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Construction of a mobile application for wound assessment for nursing students and professionals

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ABSTRACT

Objective: To develop a mobile application for wound analysis that includes the TIMERS framework, a human body map, and wound assessment criteria for nursing professionals and students. **Method:** This study employed a methodological research approach focused on technological development. The research was conducted in three stages: the pre-project phase, the structuring of the research through a literature review on the topic, and the evaluation phase, which involved developing the prototype. **Results:** A prototype of the application, Avalia Feridas, was initially created, limited to the Android operating system. This app includes the TIMERS framework, wound assessment criteria, and a human body map. The application aims to enhance nursing care by providing individualized interventions, thereby contributing to the wound healing process. **Conclusion:** The application supports the development of critical thinking in wound assessment, offering guidance to nursing students and professionals in their practice. The next objective is to validate the app, with the goal of making this tool available to the public.

DESCRIPTORS: Technology. Nursing care. Nursing assessment. Enterostomal therapy. Wounds and injuries.

Construção de aplicativo móvel de avaliação de feridas para acadêmicos e profissionais de enfermagem

RESUMO

Objetivo: Desenvolver um aplicativo móvel para análise de feridas, contemplando o acrônimo TIMERS, mapa do corpo humano e os critérios de avaliação de feridas para profissionais e acadêmicos de enfermagem. **Método:** Pesquisa metodológica com produção tecnológica. A pesquisa dividiu-se em três etapas: pré-projeto, estruturação da pesquisa por meio de revisão da literatura sobre o tema e avaliação do trabalho com o desenvolvimento do protótipo. **Resultados:** Criou-se inicialmente um protótipo restrito ao sistema *Android*. O Avalia Feridas possui em seu arcabouço a ferramenta TIMERS, os critérios de avaliação de feridas e o mapa do corpo humano, assim busca favorecer melhor assistência de enfermagem, propiciando condutas individualizadas e colaborando com o processo de cicatrização. **Conclusão:** O aplicativo contribui para formar um senso crítico na avaliação de feridas, direcionando o acadêmico e o profissional de enfermagem na sua assistência. Posteriormente, o objetivo é validar o *app* para disponibilizá-lo ao público.

DESCRITORES: Tecnologia. Cuidados de enfermagem. Avaliação em enfermagem. Estomaterapia. Ferimentos e lesões.

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Construcción de una aplicación móvil de evaluación de heridas para estudiantes y profesionales de enfermería

RESUMEN

Objetivo: Desarrollar una aplicación móvil para el análisis de heridas, incluyendo el acrónimo TIMERS, un mapa del cuerpo humano y los criterios de evaluación de heridas para profesionales y académicos de enfermería. **Método:** Investigación metodológica con producción tecnológica. La investigación se dividió en 3 etapas: anteproyecto, estructurando la investigación mediante una revisión de la literatura sobre el tema y evaluación del trabajo con el desarrollo del prototipo. **Resultados:** Inicialmente, se creó un prototipo restringido al sistema Android. "*Avalia Feridas*" cuenta con la herramienta TIMERS, los criterios de evaluación de heridas y el mapa del cuerpo humano. Así, la aplicación busca promover una mejor atención de enfermería, brindando conductas individualizadas, contribuyendo aún más con el proceso de cicatrización. **Conclusión:** La aplicación contribuye a la formación de un sentido crítico en la evaluación de heridas, brindando orientación a académicos y profesionales de enfermería en su cuidado. Posteriormente, el objetivo pasa a ser la validación de la aplicación para ponerla a disposición del público.

DESCRIPTORES: Tecnología. Atención de enfermería. Evaluación en enfermería. Estomaterapia. Heridas y lesiones.

INTRODUCTION

Currently, technology is driving significant advancements in various aspects of health care, including patient care, research projects, and improving teaching methods. One of the areas of health care that has expanded with the help of technological tools is stomal therapy. Established as a nursing specialty in the United States in 1950, stomal therapy has since spread throughout the world and is now essential in the treatment of wounds, ostomies, and incontinence[1].

Stomal therapy has come a long way to become a field rich in innovative approaches and scientific foundations. Early records of the first wound care interventions were based on empirical, magical, and humoral knowledge. The classical triad of interventions became a widely used method according to some Sanskrit documents dating back to 2000 B.C. This technique involved washing the wound, covering it with plasters (made of copper, zinc, milk, bread, honey, etc.) and protecting it[2].

In the 18th century, significant events paved the way for advances in wound management techniques. The discoveries of scientist Louis Pasteur (1822-1895), who proved the existence of microorganisms and helped develop Germ Theory, led to a better understanding of infection. This knowledge was later supported by the importance of handwashing with antiseptics, a theory advocated by Semmelweis (1818–1865)[3].

In the 1980s, the United States and several European countries began to develop tools to assess wounds with greater precision and principles, leading to the revision of protocols and the creation of new dressing techniques. Today, technology has introduced a wide range of new products and procedures to the field of stomal therapy. However, nurses without specialized training often struggle to provide accurate care. This difficulty begins with wound assessment; if the assessment is incorrect, it leads to poor planning and the goal of wound healing may be delayed or even not achieved[4].

One of the most important globally recognized tools, validated in Brazil and focused on the assessment of wound healing, is the TIME framework. TIME is an acronym introduced in 2003, developed by a group of medical and nursing experts specialized in wound care. TIME was later revised and published in 2004. The tool outlines a specific sequence for assessing the wound bed: T (tissue) evaluates tissue types, I (infection) addresses infection and/or inflammation, M (moisture) evaluates exudate and moisture levels, and E (edge) examines the wound edges[5].

The TIME framework focuses on specific wound parameters, so if a wound is not responding to treatment or healing slowly, other factors that may be influencing the outcome need to be identified. Therefore, TIME has been updated to include repair/regeneration (R) and social (S) factors. The new TIMERS framework provides guidelines for wound assessment parameters, when to consider advanced adjunctive therapies, and factors that may slow the healing process[6].

The use of the TIMERS framework in stomal therapy provides a holistic view of the patient, promotes best practices, and enables the creation of a scientifically based plan for delivering quality patient care.

The idea for this research arose from the authors' experiences as nursing students during their extracurricular practicum experiences. Challenges began with patient assessment, followed by the decision-making process for the appropriate course of action. During this time, the authors searched the app stores on both Android and iOS platforms for a tool that could assist with comprehensive patient assessment. However, they found that the available applications were limited and did not provide a holistic approach to assessment, treatment decisions, and wound progression. Therefore, the development of a tool that guides users in initiating patient care, improves documentation of wound progression, and assists in the decision-making process is paramount to the delivery of quality care. This highlighted the need for a tool that addresses these needs and provides an innovative, comprehensive model to support more effective wound assessment and management.

In addition to improving the quality of care for patients with wounds, applied technology also facilitates the dissemination of knowledge accessible to any nursing student or professional. Therefore, this study aims to develop a mobile application that incorporates the TIMERS assessment framework along with clinical wound assessment criteria. The application will also include a map of the human body that will allow users to topographically locate lesions, thereby contributing to the education of the study target audience.

Through a literature review, the challenges were addressed and corresponding practices were improved, leading to the goal of creating an accessible educational tool focused on wound assessment. Therefore, after analyzing the contributions of technology to health care, this study defined its technological tool through the development of a mobile application.

Based on this context, the following guiding question was formulated How can the creation of a mobile application contribute to the education and learning of nursing students and nurses? The aim of this study was to develop a mobile application for wound analysis that incorporates the TIMERS framework, a human body map, and wound assessment criteria for nursing professionals and students.

METHODS

This study is methodological in nature, focusing on the technological development of a mobile application. It was conducted within the facilities of a private higher education institution (HEI) in the state of Piauí, Brazil, by nursing students in collaboration with information technology (IT) students. The application includes features such as the TIMERS framework, a human body map and wound assessment criteria.

In order to implement this project, the undergraduate nursing and IT programs were integrated. At the beginning of this study, several criteria for participation were established: IT students from the eighth semester on, or those who had already graduated, with experience in developing or beginning to create applications (apps). Two IT students participated in the development of the application under the supervision of the course coordinator.

Based on the technological development model by Filatro e Cairos[7], this work was carried out in three phases:

1. Pre-project, which involved the initial planning of the research, choosing the topic, and selecting publications for the theoretical framework;
2. Research structuring, which focused on the selection of content through the identified publications, the construction of tables, the selection of IT students for the technological development of the application, and the evaluation of the prototype's performance; and
3. Research finalization.

The content of the Avalia Feridas app is based on the TIMERS framework, with information organized according to each letter of the acronym. It includes assessment criteria divided into ten sections to guide the nurse or student in wound assessment. In addition, the app includes a human body map that anatomically illustrates the areas to help document wound progression. The research content, such as photographs, was drawn from existing literature, so there was no need for ethics committee approval.

For the theoretical foundation of the app, both physical and digital books in the field of stomal therapy were used, and these sources are cited in the tables of contents of the app. In addition to books, databases such as the Virtual Health Library (BVS), Scientific Electronic Library Online (SciELO), Latin American and Caribbean Health Sciences Literature (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed (PubMed Central) were used. The search included descriptors such as technology, nursing care, and nursing assessment, and covered the period from August 2022 to April 2023.

Technological development

According to the requirements of the application, the Flutter framework was chosen. Flutter is an open-source user interface development kit maintained by Google. It uses Dart as its programming language, allowing the creation of applications that can be natively compiled across multiple operating systems, including Android, iOS, Windows, Mac, Linux, Fuchsia, and Web, all from a single code base with only minor customizations.

The application code was written using Visual Studio Code (VSCode), an integrated development environment (IDE) that simplifies application development by providing several tools in a single program. These tools include support for code debugging, integrated Git version control, and code refactoring.

Figma was used to design the app's layout because it is a vector graphics editor and prototyping tool that promotes real-time team collaboration. Figma also facilitates usability testing by providing screen recording and commenting capabilities, allowing developers to quickly visualize how the app will look.

GitHub was chosen as the source code hosting and version control platform to track source code changes and facilitate collaboration among developers. GitHub provides repositories for storing and managing source code and is widely used by the software development community for its collaborative working environment and efficient code management. Firebase was chosen as the database to store the necessary information such as logins, images, and data related to the TIMERS categories. Firebase also supports development by allowing developers to skip the backend development stage, streamlining the process.

RESULTS

The app Avalia Feridas was named to reflect its core function — to provide wound assessment tools that help determine interventions to promote better healing. This app is classified as hard technology because it involves the development of software that provides nursing students with a tool to guide them during their internships as well as serving as a reference for nursing professionals during their practice[8].

Figma was chosen for the app's interface layout, as it supports both Android and iOS platforms. However, for the scope of this project, the app was developed for Android only. Firebase was used to develop the mobile application because of its simplicity, ability to quickly create a free app, and low data consumption.

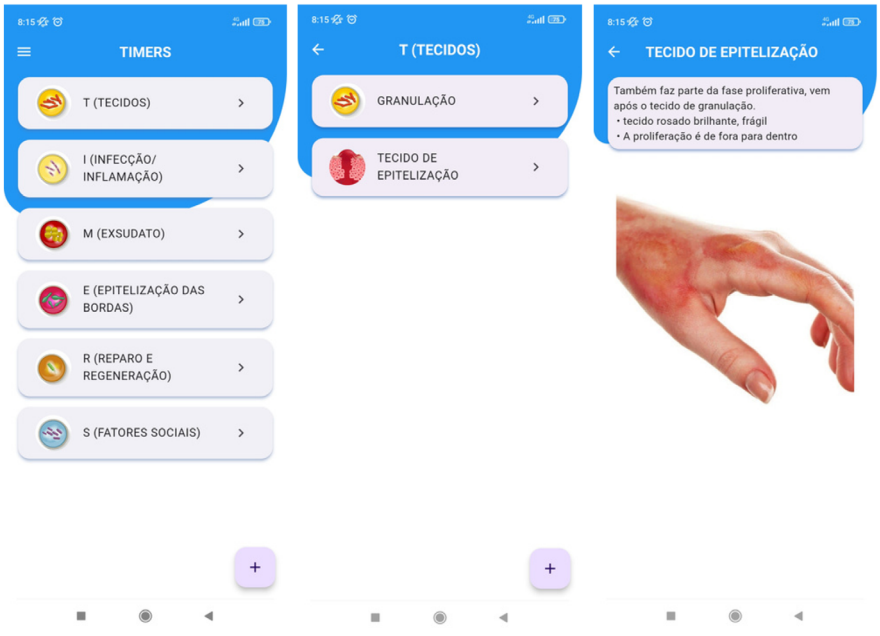
Figure 1 illustrates the initial screens of the application, beginning with the login screen, where the user must enter their registered email and password. Once logged in, the user is directed to the main menu of the app, which includes options such as the TIMERS acronym, wound assessment criteria, treatment/drainage options, wound progression, and a human body map, as per Figure 1.

When the user selects the TIMERS option, a list of each letter of the acronym appears, along with its corresponding content. For example, clicking on "T" (tissue) takes the user to information about the types of tissue found in a wound, such as granulation, epithelialization, and necrosis. Each tissue type is listed with its characteristics and illustrated to aid in identification, as shown in Figure 2.

The Avalia Feridas app also includes clinical criteria for wound assessment. The most relevant criteria are: complexity, etiology, anatomical location, exudate, contamination level, tissue loss classification, type of tissue present in the wound bed, wound edges/margins, periwound skin, measurement, and pain. The goal is to expand the user's understanding of the healing process so that when the assessment is complete, the user will know how to proceed and manage the wound.

Source: Prepared by the authors, 2023.

Figure 1. Login screen and main menu of the Avalia Feridas app. Teresina (PI), Brazil, 2023.



Source: Prepared by the authors, 2023.

Figure 2. Screenshots of the TIMERS acronym. Teresina (PI), Brazil, 2023.

As shown in Figure 3, when the user clicks on the evaluation criteria, they are taken to a screen that displays the ten criteria. Clicking on a criterion brings up detailed information. Criterion 5 (level of contamination) differs from the others in that it includes content already covered in the TIMERS framework. Therefore, a shortcut has been created to take the user to the "I" (infection/inflammation) section of TIMERS, providing a convenient way to resolve doubts. The last criterion offers a unique feature for pain assessment: the app provides an image illustrating the facial pain scale, which enhances the patient assessment process.

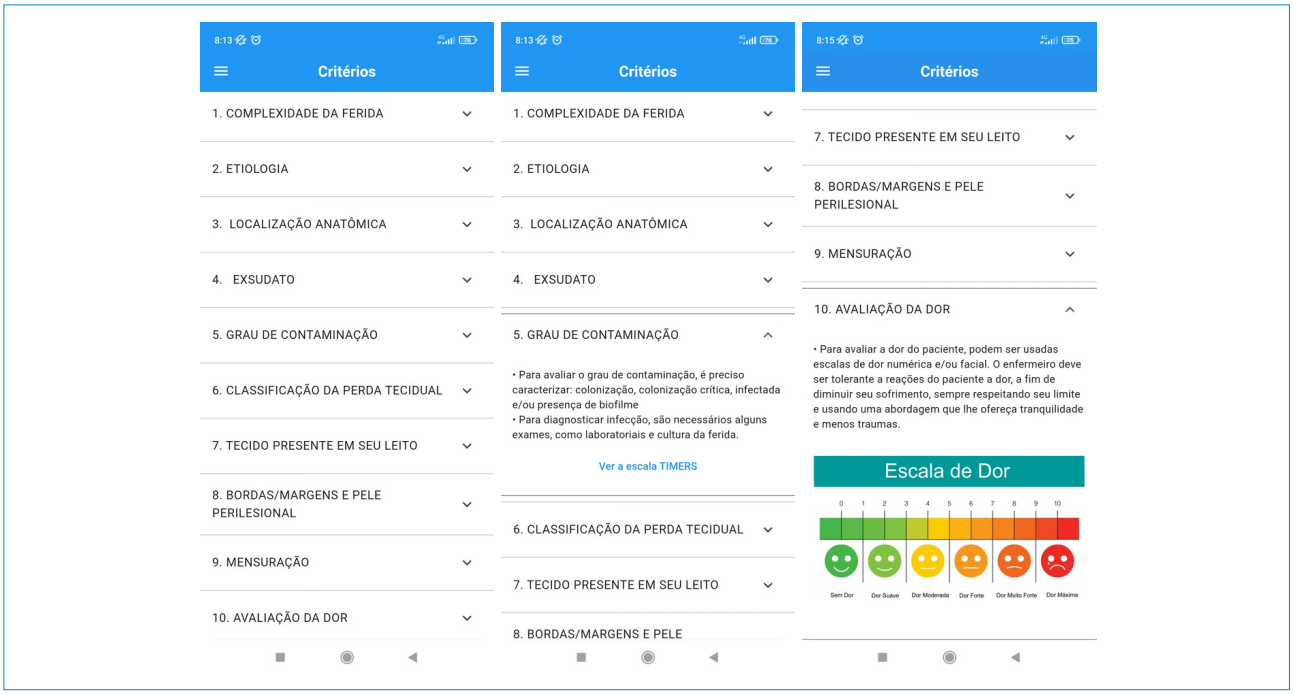
Finally, Figure 4 shows a map of the human body divided into the head, torso, upper limbs, and lower limbs. Clicking on a specific region allows the user to zoom in on the image, providing anatomical knowledge of the human body and enabling an accurate topographical description of the wound and its location. This approach supports a detailed, clear, objective nursing report.

The content of the app was derived from the research, which was then selected and organized into tables. This process allowed the listing of information for each topic and gave the IT students the guidance they needed to develop the Avalia Feridas app: https://1drv.ms/w/s!Aoii0_E56ZpNjVgiVt0j3oM6WjrI.

DISCUSSION

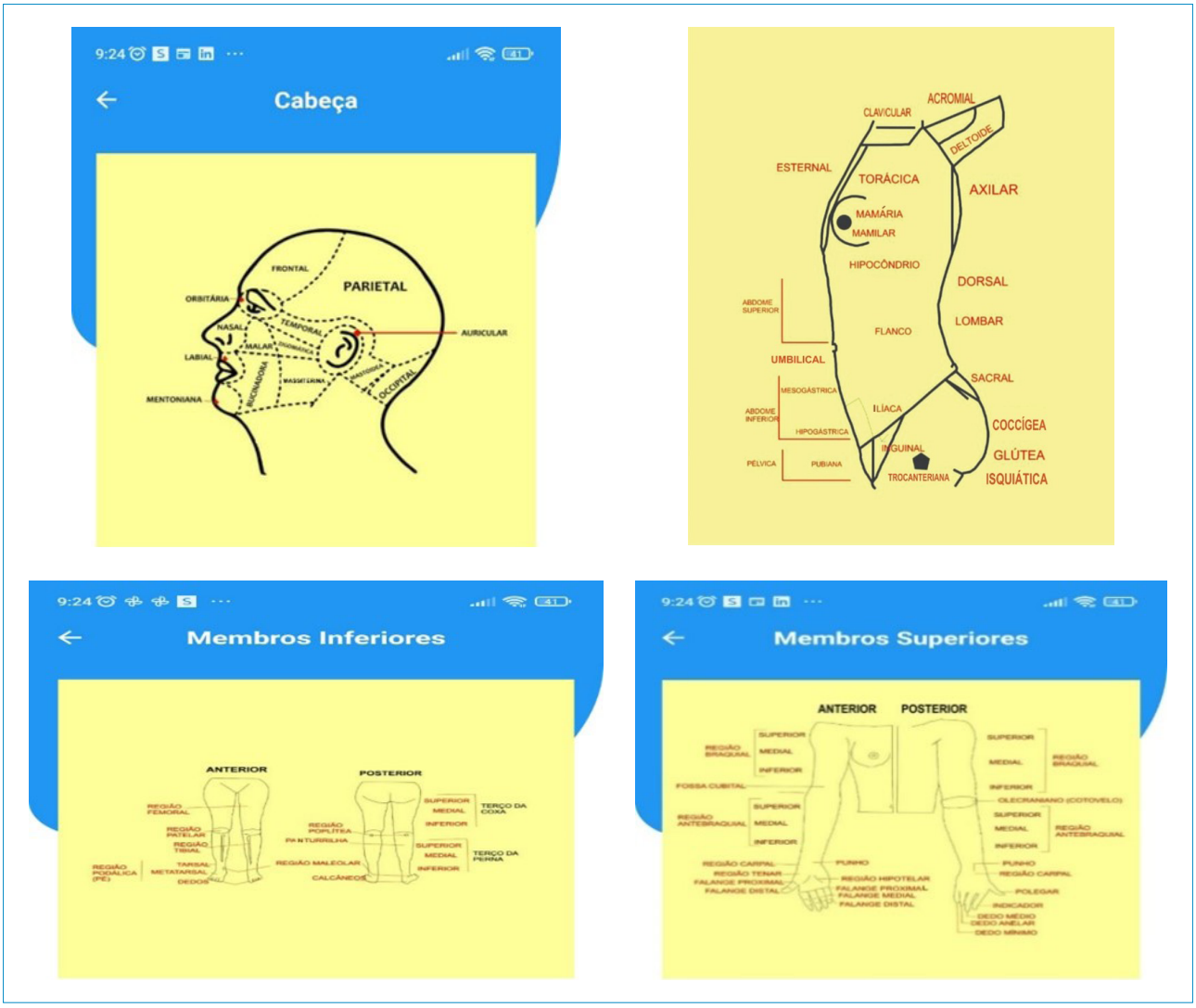
Since the dawn of human life, technology has evolved with us, influencing everything from the places we live to the way we live. In the context of health care, technology has enhanced the interaction between patients and professionals, providing various tools to support care. In addition, because it operates on a global scale, technology facilitates the training and continuing education of health care workers[9].

Mobile health (mHealth) has gained significant traction, particularly in the research community. mHealth refers to medical and public health practices supported by mobile devices and is seen as a key driver in the dissemination of health information to the general population. According to research supported by the World Health Organization (WHO), 83% of member states offer at least one type of mobile health service. Among the most widely used are free emergency phone services (55%) and mobile telemedicine (54%)[10-12].



Source: Prepared by the authors, 2023.

Figure 3. Clinical criteria screens for wound assessment. Teresina (PI), Brazil, 2023.



Source: Prepared by the authors, 2023.

Figure 4. Screenshots of the human body map. Teresina (PI), Brazil, 2023.

In Brazil, mHealth has not yet reached the same scale as in first-world countries. However, its use could significantly improve service delivery within the Unified Health System (SUS) and reduce the burden on the network. The Brazilian health care system provides free care not only to its own population but also to foreigners, serving an average of 200 million people[10].

Currently, there are 43 mobile applications associated with municipal and state health departments and the Ministry of Health in Brazil. However, according to research, these applications are not widely used, with an average rating of 3.5. The most widely used mobile health service is the Centro de Valorização da Vida (CVV), which provides psychological support to patients in need[11,13].

Epidemiologically, there is a constant incidence and prevalence of wounds, ostomies and incontinence due to underlying medical conditions. Numerous surgeries are performed daily, and due to various factors, many patients experience problems with surgical wound closure, often requiring secondary or tertiary healing, resulting in dehiscence. This often results in complex healing processes, underscoring the growing need for stomal therapists and the development of more technological products that encompass assessment, treatment, and education[14].

There is a noticeable trend toward the development of technological tools for this specialty, whether to educate the community in need of such care, to facilitate the delivery of care as demonstrated by this research, or to innovate in terms of products or techniques that improve treatment[15,16].

In health care, different types of technologies are used: soft technologies (interpersonal relationships), soft-hard technologies (structured knowledge, such as theories), and hard technologies (material resources). These technologies are also used in dentistry, starting with the reception of the patient and continuing with a relationship-based approach. During this interaction, patient history is taken, a diagnostic hypothesis is developed, theoretical knowledge is applied, and materials are used in the treatment. This reflects the use of soft, soft-hard, and hard technologies[17].

The development of care applications plays a critical role in modernizing and improving health care. By integrating technology into clinical practice, these tools offer significant benefits. First, apps can streamline the documentation and management of patient information, allowing nurses to quickly access relevant data while providing care.

Nursing apps not only improve professional efficiency but also promote safer, more personalized, and patient-centered care, reflecting the ongoing evolution of clinical practice supported by technology. These benefits were demonstrated in a study that developed an app for nursing history and diagnosis, which are essential steps in daily nursing care[18].

This study highlighted the importance of involving IT students to ensure that the prototype was developed accurately and securely, demonstrating the strong link between health care and technology. IT enables the rapid dissemination, diffusion, and updating of knowledge, which supports decision-making in health care[9,15].

The app is designed to assist nursing students and professionals in wound assessment based on the TIMERS classification scale for complex wounds[19]. The content is a combination of theory and practice derived from the literature, presented in a clear, concise manner by using real images taken from books to create a realistic scenario and enhance user interaction with the tool[9,15,16].

Avalia Feridas also allows the identification of causative and aggravating factors, the establishment of treatment plans and prevention strategies. As technology advances, more and more mobile apps are being created, as research shows that these tools are effective in helping health care workers diagnose and treat patients, as well as the overall public. For example, the MirOculus app can diagnose up to 45 types of cancer. This app was developed in 2012 as part of a National Aeronautics and Space Administration (NASA)-sponsored program at Singularity University[20].

Based on the literature, several applications have been developed with a similar focus on wound assessment. These examples demonstrate that, in addition to a thorough patient history, professionals, or students must be able to assess the wound, from its etiology to its characteristics. Avalia Feridas not only focuses on assessment, but also emphasizes the importance of documenting wound progression. Its structure includes a map, and future versions will include a space for recording progress[21-23].

In addition, the use of software that provides easy access to information and supports management metrics is gaining traction in nursing practice. The more resolution and speed a software offers, the more attractive it becomes to users. Avalia Feridas aims to provide a complete and high-resolution application, in addition to exceptional content.

Initially, this study was only intended to develop the layout of the app, but a prototype was eventually created. One limitation was the inability to develop certain features, such as a section for users to record daily updates to track their patients. In addition, the prototype does not allow users to delete content, images, or icons, nor does it provide access to the overall public, as it is restricted to the app's developers. The goal is to improve the functionality of the device and thereby spread knowledge to users.

Despite some limitations, the app developed in this study stands out in the scientific market for its evaluation criteria, the human body map and the space for recording progress. This creation, which is also intended as a teaching tool, aims to bring about significant changes in the care of patients with acute and hard-to-heal wounds by promoting a holistic view of each case. It provides nursing students and professionals with strong clinical reasoning skills that can be applied in their field. This technological tool will provide quick and easy access to information, enriching the knowledge of its target audience.

CONCLUSION

With an increasing number of patients suffering from complex wounds, often due to chronic and neoplastic conditions, it has become essential for nurses to have in-depth knowledge of the care required for these patients. Stomatherapy, when

combined with technology, offers a wide range of products and tools that enable nursing students and professionals to perform high-quality assessments, thereby improving care by focusing on the individual needs of each patient.

This study successfully achieved its goal of developing a technological wound assessment tool specifically designed for nursing students and professionals. The methodological process of creating the app provided the researchers with valuable technical and methodological knowledge, resulting in immeasurable scientific enrichment. This work aims to assist nursing students and professionals in their daily wound assessment, making it a crucial tool for providing dignified care to patients with wounds.

The plan is to validate the app with stomal therapy and dermatology professionals (nurses) and then make the product available on digital platforms. This will ensure that countless nursing students and professionals will have access to this technology.

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REFERENCES

1. Costa CCP, Soares SSS, Vieira MLC, Oliveira MD, Pedro RS, Chaves USB, Souza NVDO. Estomaterapeutas no mundo do trabalho: facilidades e dificuldades para o exercício profissional. Esc Anna Nery. 2021;25(2):e20200262. https://doi.org/10.1590/2177-9465-EAN-2020-0262
2. Vieira RQ, Sanchez BCS, Fernandes RP, Dias TN, Aquino UM, Santos AE. Primeiros escritos sobre os cuidados de enfermagem em feridas e curativos no Brasil (1916–1947). Hist Enferm Rev Eletrônica. 2017;8(2):106-17.
3. Santos E, Cunha M. A brief history of the evolution of wound care. Millenium. 2022;2(ed espec nº10):9-11. https://doi.org/10.29352/mill0210e.27313
4. Mandelbaum SH, Di Santis EP, Mandelbaum MHS. Cicatrização: conceitos atuais e recursos auxiliares – parte I. An Bras Dermatol. 2003;78(4):393-410. https://doi.org/10.1590/S0365-05962003000400002
5. Cardinelli CC, Lopes LPN, Di Piero KC, Freitas ZMF. Instruments for wound assessment: scoping review. Res Soc Dev. 2021;10(11):e144101119246. https://doi.org/10.33448/rsd-v10i11.19246
6. Atkin L, Bućko Z, Monteiro EC, Cutting K, Moffatt C, Probst A, Romanelli M, Schultz GS, Tettelbach W. Implementing TIMERS: the race against hard-to-heal wounds. J Wound Care. 2019;23(Sup3a):S1-S50. https://doi.org/10.12968/jowc.2019.28.Sup3a.S1
7. Filatos A, Cairo S. Produção de conteúdos educacionais. São Paulo: Saraiva; 2015. 480 p.
8. Barra DCC, Paim SMS, Dal Sasso GTM, Colla GW. Métodos para desenvolvimento de aplicativos móveis em saúde: revisão integrativa da literatura. Texto Contexto Enferm. 2017;26(4):e2260017. https://doi.org/10.1590/0104-07072017002260017
9. Pizzalato AC, Sarquis LMM, Danski MTR. Nuring APHMÓVEL: aplicativo móvel para registro do processo de enfermagem na assistência pré-hospitalar de urgência. Rev Bras Enferm. 2021;74(Suppl 6):e20201029. https://doi.org/10.1590/0034-7167-2020-1029
10. Marquez CM. Mobile health can be patient-centered and help solve inequality issues in Brazil's Unified Health System. Front Public Health. 2023;11:1032412. https://doi.org/10.3389/fpubh.2023.1032412
11. Nichiata LYI, Passaro T. mHealth e saúde pública: a presença digital do Sistema Único de Saúde do Brasil por meio de aplicativos de dispositivos móveis. Reciis –Revista Eletrônica de Comunicação, Informação & Inovação em Saúde. 2023;17(3):503-16. https://doi.org/10.29397/reciis.v17i3.3663

12. World Health Organization. mHealth: new horizons for health through mobile technologies: second global survey on eHealth. Geneva: World Health Organization; 2011.

13. Gonzalez A, Santos ACB, Santos EA, Blanco LM, Gabbai M, Jesus RC. Relatório de atividades nacionais do CVV. 4º trimestre de 2022. São José dos Campos (SP): LVBA Comunicação; 2022 [accessed on 22 Apr. 2024]. Available from: https://cvv.org.br/wp-content/uploads/2023/03/RelatorioCVV_4-trimestre-de-2022.pdf.pdf

14. Andrade PGR, Borges EL, Spira JAO. A utilização do Allevyn AG Adhesive® em úlcera venosa recalcitrante. In: Congresso Paulista de Estomaterapia On-line; 2020 [accessed on 20 Nov. 2022]. Available from: https://anais.sobest.com.br/cpe/article/view/32

15. Miyahara CTS. Guia prático: feridas crônicas. Guarapuava: Unicentro; 2021.

16. Santos DM. Construção e validação de instrumentos para a sistematização da assistência de enfermagem em uma clínica de enfermagem em estomaterapia [tese]. Rio de Janeiro (RJ): Universidade do Estado do Rio de Janeiro; 2018.

17. Santos Junior EM, Esteves APVS. O uso de tecnologias leves, leves e duras no diagnóstico de Neuropatia Diabética. Brazilian Journal of Development. 2023;9(5):17225-32. https://doi.org/10.34117/bjdv9n5-183

18. Melo EBM, Primo CC, Romero WG, Sant'Anna HC, Sequeira CAC, Lima EFA, Fiorese M. Construction and validation of a mobile application for development of nursing history and diagnosis. Rev Bras Enferm. 2020;73(Suppl 6):e20190674. https://doi.org/10.1590/0034-7167-2019-0674

19. Ferreira SL, Barbosa IV, Alexandre SG, Abreu RNDC, Mota CFA, Cabral JFF, Oliveira GMS, Vidal CT. Construção e validação de tecnologia educacional para familiares de pessoas com úlcera venosa. Rev Bras Enferm. 2022;75(5):e20210555. https://doi.org/10.1590/0034-7167-2021-0555

20. Instituto Nacional do Câncer. Rede Câncer. Novidade: aplicativos e games sobre câncer para dispositivos móveis ajudam profissionais, pesquisadores e pacientes. Saúde na palma da mão. 2017 [accessed on 13 Nov. 2023]. Available from: https://www.inca.gov.br/sites/ufu.sti.inca.local/files//media/document//rrc-27-novidade-saude-na-palma-da-mao.pdf

21. Mastrodomenico NV, Vocci MC, Arruda CF, Ferreira ASSBS, Fontes CMB. Desenvolvimento de aplicativo móvel para predição do risco de lesão por pressão: escala de Glamorgan. Revista Nursing. 2023;26(302):9766-70. https://doi.org/10.36489/nursing.2023v26i302p9766-9770

22. Rocha AA. Feridômetro: aplicativo de auxilio à aprendizagem do acrônimo timeres (conclusão de curso). Campina Grande (PB): Universidade Federal de Campina Grande; 2021.

23. Brasil LS, Lima AB, Gomes DA, Souza ERG, Andrade MC. Desenvolvimento e validação de aplicativo móvel para tratamento de feridas. Revista de Ciência e Inovação do IFFAR. 2022;8:1-22. https://doi.org/10.26669/2448-4091.2022.308