



Educational technology validity to prevent diabetes-related foot disease

Validação de tecnologia educativa para prevenção da doença do pé relacionada ao diabetes

Validación de tecnología educativa para la prevención de enfermedades del pie relacionadas con la diabetes

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ABSTRACT

Objective: to validate the content of the Educational Technology (LISTEN, SEE, DO) for the prevention of foot alterations in people with Diabetes Mellitus. **Method:** methodological research for content validation. Judges were selected from the Lattes/*Conselho Nacional de Desenvolvimento Científico e Tecnológico* Platform using the expression "diabetic foot" and including advanced search filters, resulting in 51 potential judges, of which 32 judges responded. The results were analyzed in relation to the Committee's Concordance Rate (CCR) and the Content Validity Index (CVI) of its sub-items. **Results:** all items of the educational technology reached the previously established indices with experts' agreement on the evaluated content (CCR) being higher than 96% in each item, and the CVI being higher than 0.90 in each sub-item. **Conclusion and implications for practice:** the Educational Technology LISTEN, SEE, DO met the previously established criteria for content validation and was considered by judges to have appropriate item composition, with clear and relevant sub-items. The validated technology provides material for preventing diabetic foot using innovative strategies that stimulate people in an auditory, visual, and kinesthetic way.

Keywords: Diabetes Mellitus; Diabetic Foot; Nursing Methodology Research; Educational Technology; Validation Study.

RESUMO

Objetivo: validar o conteúdo da Tecnologia Educativa (OUVIR, VER, FAZER) para prevenção de alterações nos pés de pessoas com Diabetes Mellitus. **Método:** pesquisa metodológica para a validação de conteúdo. Juízes selecionados na Plataforma Lattes/*Conselho Nacional de Desenvolvimento Científico e Tecnológico* com a expressão pé diabético e incluindo filtros de busca avançada, resultando em 51 potenciais juizes, dos quais obteve-se o retorno de 32 juizes. Os resultados foram analisados quanto a Taxa de Concordância do Comitê (TCC) e Índice de Validade de Conteúdo (IVC) dos seus subitens. **Resultados:** todos os itens da tecnologia educativa atingiram os índices previamente estabelecidos com a concordância dos experts sobre o conteúdo avaliado (TCC) que foi superior a 96% em cada um dos itens e o IVC foi superior a 0,90 em cada um dos subitens. **Conclusão e implicações para a prática:** a Tecnologia Educativa OUVIR, VER, FAZER atendeu aos critérios previamente estabelecidos de validação de conteúdo e foi considerada pelos juizes como tendo a composição adequada dos itens, além de seus subitens terem clareza e serem relevantes. a Tecnologia validada disponibiliza um material para prevenção do pé diabético usando estratégias inovadoras que estimulam as pessoas de forma auditiva, visual e cinestésica.

Palavras-chaves: Diabetes Mellitus; Estudo de Validação; Pé Diabético; Pesquisa Metodológica em Enfermagem; Tecnologia Educacional.

RESUMEN

Objetivo: validar el contenido de la Tecnología Educativa (ESCUCHAR, VER, HACER) para prevenir alteraciones en los pies de personas con Diabetes Mellitus. **Método:** investigación metodológica para la validación de contenido. Jueces seleccionados en la Plataforma Lattes/*Conselho Nacional de Desenvolvimento Científico e Tecnológico* con la expresión pie diabético e incluyendo filtros de búsqueda avanzada, resultando en 51 jueces potenciales, de los cuales se obtuvo la retroalimentación de 32 jueces. Los resultados fueron analizados en relación con el Tasa de cumplimiento del comité (TCC) y al Índice de Validez de Contenido (CVI) de sus subelementos. **Resultados:** todos los elementos de tecnología educativa alcanzaron los índices previamente establecidos con la concordancia de los expertos sobre el contenido evaluado (TCC), el cual fue superior al 96% en cada uno de los elementos y el CVI fue superior a 0,90 en cada uno de los subelementos. **Conclusión e implicaciones para la práctica:** la Tecnología Educativa ESCUCHA, VE, HACE cumplió con los criterios de validación de contenido previamente establecidos y fue considerada por los jueces con la composición adecuada de elementos, además de que sus subelementos son claros y pertinentes. La tecnología validada proporciona material para la prevención del pie diabético utilizando estrategias innovadoras que estimulan a las personas de forma auditiva, visual y cinestésica.

Palabras clave: Diabetes Mellitus; Estudio de Validación; Pie Diabético; Investigación Metodológica en Enfermería; Tecnología Educacional.

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INTRODUCTION

Diabetic foot is a chronic complication in people with diabetes mellitus (DM) and involves a wide range of problems, with the presence of infections, ulceration and/or destruction of deep tissues, along with neurological and vascular changes, representing one of the main causes of morbidity and mortality in these people.¹

It is estimated that 50-70% of all lower limb amputations are related to DM, with 85% of these amputations being preceded by a foot ulcer.² The costs of treating ulcers and amputations indicate the importance of preventing these changes, as once injuries begin, they are difficult to control. The financial costs for health systems can reach 40% of the resources used to treat people with DM, plus personal costs involving emotional, physical and social aspects.^{2,3}

Therefore, finding strategies to help prevent this complication is at the forefront of healthcare interest, as the effectiveness of foot education remains limited, particularly in relation to long-term behavior modification and prevention of ulceration and amputation.⁴ Health education technologies for people with DM can change this situation. However, it does not only depend on people's desire and conditions they have to provide care, but also on professionals' preparation to develop this education in a way that motivates and prepares people for appropriate foot care using different educational strategies.^{4,5}

Some studies have shown that health education developed in an interactive way increases understanding of diabetic foot prevention measures. There is an indication that educational activity must include practical demonstrations, using visual, auditory and kinesthetic strategies, as the more concrete the guidelines, such as demonstrations on the feet of people with DM and the manipulation of the products to be used, the greater will be the chance of success.^{4,6-8} Furthermore, it is important to individualize education, recognizing each person's needs and possibilities.⁴

Considering these indications and experiences with the care of people with DM, researchers linked to the Center for Studies and Assistance in Nursing and Health for People with Chronic Conditions (NUCRON) at the *Universidade Federal de Santa Catarina* developed and tested a technology called "LISTEN, SEE, DO", which seeks not only to tell people about what is important, but also to show them how to do it and accompany them in performing care. This technology achieved excellent results in terms of retaining guidelines, observed in pre- and post-tests after its application to 49 people with DM.⁹

The educational technology "LISTEN, SEE, DO" was developed based on: structured literature review; consultation of main consensus statements of diabetes societies (American Diabetes Association; International Working Group on the Diabetic Foot and Brazilian Diabetes Society (*Sociedade Brasileira de Diabetes*));^{3,10,11} experience of researchers in caring for people with DM; results of research carried out by NUCRON members.

The technology presents easy-to-understand content, containing essential information for daily care for people with DM who have not yet developed foot injuries, with a playful and problematizing approach, to be carried out by nurses involving stimulation visual, auditory and kinesthetic.

The technology can be integrated into the educational process that nurses develop when caring for people with DM, not being limited to looking at their feet. The technology addresses eight items to be guided with the help of a set of suitable and unsuitable materials for daily foot care, such as different products for washing and moisturizing the feet, instruments for cutting nails, shoes of different shapes and socks from different materials. The intention is that these people not only listen to the instructions, but have the opportunity to see how to do it, to choose the most appropriate products from a list of different options and to repeat this care on their own feet under the supervision of a nurse. This technology can be used in primary care, in specialized outpatient clinics or during hospital stays.

Recognizing the potential of this technology, which had not yet been subjected to validity by expert judges, we decided to carry out content validity. Content validity refers to the degree to which an instrument shows a specific domain of content, which in the specific case of this validity is the content of an educational technology for preventing diabetes-related foot disease.¹²

The study aimed to validate the educational technology "LISTEN, SEE, DO" content to prevent changes in the feet of people with DM.

METHOD

This is methodological research in nursing, of the validity study type, carried out in a single stage to validate the educational technology "LISTEN, SEE, DO" content. The proposal was to verify whether the content of this technology effectively covers the aspects necessary for health education in relation to the care carried out by people with DM and/or their families, to prevent changes in people's feet, in addition to verifying if it does not contain elements that can be assigned to other objects.¹²

The selection of participants for validity, called judges, was carried out through the Lattes Platform of the Brazilian National Council for Scientific and Technological Development (CNPq - *Conselho Nacional de Desenvolvimento Científico e Tecnológico*), with advanced search using the expression "diabetic foot" and applying the filters: training: doctoral degree; professional activity: health sciences/nursing. A total of 72 resumes were analyzed and scored according to previously established criteria adapted from Fehring (1987): doctoral training (3 points); minimum of three years of experience in clinical nursing practice, including people with DM (1 point); development of research carried out on the topic of care for people with DM (2 points); article published on the topic of care for people with DM (1 point per article, up to a limit of five points). Participants with a minimum score of seven points were included. From this analysis, 51 reached the minimum score established.

Of the 51 potential judges selected, emails were obtained from 49 of them, to which a message was sent inviting them to participate. No response was obtained from 17 judges, even after two attempts to contact them via email, obtaining a sample of 32 participants. Data collection took place from December 2020 to March 2021.

For those who agreed to participate, the Informed Consent Form (ICF) and content validity instrument for the educational technology “LISTEN, SEE, DO” for diabetic foot prevention, via email, to be answered using Google Forms, were sent. The judges initially assessed whether all the precautions contained in each of the eight technology items were adequate and then assessed the sub-items that corresponded to the necessary precautions in terms of clarity and relevance. A Likert-type scale was used, each with four points, in relation to clarity: (1) Totally disagree; (2) Partially disagree; (3) Partially agree; and (4) Completely agree. Relevance: (1) Not relevant; (2) Needs major review; (3) Needs minor review; and (4) Relevant.

The results were analyzed in relation to the Committee Agreement Rate (CAR) and in relation to the Content Validity Index (CVI). To calculate judges' agreement (CAR) on the assessed content, it was established that the agreement rate should be greater than or equal to 80%.¹³ Results with an index below 80% should be reformulated or eliminated, based on judges' suggestions. To calculate the CVI, the set composed of options 3 and 4, both in terms of clarity and relevance, should reach a minimum index of 0.90, using a formula that has been widely used.¹⁴

The research project was sent to the Research Ethics Committee of the *Universidade do Estado do Amazonas* and was approved under Opinion 4.363.008, Certificate of Presentation for Ethical Consideration (CAAE - *Certificado de Apresentação para Apreciação Ética*) 37178320.0.0000.5016.

RESULTS

The educational technology “LISTEN, SEE, DO” content validity was carried out by 32 expert judges, mostly female (90.6%), with an average age of 48.5 years (31 to 70 years), an average time of training as a nurse of 27 years and time of obtaining a doctoral degree of eight years. A total of 29 participants were linked to higher education institutions (universities, colleges and university centers), with one linked to a city hall and two to a hospital.

Expert judges' judgment showed that all items and sub-items of educational technology “LISTEN, SEE, DO” reached the previously established indices, i.e., experts' agreement on the assessed content (CAR) was greater than 96%, with a CVI greater than 0.90, as shown in Table 1. Item 7 “What types of shoes are suitable” was the one that obtained the highest CVI, with an index of 1.0, both in relation to clarity and relevance in all subitems. The subitems of the other items had a CVI variation between 0.93 and 1.0.

Considering this result of judges' judgment, there would be no need to make changes to the technology. However, all suggestions were assessed, and adjustments (complementations and/or additions) were made due to their contribution to greater clarity in the technology sub-items. The changes made are shown in Chart 1, highlighting that in items 3, 6 and 7 there were no changes and that in items 4 and 8 a subitem was added.

DISCUSSION

The agreement obtained among judges and the high validity index of each item and subitems in the process of validating the educational technology “LISTEN, SEE, DO” content results from its composition having broad support in the literature, especially in the consensus of scientific societies focusing on DM.^{3,10,11,15-17}

The first item that deals with observing the foot expresses the need for people to pay attention to place the foot as an element of daily observation, pay attention to details and be able to detect small changes. Most authors address the inspection/observation that professionals must carry out, exploring little about what to specifically advise people in the observation that they themselves must carry out. They emphasize the importance of daily inspection of the feet on the entire surface of both feet, including the areas between the toes, in addition to observing deformities and checking whether a person is capable of inspecting their own feet.^{8,10,11,15,17}

In the educational technology “LISTEN, SEE, DO”, the intention is for nurses to motivate and develop this observation skill in people and/or family members, which does not exempt professionals from their periodic assessment and use of specific instruments for assessing the feet. The purpose is for people to know how to detect changes in early stages and seek help from professionals.

It is important to highlight that the observation conditions of people with DM can be affected by visual difficulties resulting from diabetic retinopathy, or by changes in body flexibility that prevent them from looking, for instance, at the soles of their feet. Therefore, it is essential that a family member or caregiver is integrated into the educational process, as recommended by different authors.^{3,4,10,17-19}

The technology content in the item that addresses observation was changed, including “cuts”, i.e., identification of a continuity solution and also the observation of the presence of bleeding or secretions, which was considered relevant to better detail the observation that people should do.

The second item addresses the product to be used to wash the feet and water temperature. The recommendation, according to some authors, is to use water at a temperature below 37° C,¹⁷ which is equivalent to a warm temperature, close to body temperature. Difficulty in accessing water thermometers leads to a subjective assessment, such as previously testing the water before washing the feet or before bathing, in a more sensitive area of the body, such as the inner part of the forearm.²⁰

Table 1. Committee Agreement Rate and Content Validity Index resulting from judges’ judgment (n=32) of items and sub-items that make up the educational technology “LISTEN, SEE, DO” in relation to CLARITY AND RELEVANCE. Manaus, AM, 2021.

Assessment items and sub-items	CVI* Clarity	CVI** Relevance
ITEM 1 - What to look for on feet daily – CAR** 98.9%		
1.1 Foot moisture	0.93	0.96
1.2 Presence of injuries: scratches, wounds	0.93	0.96
1.3 Presence of calluses	0.96	0.96
1.4 Presence of cracks in the heels	0.96	0.96
1.5 Presence of blisters	0.96	0.93
1.6 Presence of changes between the fingers	0.96	0.93
1.7 Nail size and shape	1	0.96
ITEM 2 - What product to use to wash the feet and water temperature CAR 98.9%		
2.1. Use bar or liquid soaps that are neutral - fragrance-free and glycerin-free	0.93	0.93
2.2 Wash with warm water – test the temperature on the inside of the arm	1	1
ITEM 3 - How to dry the feet - CAR 100%		
3.1. Do not leave the feet damp or wet	0.96	0.96
3.2. Dry the entire foot with a soft towel, especially between the toes	1	0.96
ITEM 4 - How to moisturize the skin on the feet - CAR 100%		
4. 1. Apply moisturizer only after washing the feet	0.90	1
4. 2. Apply moisturizing cream to the feet at least twice a day	0.96	1
4. 3. Apply the moisturizer gently, in circular movements, including the back of the feet, soles of the feet, heels and over the toes	1	1
4. 4. Do not apply moisturizer between the fingers	0.96	0.96
ITEM 5 - How to cut the nails - CAR 100%		
5. 1. Cut toenails only with appropriate instruments: scissors, clippers or nail clippers	0.96	0.93
5. 2. Request help cutting the toenails	1	1
5. 3. Cut the nails straight and never rounded	0.90	1
5. 4. Cut to medium size - on the top line of the finger	0.93	1
5. 5. Do not let the nails be too long	1	0.93
ITEM 6 - What to do with calluses and cuticles – CAR 100%		
6.1. Never remove cuticles	1	0.96
6.2. Never remove calluses	1	1
6.3. Never soak the feet (foot bath)	0.96	1
6.4. Consult a professional, preferably a podiatrist, if there are calluses or problems with the cuticles	1	1
6.5. Wear suitable shoes that do not cause calluses	1	0.96
ITEM 7 - What types of shoes are suitable – CAR 100%		
7.1. Shoes should be soft and comfortable - never wear tight shoes	1	1
7.2. The toe of the shoe must have a rounded or square shape and never a “thin toe”.	1	1
7.3. Shoes must be seamless (internal seams can cause injuries or calluses)	1	1
7.4. Prefer closed shoes to protect the feet	1	1
7. 5. Avoid walking barefoot or wearing high-heeled shoes	1	1
ITEM 8 - What type of socks to use – CAR 96.9%		
8.1. Wear cotton (soft) socks and not nylon	1	1
8.2. Wear socks without elastic at the top	0.96	0.96
8.3. Wear seamless socks	1	1
8.4. Prefer light colored socks - helps identify the presence of secretions and bleeding	1	0.96

* CVI: Content Validity Index; **CAR: Committee Agreement Rate.

Chart 1. Changes made to sub-items according to judges' suggestions.

Item	Subitems	
	Previous version	Final version
1. What to look for on the feet daily	1.2 Presence of injuries: scratches, wounds	1.2. Presence of injuries (cuts, scrapes, wounds), bleeding or secretions
2. What product to use to wash the feet and water temperature	2.1. Use bar or liquid soaps that are neutral - fragrance-free and glycerin-free	2.1. Use bar or liquid soaps that are neutral, fragrance-free and preferably glycerin
	2.2 Wash with warm water – test the temperature on the inside of the arm	2.2. Wash with warm water (test water temperature on the inside of the forearm). Very hot water can cause burns or blisters when sensitivity is reduced
3. How to dry the feet		No changes
4. How to use moisturizing creams?	4.3. Apply the moisturizing cream gently, in circular movements, including the back of the feet, soles of the feet, heels and over the toes	4.3. Apply the moisturizing cream to the top of the feet, soles, heels and toes. Do not apply between the fingers (promotes excessive humidity and the proliferation of fungi/bacteria)
	4.4. Do not apply moisturizer between the fingers	4.5. Wait for the moisturizer to absorb/dry before walking (avoid slipping)
5. How to cut the nails	5. 1. Cut the toenails only with appropriate instruments: scissors, clippers or nail clippers	5.1. Cut toenails only with appropriate instruments: blunt scissors, clippers or nail clippers
	5. 4. Cut to medium size - on the top line of the finger	5.4. Nails must be cut straight across the top of the finger and never rounded (to prevent them from becoming "ingrown")
	5.5. Do not let the nails be too long	5.5. Cut the nails whenever you consider it necessary, i.e., when the nail extends beyond the top of the fingers
6. What to do with calluses and cuticles		No changes
7. What types of shoes are suitable		No changes
8. What type of socks to use	8.1. Wear cotton (soft) socks and not nylon	8.1. Wear soft cotton socks (do not wear nylon socks or other synthetic materials)
	8.2. Wear socks without elastic at the top	8.2. Wear socks without elastic (elastic can tighten/garrot the ankle and compromise blood circulation in the feet)
		8.5. Change socks after each use

Another indication found in some texts is to use water at room temperature, but this only applies to warmer places, but not to colder places.¹⁹⁻²¹

The recommended product to be used for washing feet is soap that is neutral, fragrance-free and preferably glycerin.^{17,22} This indication can be a problem since this type of soap has a higher cost. However, other soaps can cause even greater skin dryness, which is already common in people with DM, making it more sensitive to the appearance of injuries.

The third item that explores foot drying has a simple recommendation to dry the entire foot with a soft towel, as humidity favors the development of fungus, especially between the toes. In warmer countries, such as Brazil, more notably in the north and northeast regions, the use of closed shoes can cause greater sweating in the feet, which generates some discussions and resistance about the use of this type of shoe among people with DM. A study carried out in Malaysia, a country that also has higher temperatures, found that 60% of people with DM wore open sandals, even with the recommendation to wear closed shoes.²³

Moisturizing the feet with creams, the fourth item of technology, is an indication that was considered relevant. Its use requires some care, such as avoiding putting it between the fingers and avoiding walking right after using it, as it can cause falls. The choice of cream with urea as the ideal choice is again due to its high cost, which may make the use of this type of cream unfeasible for people of lower socioeconomic status. A study showed that a moisturizing cream containing urea, glycerin and petroleum jelly helped not only in preventing fissures but also in the recovery of those who already had these fissures.²⁴

Nail cutting, the fifth item of technology, is a source of recurring concern, as incorrect cutting can lead to serious injuries.^{3,7,10,15-17} There are many recommendations on how to make this cut, but the one considered most appropriate is the one that indicates that nails should be cut in a straight line along the top edge of the fingers.^{10,17} Three studies carried out in Brazil that assessed nail cutting showed that nail cutting is a problem. The first study highlighted that 75.2% of men had incorrect nail cutting, while in women it was 50.8%.²⁵

Differently, the second study showed that 26.3% of participants had inadequately cut nails, with women having twice as many problems.²⁶ The third study that also assessed nail cutting identified that 25.8% had an inadequate nail cut, but did not compare men and women.²⁷

Regarding the frequency of cutting, this topic is not much explored in the literature. The indication of this frequency depends on nail growth, which is individual. The judges who assessed the technology content suggested changing from “Do not let the nails be too long” to “Cut the nails whenever you consider it necessary, i.e., when the nail goes beyond the top line of the fingers”, which was considered clearer.

The sixth technology item, which addresses what to do with calluses and cuticles, was considered clear and relevant, with no suggestions for changes. Regarding guidance on removing calluses, some authors recommend removing them gently with sandpaper and pumice, without using sharp objects⁷ and others, and it is necessary to consult a health professional before taking any action.^{17,19} It is important not to use chemical agents or plasters.^{10,17} Regarding the cuticle, the advice is not to remove it. The educational technology “LISTEN, SEE, DO” option was to recommend not removing calluses and cuticles, understanding that the inappropriate use of instruments and/or products could worsen the situation.

The seventh item, which addresses the appropriate use of shoes, reached consensus among judges, all of whom agreed on its clarity and relevance. As previously mentioned, people often make an inappropriate choice of footwear type and size, with difficulty accepting the use of closed shoes in countries with a hotter climate. There are several studies that explore the choice of appropriate shoes, highlighting that purchasing these shoes is elementary. There are different strategies for this, with some new technologies being highlighted, such as those that determine plantar strength, delimitation of foot size, among others.^{3-4,8,17,26}

Another aspect studied is shoe quality. A study showed that more than 70% of people with DM use low-quality shoes, referring to Malaysia, the United Kingdom and the United States.²³ A study carried out in Maringá/PR showed that 96.3% of people did not wear shoes suitable for DM, although 56.3% wore closed shoes,²⁶ and another study showed a similar situation, with only 15% of participants wearing suitable shoes.²⁸ It is important to highlight that in underdeveloped countries with social inequality, the acquisition of this type of footwear may be inaccessible to a large portion of the population, and must be made available through public policies.

The use of socks, last item, presented clarity and relevance. However, some suggestions from judges were presented and added, such as guidance on changing socks after use,^{10,17,22,26} recommending the use of always clean socks as a protective factor for the feet. It is recommended not to wear shoes without socks due to the risk of falls and not to wear tight socks.^{10,29} The type of sock is another element of concern, with the recommendation to wear socks that are seamless, that are not too tight and that are made of wool or cotton.^{10,17,26}

CONCLUSION AND IMPLICATIONS FOR PRACTICE

The educational technology “LISTEN, SEE, DO” met the previously established content validity criteria and was considered by judges to have the appropriate composition of items, in addition to its sub-items being clear and relevant. This technology, in a synthetic way, recommends guidelines regarding feet observation; product to be used to wash feet and observe water temperature; how to dry and moisturize the feet; how to cut nails and instruments to be used; what to do with calluses and cuticles; suitable types of shoes and socks.

Nurses need to invest more in preventing diabetic foot by using new technologies that motivate people to prevent this complication. The availability of validated technology to develop health education for people with DM that uses strategies that encourage people in different ways (auditory, visual and kinesthetic) could contribute to changing people’s behavior so that they can carry out care preventive measures more appropriately focusing on items known to be relevant.

It is essential to invest in health policies that guarantee the conditions for preventing DM complications. Health services need to have available the necessary materials to carry out educational activities, such as the one proposed by the educational technology “LISTEN, SEE, DO”, which enable not only auditory, but also visual and kinesthetic stimulation. Its low cost and ease of access can be the difference in changing behaviors to provide care that effectively impacts diabetic foot prevention.

Otherwise, it is worth highlighting that one of the problems in providing care is its high cost for people with DM, who often do not have access to products such as neutral soap, moisturizing cream, shoes and special socks. This situation can be an impediment or restrictive in the provision of care, with the need to increase the availability of these products through the Brazilian Health System (*Sistema Único de Saúde*), understanding that the cost-benefit ratio would be favorable, as the costs of foot injuries far exceed all investments in prevention.

This study presents as a limitation the absence of nurses working in healthcare practice as judges, since it established doctoral training as an inclusion criterion, which restricted the selection of these professionals. However, each judge had knowledge about the topic at an advanced level and, in the future, the technology should be used by nurses in their care practice and assessed on its applicability. Furthermore, there is a need for validity with the target audience, i.e., with people with DM.

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