and without heels); and pictures of feet with deformities and callouses. 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**

<table>
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<tr>
<th>GUIDING QUESTIONS</th>
<th>DEVELOPMENT</th>
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|1. How to perform self-assessment of feet? | **HEAR** provide strategies for self-assessment of the feet and aspects that must be observed:  
- Suggest that the feet evaluation should be done daily;  
- Carefully observe the feet moisturizing conditions, if there are injuries, calluses, cracks, blisters on the skin of the back of the foot, sole, heel and between the toes;  
- Look at the length and shape of the nails;  
- 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;  
- Ask the family member/caregiver to check the feet of the person with DM, if they have visual or mobility difficulties, for example.  
**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. Evaluate the moisturizing conditions of the feet, check for injuries, calluses, cracks, and blisters. Also observe the length and shape of the nails.  
**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. What washing product to use on the feet and the appropriate water temperature? | **HEAR** suggest the ideal products for foot hygiene and adequate water temperature:  
- Bar or liquid soaps that are neutral, such as unscented ones or glycerin-based;  
- Avoid strongly scented soaps;  
- Suggest that the water must be lukewarm;  
- 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.  
**SEE** choose, among the many products available, the appropriate soap and simulate the washing on the model foot.  
**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:  
- Emphasize the need for drying between the toes, because if it stays moist between the toes, it will favor excessive humidity and proliferation of fungi and bacteria.  
**SEE** perform the care, simulating the drying, of the model foot with a towel.  
**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 need for using moisturizers and how to apply:  
- Emphasize that moisturizers keep adequate skin moisture, preventing dryness, cracks and fissures;  
- Suggest that it should be applied after washing the feet and whenever necessary (at least twice a day);  
- 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.  
**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.  
**DO** ask the person to apply the moisturizer on the foot or, if necessary, ask the family member to do it. 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:  
- Emphasize the appropriate instruments: scissors, nail clippers and pliers;  
- 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;  
- Emphasize that the frequency of the cut is decided by the person him/herself in his/her daily assessment.  
**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).  
**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.  
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:  
- Emphasize the importance of never leaving your feet soaking and never removing calluses and cuticles at home;  
- To advise on the use of callus protectors, if necessary, and the use of shoes that do not hurt or worsen callus;  
- Emphasize the risk of injury and possible difficulty in healing any foot wound, as a person with DM.  
**SEE**: show the callus on the model foot pointing to its most frequent areas. Show figures of different types of calluses and areas.  
**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:  
- Wear cotton (soft) socks, not nylon ones;  
- Wear socks without elastic, as the elastic can tighten/constrict the ankle and compromise blood circulation in the feet;  
- Wear seamless socks, as the seams can cause skin damage;  
- Prefer light-colored socks, because if there is any injury and bleeding, they will be easily seen in the sock.  
**SEE**: choose, among the several socks available, the most suitable to dress the model foot.  
**DO**: ask the person to choose the socks among those presented or, if necessary, ask the family member to do it.  
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:  
- Never wear tight shoes, they must be soft and comfortable;  
- The tip of the shoe should have a rounded or square shape, and not a “pointed toe”;  
- They must be seamless, as the internal seams can hurt or calluses;  
- 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;  
- Avoid walking barefoot or wearing high-heels.  
**SEE**: choose among the various shoes available, the most suitable to put on the model foot.  
**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 to the 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 step may 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 out of 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 ulcers was 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 foot ulcer 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
association with 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
 crucial in 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, to prevent, 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 ulcers represents
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, specifically in medical-surgical
inpatient units, emergency rest, and outpatient
RESUMO

Objetivo: delinear el percurso 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 Enfermería y 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 del proceso del patrón educativo, los materiales necesarios y el abordaje pedagógico; 6) Entrenamiento del equipo de investigadoras para la realización de la tecnología educativa; 7) Teste 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 “OUIR-VER-FAZER”, incluyendo la orientación y demostración de los cuidados 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 costo y simples aplicación que puede contribuir a la prevención del pie diabético.


