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Production of educational videos to raise awareness among people with Diabetes and the general population about the correct disposal of waste

Abstract

Diabetes mellitus increases every year, accompanied by advances in technology for its treatment. The production of waste from this aspect has become a problem for irregular disposal and, consequently, for environmental preservation. The study aims to describe the development and evaluate the impact of two educational videos on raising awareness of the correct disposal of healthcare waste generated at home by patients with diabetes mellitus and the correct separation of general waste. This work was carried out in the city of Ribeirão Preto, with the development of a case study composed of four stages: literature review; visits to five health units to check waste disposal by people with diabetes mellitus; the recording of two educational videos on healthcare waste and general waste; and finally, the development of a survey, containing 15 questions structured on a Likert scale about the two videos. Regarding the results, 46.15% had a master's degree, 69.23% responded “very satisfied” concerning the

content of the videos encouraging people living with Diabetes to carry out the correct management of healthcare waste at home, as well as 84.61% for the contribution of social education to the separation of general waste. We conclude that after validation of the videos by the judges, the strategy can contribute innovatively to reaching the attention of interlocutors, contributing to the construction of a conscious and sustainable society.

Keywords: Health education; public health; diabetes mellitus; environment.

Produção de vídeos educativos para conscientizar pessoas com Diabetes e a população em geral sobre o descarte correto de resíduos

Resumo

A Diabetes *mellitus* aumenta a cada ano, acompanhada da tecnologia para o seu tratamento. A produção de resíduos provenientes dessa vertente tem se tornado uma problemática para o descarte irregular e, consequentemente, para a preservação ambiental. O estudo tem como objetivo descrever o desenvolvimento e avaliar o impacto de dois vídeos educativos sobre a conscientização do descarte correto dos resíduos de serviço de saúde gerados em domicílio por pacientes com diabetes *mellitus* e a separação correta dos resíduos gerais. Esse trabalho foi realizado na cidade de Ribeirão Preto, com o desenvolvimento de um estudo de caso composto por quatro etapas: revisão da literatura; visitas em cinco unidades de saúde para verificação do descarte de resíduos por pessoas com diabetes *mellitus*; gravação de dois vídeos educativos sobre resíduos de serviço de saúde e resíduos gerais; e, por fim, a elaboração de um *survey*, contendo 15 questões estruturadas em uma escala Likert sobre os dois vídeos. Em relação aos resultados, foi observado que 46,15% possuíam mestrado, 69,23% responderam “muito satisfeito” em relação ao conteúdo dos vídeos em incentivar pessoas que vivem com Diabetes a realizarem o gerenciamento correto dos resíduos de saúde em domicílio, assim como 84,61% para a contribuição da educação social para a separação de resíduos gerais. Concluímos que, após a validação dos vídeos pelos juízes, a estratégia pode contribuir de forma inovadora para alcançar a atenção dos interlocutores, contribuindo para a construção de uma sociedade consciente e sustentável.

Palavras-chave: Educação em saúde; saúde pública; diabetes mellitus; meio ambiente.

Introduction

Diabetes mellitus (DM) is considered a major global public health issue and has been increasing over the past decades (KLONOFF *et al*. 2020; RODACKI *et al*., 2022; WHO, 2019). It is a chronic disease that affects approximately 537 million adults. The number of individuals living with diabetes is projected to rise to 643 million by 2030 and 783 million by 2045 (INTERNATIONAL DIABETES FEDERATION, 2021).

Patients diagnosed with DM require regular blood tests and daily insulin injections, which are commonly performed at home. This highlights the self-management of the disease by the patients themselves (PITITTO *et al.*, 2022).

Technological advancements in the treatment of DM have been steadily increasing. The devices used for the treatment and management of the disease (most of which are single-use and intended for individual application) contribute to the generation of waste. Materials produced in the home setting often become equivalent to medical waste. As a result, environmental sustainability has ceased to be merely a contemporary buzzword and has increasingly been embraced by healthcare institutions, governments, and corporate organizations throughout the world (KLONOFF *et al.*, 2020).

The connection between waste generation and DM treatment technologies underscores this urgency. Only 10% of the resulting waste is classified as hazardous, while the remaining 90% consists of packaging materials that could be recycled if properly separated (HEINEMANN; KRISIUNAS, 2019; KLONOFF *et al*., 2020; RODACKI *et al*., 2022; WHO, 2019).

The improper disposal of sharps used in insulin therapy can lead to environmental and public health issues, such as needlestick injuries affecting patients themselves, children, other family members, and members of the broader community (HASSAN *et al.*, 2021).

According to Collegiate Board of Directors Resolution No. 222, dated March 2018, Article 86, Section IX, states that sharps must be discarded in identified, rigid containers equipped with lids, and resistant to puncture, rupture, and leakage. Article 87 further specifies that containers used for the disposal of healthcare waste (Group E) must be replaced as needed or when the fill level reaches three-quarters (3/4) of their capacity, or according to the manufacturer's instructions. Manual emptying and reuse of these containers are strictly prohibited (BRAZIL, 2018; SANTOS; RUIZ, 2020).

Based on State Law No. 10782/01 and Ordinance 2,583/07, which ensured the provision of medications and supplies to individuals with diabetes in the state of São Paulo, it became evident that healthcare waste (HCW) is also generated in the home environment. Single-use disposable devices for the treatment of DM generate a significant amount of contaminated waste. This includes needles, lancets, insulin vials, syringes, glucose monitoring strips, insulin pens, disposable pumps, infusion catheters, glucose sensors, as well as batteries, glucose monitors, and device packaging, which contribute to other types of waste (BRASIL, 2001; BRASIL, 2007; KLONOFF *et al*. 2020).

A study conducted in Paraná indicates that the lack of guidance provided to patients with DM undergoing insulin therapy leads to the disposal of waste in regular household trash,

increasing risks to public health and the environment. This highlights that the management of healthcare waste generated in the home setting remains a topic requiring targeted guidance and interventions to protect workers and preserve the environment. (SANTOS; RUIZ, 2020).

It is observed that waste produced by the population is still improperly managed, resulting in negative environmental impacts. Therefore, there is a pressing need to reinforce proper waste disposal practices (BORBA; SILVA, 2021, QUEMEL *et al*., 2021; OLIVEIRA *et al.*, 2021; VELHO *et al*., 2021).

Considering that diabetes education is the primary tool to ensure self-care, the proper disposal of healthcare waste (HCW) generated in the homes of these patients is necessary. However, there are currently no specific guidelines regarding waste generated in the home setting, and recommendations for safe disposal are based on protocols established for healthcare facilities (PITITTO *et al.*, 2022).

Considering the aforementioned issue, this study aims to develop and validate two educational videos targeted at healthcare professionals and the general population, with a focus on individuals living with DM. The videos intend to raise awareness about the proper disposal of HCW generated in the home setting, as well as the correct segregation of general waste.

Material and Methods

With the purpose of achieving the aim presented, a case study was conducted, with a quantitative approach. (Yin, 2015) justifies that the legitimacy of such a study relies on multiple investigative strategies, as historical, experimental, and survey approaches alone are not sufficiently comprehensive. The case study addresses this by defining the case as a “contemporary phenomenon (the ‘case’) studied in depth and within its real-world context, especially when the boundaries between the phenomenon and context are not clearly evident” (YIN, 2015, p.17).

Furthermore, the robustness of a case study depends on a thorough literature review and the inclusion of theoretical propositions before data collection. The quality of the study design should meet four criteria (construct validity, internal validity, external validity, and reliability), which the researcher must strive to maximize. In addition, this study included a questionnaire developed in a virtual environment for the validation of the educational material. The research was conducted between August and December 2021, as part of a university extension project: USP Challenge: Sustainable Cities 202, in partnership with the School of Economics, Business, and Accounting at the University of São Paulo (USP), and was carried out in five stages.

Table 01: Study Stages (2024)

Stages	Procedure	Object
(1) Documentary Research	Brazilian healthcare waste management legislation (RSS)	Collegiate Board of Directors Resolution CONAMA, PNRS
(2) Literature Review	LILACS (Latin American and Caribbean Health Sciences Literature), MEDLINE (Medical Literature Analysis and Retrieval System Online), Virtual Health Library (VHL), and PUBMED Portal	Descriptors “Healthcare Waste”, “Diabetes Mellitus”, “Environmental Health Education”, “Healthcare Waste Disposal”
(3) Visits to UBS (Primary Healthcare Units)	4 Primary Healthcare Units (UBSs) in the Northern District of Ribeirão Preto	UBDS Sumarezinho (Cuiabá), USF Maria Casagrande Lopes, USF Núcleo 1, USF Núcleo 2.
(4) Videos Development	Based on the legislation and the information obtained during the visits	
(5) Survey with judges, users, and healthcare system professionals	Made available via online link	13 respondents: 1 healthcare service user; 5 professionals; 7 expert judges.

Source: Org: The authors (2024).

In the first stage, with the aim of understanding the home disposal habits of healthcare waste by patients living with DM and identifying the themes to be addressed in the educational videos, Collegiate Board of Directors Resolution No. 222, dated March 28, 2018, which

regulates Good Practices for the Management of Healthcare Waste, was used as a reference (BRAZIL, 2018). Additionally, an integrative literature review was conducted in August 2021, using the following databases: LILACS (Latin American and Caribbean Health Sciences Literature), MEDLINE (Medical Literature Analysis and Retrieval System Online), the Virtual Health Library (VHL), and the PUBMED Portal. The descriptors used were “Healthcare Waste,” “Diabetes Mellitus”, “Environmental Health Education,” and “Healthcare Waste Disposal.”

The review included articles and/or theses that incorporated the concept of “Healthcare Waste Disposal” in the title or abstract, in Portuguese, English, or Spanish. Studies addressing the same topic but involving children, as well as duplicate publications, were excluded. The search was limited to publications from the past five years.

The second stage involved selecting the sample and visiting healthcare service units in the municipality of Ribeirão Preto, São Paulo, to understand how patients with DM were instructed to dispose of healthcare waste at home. Twenty Primary Healthcare Units (UBS) located in the Northern District were contacted to confirm their operating hours and availability for the visits. Due to a lack of standardization across units, some allowed the visits, while others required official authorization documents to be approved by their internal committee. Thus, of the 20 UBSs contacted, 15 responded to the phone inquiry regarding operating hours.

The units that were visited and where interviews were conducted included: UBDS Sumarezinho (Cuiabá), USF Maria Casagrande Lopes, USF Núcleo 1, USF Núcleo 2.

In the third stage, two videos were produced using the video and audio editing software Davinci Resolve, with footage captured using a Sony HRX MC 2500 camera. The videos were structured based on two distinct scripts and recorded in a space provided by the Ribeirão Preto School of Nursing at the University of São Paulo [*Universidade de São Paulo*]. The first video aims to raise awareness about the proper disposal of healthcare waste generated at home by patients with DM, based on Collegiate Board of Directors Resolution No. 222, dated March 28, 2018, issued by the Brazilian Ministry of Health. It also includes guidance on the separation of general waste for selective collection, aligning with broader goals of environmental education. The second video focuses primarily on general environmental education, specifically the proper separation of household waste for selective collection, while still providing information relevant to the diabetes community. Thus, both materials share overlapping educational objectives, seeking to promote accessible and engaging awareness for the general population.

The fourth stage involved the development of a web survey, which followed the guidelines of The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) ensuring

data quality and interpretability (EYSENBACH, 2004; BONI, 2020). A convenience sampling method was used. A 15-item Likert-type scale was applied, divided into two sections, and administered through the Google Forms® platform. The collected data were anonymous and untraceable, and the goal was to evaluate educational technologies. After participants accepted the invitation via the WhatsApp® application, they were sent the Informed Consent Form, followed by the instrument itself along with links to both educational videos embedded within the questionnaire. For the validation of the audiovisual material, expert judges were selected through non-probabilistic sampling based on the criteria of relevance, structure, objectives, and presentation. Inclusion criteria included being a professional in the field of health or communication and scoring at least five points according to Fehring's classification system (MELO *et al.*, 2011). Fehring's systematization aims to assess the competence of expert judges concerning the topic addressed, classifying them according to their professional qualifications based on the following criteria: PhD degree (4 points), Master's Degree (3 points), publication in an indexed journal on the topic of interest (2 points), specialization in the area of interest (2 points), a minimum of five years of clinical practice in the relevant field (2 points), and participation in a scientific event on the topic of interest within the last two years (1 point). Participants who did not complete the web survey in full were excluded from the study.

The responses were analyzed quantitatively through percentage calculations, by multiplying the number of items in the evaluation instruments by the number of evaluators, thereby determining the maximum possible score. Items for which there was agreement equal or greater than 70% in the "very satisfied" and "satisfied" categories were considered validated. This measure was referred to as Content Validity Index (CVI) [*IVC - Índice de Validação de Conteúdo*].

Results

Stage 1

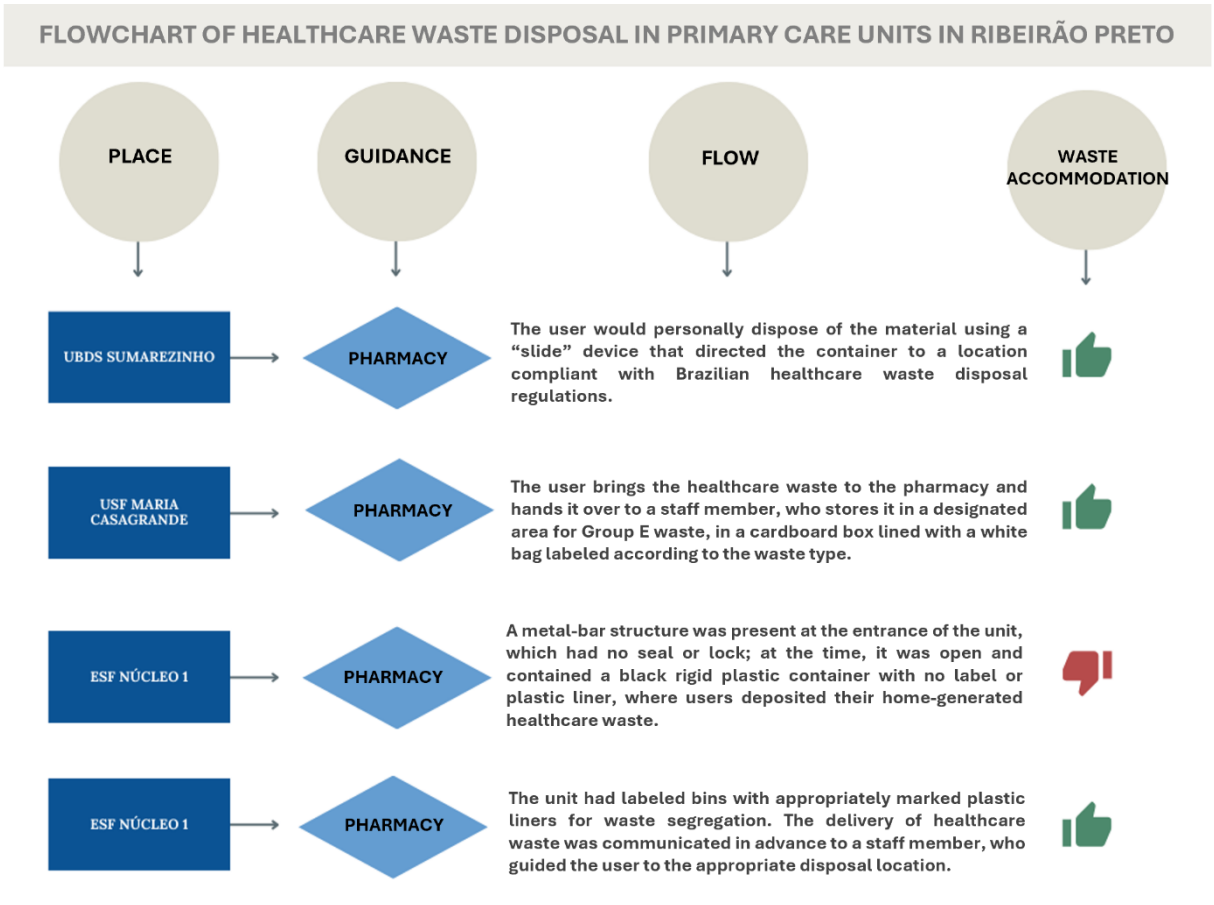
During the literature review process, the search yielded eleven national articles, five international articles, six national protocols, and three international protocols, totaling twenty-five documents selected for full-text reading by the authors. The topics that emerged from the reviewed materials served as the basis for defining the themes to be addressed in the videos. These included: proper handling and management of sharps at home by individuals with DM; appropriate disposal of sharps; selection of suitable containers for sharps disposal; correct segregation of healthcare waste at home; correct separation of general household waste; proper external disposal of healthcare waste; proper routing of recyclable and organic waste;

creating a safe environment; practicing environmental sustainability; and promoting environmental, social, and health education.

Stage 2

Visits were conducted at four healthcare units in the city of Ribeirão Preto, São Paulo, from September 2021 to October 2021. These included: three Family Health Strategy (FHS) [ESF - *Estratégia Saúde da Família*] units and one District Basic Health Unit (DBHU) [UBDS - *Unidade Básica Distrital de Saúde*]. It was observed that there was a lack of standardization in the guidance provided to healthcare service users regarding the disposal of healthcare waste in the home setting.

Figure 1: Flowchart of Healthcare Waste Disposal in Four Healthcare Units in the Municipality of Ribeirão Preto (2024)



Source: Org: The authors (2024).

The collection of materials from the units was carried out periodically by a private company contracted by the Municipal Government. All waste was weighed in kilograms and subjected to double-checking.

Stage 3

The videos were produced in the city of Ribeirão Preto, São Paulo, in a space provided by the Ribeirão Preto School of Nursing at the University of São Paulo [*Universidade de São Paulo*], specifically within the “Prof. Dr. Maria Cecília Puntel de Almeida” Teaching and Research Laboratories Complex. The production was carried out by two volunteer undergraduate students from the Bachelor's Degree in Nursing program at the same institution. Video 1 aimed to raise awareness about the proper disposal of healthcare waste generated at home by patients with diabetes mellitus, based on national healthcare waste disposal policies (BRAZIL, 2018). It also presented guidelines for the separation of general household waste for selective collection, a topic aligned with broader goals of environmental education. Video 2 focused on general environmental education regarding the proper separation of household waste for selective collection, while also including specific information for the diabetes community. Therefore, both materials share common educational objectives, aiming to promote engaging and accessible awareness for the general population.

During the script development process, the focus was on clearly presenting correct practices for waste separation and disposal through simple, sequential steps. The intention was to avoid illustrating unfeasible or incorrect practices, even as negative examples, as their inclusion could confuse part of the audience and potentially have the opposite effect by inadvertently encouraging such behaviors. Another important aspect considered was the creation of the setting, which portrayed the everyday routine of a person living with diabetes at home. The goal was to evoke a sense of intimacy, conveying warmth and recognition through the characters depicted.

Video 1, which focused on the disposal of healthcare waste in the home setting, had a duration of 3 minutes and 9 seconds. The materials used to portray diabetes management and treatment included: glucose test strips, insulin pens, lancets, cotton, black trash bags, insulin vials, syringes with needles, a fabric softener bottle, a chocolate milk container, and a PET bottle.

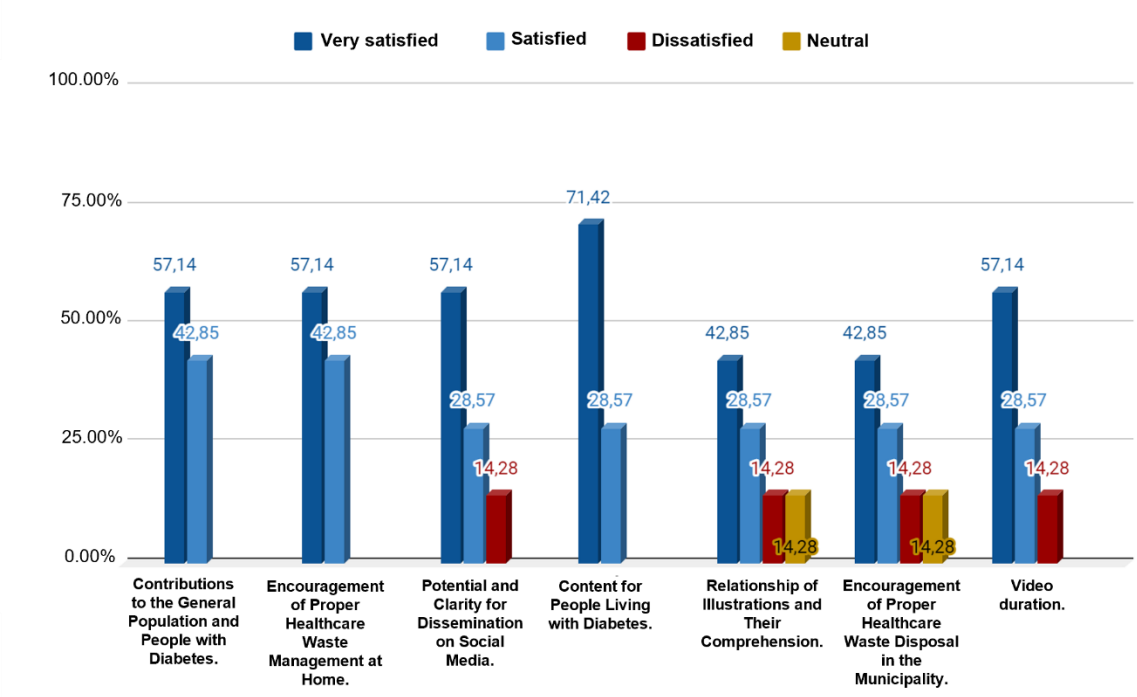
Video 2, which focused on the correct disposal of general and recyclable waste, had a duration of 3 minutes and 23 seconds. The materials used in the production included: an empty milk carton; an empty cookie package; an empty PET bottle; banana peel (or other organic waste); two trash bins (organic and recyclable); a hand towel; some type of glass waste (e.g., bottle); some type of paper waste (e.g., notebook); some cardboard waste (e.g., shoebox); batteries; trash bags; and a container with healthcare waste.

Regarding the duration of the videos, they were intentionally designed to be short, to maintain the audience's attention. The language used was accessible and relatively simple, so as not to hinder the public's understanding.

Stage 4

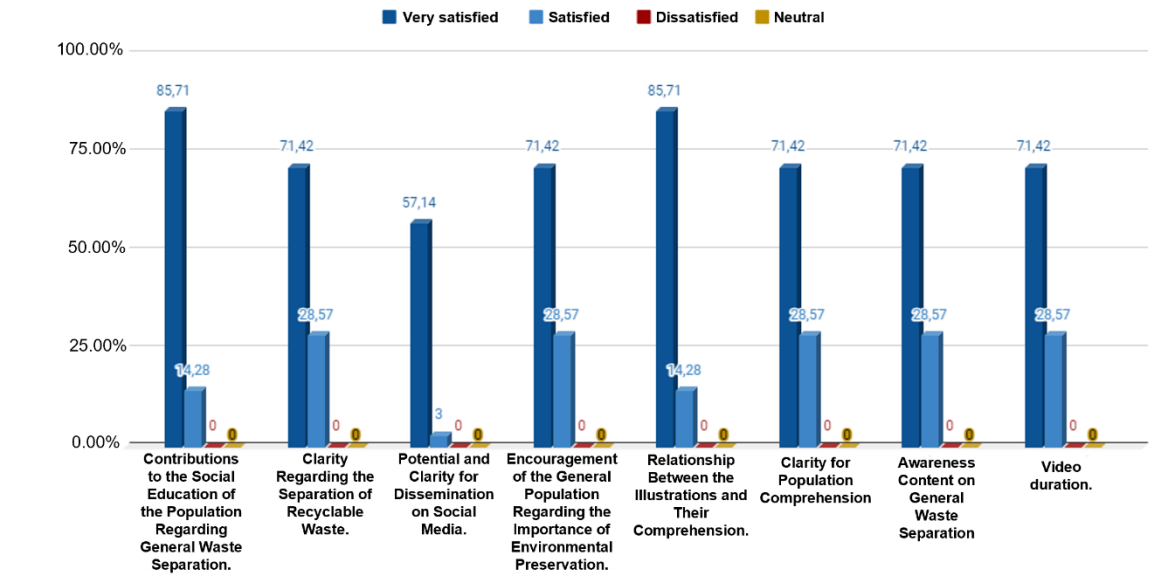
The evaluation panel consisted of six individuals: five with master's degrees and one with incomplete higher education, all aged between 24 and 52 years and professionals in the health field. The validation of Videos 1 and 2 was conducted through a questionnaire hosted on Google Forms®, aimed at collecting participant satisfaction data. The questionnaire was sent to the six panel members, who were instructed to watch the videos and respond to Likert-scale items. For Video 1, the response options were: "very satisfied," "satisfied," "neutral," "dissatisfied," and "very dissatisfied."

Graph 1: Perceptions of Video 1: "How to Correctly Dispose of the Waste Generated by People with Diabetes?"



Source: Org: The authors (2024).

Graph 2: Perceptions of Video 2: "How to Separate Recyclable Waste?"



Source: Org: The authors (2024).

Discussion

This study aimed to develop and validate educational technologies in accordance with the recommended methodological cycles for their implementation. Validation, reliability, and legitimacy may foster behavioral change among the target population, while also promoting continuing education among healthcare professionals, educating the general population, and enabling new perspectives for intervention in how health care is conceptualized, managed, and delivered (ROSA *et al.*, 2019).

It is evident that the lack of information among the population contributes to the improper disposal of waste, especially among individuals undergoing treatment for diabetes mellitus (AGUIAR et al., 2022). This suggests that standardizing and reinforcing guidance may be one way to help prevent incorrect disposal practices. Regarding healthcare waste: “when generated in the household environment, where there is no oversight or handling by trained professionals for proper disposal, it may be discarded with regular household trash and sent to landfills, where waste collectors are prevalent and may easily be injured or contaminated due to the high presence of sharp, piercing, and potentially infectious objects” (MARTINS et al., 2022). Thus, the creation of the videos in this study aimed to promote health and environmental education, providing information to help both healthcare professionals and service users understand the importance of properly and safely separating and disposing of healthcare and general household waste.

Furthermore, (MARTINS *et al.*, 2022), in a study conducted in the state of Minas Gerais, stated that their objective was to disseminate information to the population regarding the disposal of medical waste, aiming to prevent disposal in household trash and to encourage individuals to properly return healthcare waste to the health unit closest to their residence. In this regard, it is extremely important that the scientific knowledge conveyed through the videos be shared by users not only for their own understanding but also passed on to family members and friends, raising awareness about the importance of waste separation and proper final disposal.

Another important aspect is that the material also aims to reach healthcare professionals, as they act as educators and, in this role, should guide each patient who comes to the health unit, not only in managing the disease but also in informing them about proper waste disposal. “Ongoing education for all healthcare professionals on the proper management of healthcare waste is essential for reducing the volume of waste generated, financial costs, incorrect disposal, improper allocation, and for increasing reuse and recycling. In this way, all professionals must be familiar with the Healthcare Waste Management Plan (PGRSS) and its stages. It is through knowledge that correct actions and habits are consolidated, ultimately improving the quality of healthcare waste management” (SIQUEIRA, 2022 p.4 apud HOFFMANN, SANTANA; FREITAS, 2021).

A literature review sought to gather evidence on how supplies related to the treatment of insulin-dependent diabetes mellitus patients are disposed of in Brazil. It was found that such healthcare waste is often improperly discarded, with most being sent to regular trash, posing potential health risks to urban sanitation workers and consequently harming the environment (AGUIAR *et al*., 2022; VELHO *et al*., 2021; QUEMEL *et al*., 2021). Although our study did not observe this practice, a concern arises due to identified initial gaps in the disposal process, suggesting that the risk of failure at the final stage could be considerable.

In this context, where the provision of supplies and medications to patients for the treatment of diabetes mellitus is essential, the use of ongoing educational interventions is necessary both for the general population and healthcare professionals, aiming to prevent accidents involving sharps and to promote environmental protection (BRAZIL, 2001; BRAZIL, 2007; BRAZIL, 2018; NEVES et al., 2020).

The need for educational interventions in this context is evident, as due to the lack of household healthcare waste management programs and insufficient legislation, many patients end up disposing of supplies used for diabetes mellitus treatment in inappropriate locations (SANTOS; RUIZ, 2020). Thus, these interventions have the potential to change the habits of

many individuals regarding waste separation at home, gradually encouraging them to patiently sort each category of waste, including those related to diabetes treatment.

The results highlight the importance of educational programs at this moment, as the world experienced a critical period during the COVID-19 pandemic, during which various protocols were modified to ensure public safety by offering protection and prevention strategies for the most vulnerable populations. One such strategy was the provision of continuous-use medications for extended periods and social distancing measures, which also affected the frequency of medical appointments and visits to healthcare facilities to avoid virus exposure. Lack of infrastructure and social inequity remain obstacles to the successful outcomes of these measures (BARONE *et al*., 2021). The educational videos produced on waste disposal can greatly contribute to reducing waste generation. Unlike printed materials such as informational leaflets, which users and healthcare professionals might not read and which would themselves generate additional waste, videos align with the research objective by raising awareness among healthcare professionals to promote health education and assist the population in proper disposal practices, thereby minimizing environmental risks and protecting others.

In the learning process, combining playful elements with the cognitive system are fundamental strategies for better understanding of the proposed content. However, the use of materials such as booklets, pamphlets, and other printed media has not effectively contributed to the target population (SOUZA *et al*., 2021; GONÇALVES *et al*., 2022). Besides the high printing costs, there is also the environmental impact when these materials are discarded (KLONOFF *et al.*, 2020). This approach tends to contribute economically to the healthcare system, the environment, and accessibility to the material, which may be disseminated through a “snowball” effect.

The videos aim to closely simulate the daily routine of a person living with DM, highlighting the disposal of healthcare waste and general waste, as well as their proper separation. The goal is for the viewer to feel engaged with the presented material, becoming an active participant in their own learning process. Similarly, (ARRM *et al*., 2021) emphasizes the importance of engaging individuals by incorporating health information with motivation and interactive strategies.

Conclusion

At the conclusion of this study, the validation of the videos by the evaluators was found to be adequate, confirming their suitability for educational interventions aimed at the general population. This project demonstrated how nursing professionals can develop creative and educational materials to capture citizens’ attention in an innovative way, stimulating

curiosity and engagement among viewers. Given that technology allows for rapid dissemination, such materials can reach a broader audience. It is expected that the topics addressed in the videos will contribute to improved waste management and environmental sustainability. Therefore, it is essential for nursing to invest in the development of educational materials aimed at raising awareness, not only regarding environmental issues but also individual health, always considering collective well-being and social welfare.

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