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ARTIGO ORIGINAL

COMPUTATIONAL SYSTEM APPLIED TO MOBILE TECHNOLOGY FOR EVALUATION AND TREATMENT OF WOUNDS

SISTEMA COMPUTACIONAL APLICADO À TECNOLOGIA MÓVEL PARA AVALIAÇÃO E TRATAMENTO DE FERIDAS

SISTEMA COMPUTACIONAL APLICADO A LA TECNOLOGÍA MÓVIL PARA EVALUACIÓN Y TRATAMIENTO DE HERIDAS

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ABSTRACT

Objective: to describe the development of a mobile application for evaluation and treatment of wounds. ***Method:*** methodological study. Literature search was carried out with the descriptors: wounds and injuries; dressings; cicatrization. The following steps were followed: planning of content; selection of application tools; configuration of environments, tools and educational resources; building the Internet environment for *downloading* and installing the application on mobile devices. ***Results:*** fifteen articles were selected through literature search. The application has an easy-to-use graphical interface. It stores the patient's sociodemographic characteristics, allows assessment of the wound and risk factors and recommends therapeutic procedures. ***Conclusion:*** the application developed may be very useful in clinical practice, helping to select nursing interventions for wound prevention and treatment, as well as in nursing education. ***Descriptors:*** Mobile Applications; Software; Lasers; Wounds and injuries; Algorithms; Nursing care.

RESUMO

Objetivo*:** descrever o desenvolvimento de um aplicativo móvel para a avaliação e tratamento de feridas. ***Método*:** estudo metodológico. Foi feita a pesquisa da literatura com os descritores: ferimentos e lesões; bandagens; cicatrização. Foram realizados o planejamento do conteúdo, a seleção das ferramentas do aplicativo, a definição da configuração de ambientes, ferramentas e recursos educacionais, a construção do ambiente na Internet para *download* e instalação do aplicativo no dispositivo móvel. ***Resultados*:** quinze artigos foram selecionados através da pesquisa da literatura. O aplicativo criado possui uma interface gráfica de fácil uso, armazena as características sociodemográficas do paciente, permite a avaliação da ferida e de fatores de risco e recomenda procedimentos terapêuticos. ***Conclusão: o aplicativo desenvolvido pode ter grande utilidade na prática clínica, ajudando a selecionar intervenções de enfermagem para a prevenção e tratamento de feridas, bem como na educação em enfermagem. ***Descritores*:** Aplicativos Móveis; Software; Lasers; Ferimentos e Lesões; Algortimos; Cuidados de enfermagem.

RESUMEN

Objetivo*:** describir el desarrollo de un aplicativo móvil para la evaluación y tratamiento de heridas. ***Método*:** estudio metodológico. Fue hecha la investigación de la literatura con los descriptores: heridas y lesiones; vendajes; cicatrización. Fueron realizados el planeamiento del contenido, la selección de las herramientas del aplicativo, la definición de la configuración de ambientes, herramientas y recursos educacionales, la construcción del ambiente en Internet para *download* e instalación del aplicativo en el dispositivo móvil. ***Resultados*:** quince artículos fueron seleccionados a través de la investigación de la literatura. El aplicativo creado posee una interface gráfica de fácil uso, almacena las características sociodemográficas del paciente, permite la evaluación de la herida y de factores de riesgo y recomienda procedimientos terapéuticos. ***Conclusión: el aplicativo desarrollado puede tener grande utilidad en la práctica clínica, ayudando a seleccionar intervenciones de enfermería para la prevención y tratamiento de heridas, así como en la educación en enfermería. ***Descriptores***: Aplicaciones Móviles; Programas Informáticos; Heridas y Lesiones; Evaluación.

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INTRODUCTION

Nursing professionals have a fundamental role in assisting patients with skin injuries, performing care in a holistic, technical and scientific way. Nurses follow the daily evolution of the injury, evaluate, guide and make dressings, they have mastery of the techniques because of curricular components of their academic training focused on this practice and for developing such care as one of their attributions.[1-2] To guarantee the success in wound care, it is very important to classify injuries, although the classification is quite variable and sometimes subjective. Wounds can be classified as acute and chronic according to time needed for tissue repair, and treatment includes clinical and surgical methods, being dressings the most frequently used clinical treatment.[3]

Dressing is defined as a therapeutic intervention that consists in the cleaning and application of material on a wound for protection, absorption and drainage of exudates, in order to improve the conditions of the wound bed. The dressing may sometimes be the definitive treatment itself and, on other occasions, only an intermediate stage preceding surgical treatment.[4] The choice of appropriate material for dressings depends on the pathophysiological and biochemical knowledge about tissue repair and for this, there is a need to train and update the knowledge of professionals who provide assistance.[4]

Currently, the world market presents several options of materials that can be used in different stages of wound treatment, from cleaning, debridement, reduction of bacterial population, control of exudate and stimulation of granulation.[4]

Financial resources of the patients and/or the health unit, the need for continuous use of dressings, including home visits, and evaluation of costs and benefits are some of the aspects to be considered when choosing the type of dressing, which must be appropriate to the nature, site and size of the wound.[3,5]

Health professionals who are involved in wound treatment should always seek up to date knowledge because scientific advances and technologies related to these practices are frequent, making the work challenging. It is not unusual to find professionals with difficulties to identify the correct phase of cicatrization and who confuse the normal and abnormal characteristics associated with this process. Moreover, evaluating a wound can lead to varied interpretations due to its diversity in the nature, form and site, and due to the perception and technical knowledge of each professional and subjective factors of the evaluation.[6-7]

A wound may have different evaluative records made by different professionals. This may lead to divergent or conflicting interpretations. To ensure reliability in the therapeutic behavior to be adopted, it is necessary that the opinion of a professional be in agreement with that of colleagues. This reliability can be guaranteed by means of precise instruments, with well-defined standards and criteria.[6-8]

Nursing professionals need to develop and improve their clinical skills to assess the risks of developing wounds based on scientific knowledge.[9] The use of measurement instruments, scales, protocols and clinical guidelines, applications and *online* courses for helping professionals to assess risks, formulate diagnoses, plan preventive behaviors, and determine care plans are crucial. Technological knowledge has the potential to create innovative methods of prevention and treatment in the professional environment, mainly through mobile computing systems (softwares for computers, tablets and mobile phones), a reality of the modern time.[10]

The construction of an application for nursing professionals that provide care to patients with cutaneous injuries is a valid strategy for education, diagnosis and determination of therapeutic approach, allowing the approximation between theory and practice, the interrelationship of knowledge and contextualization of learning.[11]

In a time when digital technology is an indispensable tool in the daily tasks of most professions, in the health area this happens even more intensely due to the need for fast, accurate and safe information. For this, computer engineering has developed tools (softwares) to assist professionals in the performance of their technical skills.

In a simple definition, a software consists of sequenced computer program instructions that, when executed, provide desired characteristics, functions, and performance. It is a structuring of data and commands that allows the programmer to manipulate information properly, both in the printed and virtual aspects. There are seven major categories of softwares: system, application, scientific/engineering, embedded, for product lines, for web, and artificial intelligence. In this line, applications are programs that solve a specific need and process data for administrative or technical decisions. They

are generally used for controlling real-time business functions.[12]

The use of applications as a tool for teaching, care and diagnosis of wounds is quite innovative and represents a method capable of generating the interest and motivation to want to learn more. Mobile devices that host applications are used by 45 to 85 percent of healthcare professionals and are more consulted than books and journals.[13-18]

OBJECTIVE

- To develop a mobile application to aid in the assessment of wounds.

METHOD

Study applied in the modality of technological production and literature research carried out with professors of the University of Vale do Sapucaí, after approval of the Research Ethics Committee of the Faculty of Health Sciences "Dr. José Antônio Garcia Coutinho ", under opinion number 873593.

As a methodology for the development of the multimedia application, the Contextualized Instructional *Design* (CID) was adopted. This design involves the constructivist proposal and consists in the intentional action of planning, developing and applying specific didactic situations, incorporating mechanisms that favor contextualization.[11,19] The multimedia application in mobile platform for assessment and treatment of wounds followed the 4 steps: analysis, *design*, development and implementation.

The analysis consisted of understanding the educational problem and elaborating a related solution according to the CID perspective. For the construction of the application, a bibliographic research was carried out in the Health Sciences databases, including the Cochrane Library, *Scientific Electronic Library Online* (SCIELO), Latin American and Caribbean Literature in Health Sciences (LILACS), *Medical Literature Analysis and Retrieval System Online/US National Library of Medicine* (MEDLINE), *International Nursing Index* (INI) and *Cumulative Index to Nursing and Allied Health Literature* (CINAHL), using as descriptors: "wounds and injuries"; "dressings"; and "cicatrization".

In order to select the publications to be used in the study, the inclusion criteria were: to be a primary study directly linked to the theme; be available in full length. No temporal delimitation was adopted because the intention was to compile all the studies that met the established criteria. Book chapters, theses, dissertations, monographs, technical reports, reference works and articles that did not approach the theme proposed for the study were excluded, as well as publications repeated in the databases and virtual library.

After extensive bibliographical research in indexed national and international journals and after reading of abstracts, articles describing the assessment, measurement and classification of wounds, tissue types and exudates commonly found in wounds and types of dressings and covers used in the treatment of wounds were selected. These procedures aided in obtaining data for building the application. Based on the bibliographic survey, the application was developed in three parts.

The first part of the application comprises the assessment of the wound including measurement, type of borders, type of tissue, type and amount of exudate present and signs of inflammation and/or infection. The second part classifies the main types of tissues found in the wound, namely: devitalized tissue, granulation tissue and epithelial tissue. The third part presents suggestions for therapeutic approach according to the type of tissue and exudate identified in the injury in order to promote the moist environment, the debridement of devitalized tissues and to stimulate the cicatrization. The technological infrastructure was also defined in this stage and a diagram was created to guide the construction of the tool (Figure 1).

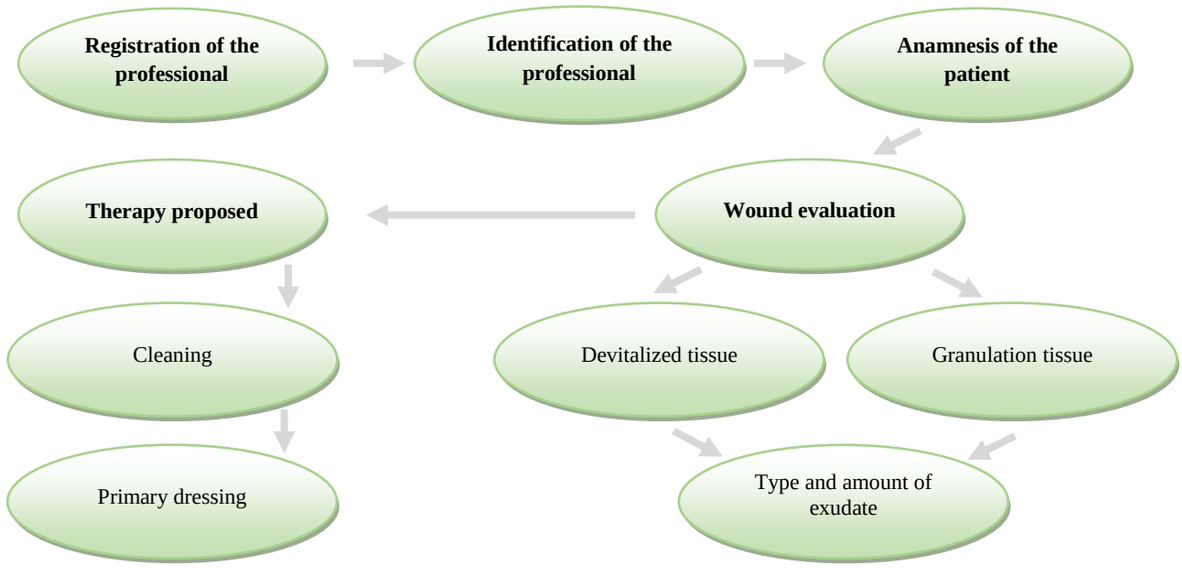

Figure 1. Diagram for construction of the multimedia application in mobile platform for evaluation and treatment of wounds. Pouso Alegre (MG), Brazil, 2017.

The stage of design involved planning and producing didactic content, defining and writing topics, selecting media and designing the interface (layout). It was decided to use texts structured in topics and connected by hypertexts.

The development stage comprised the selection of multimedia application tools, the definition of the navigation structure and planning of configuration of environments.

In the implementation stage, technological tools and educational resources were configured and an Internet environment was created to download the application and install it on mobile devices.

RESULTS

Figure 2 shows how the selection of the 15 articles that served as basis for the construction of the application took place.

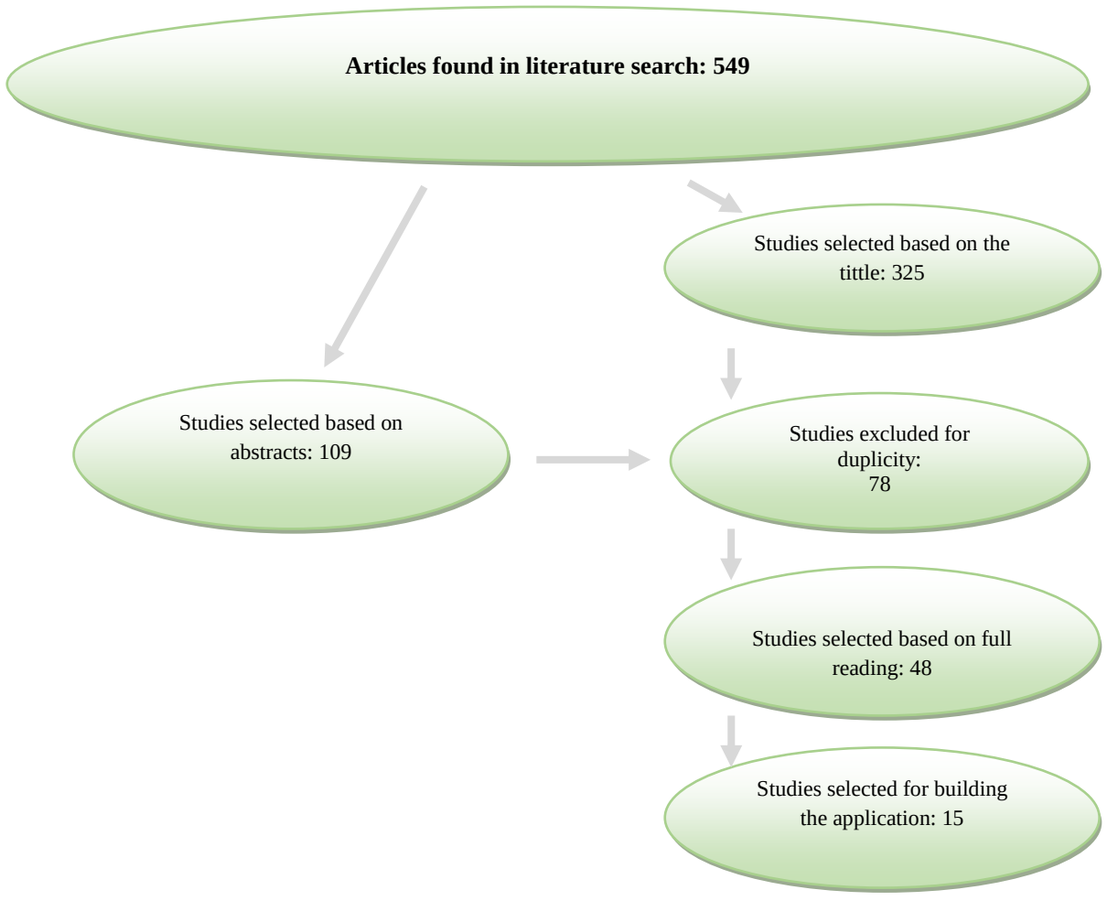

Figure 2. Flowchart of identification, selection and inclusion of studies found in the literature survey for construction of the application. Pouso Alegre (MG), Brazil, 2017.

Figure 3A shows the form for identification of patients. After filling the data related to the patient, the professional has to click on "Next", being directed to the wound evaluation form.

In the evaluation stage, the professional must first measure the size of the wound (Figure 3B) and evaluate if the border of the wound is epithelialized, hyperemic or macerated (Figure 3C).

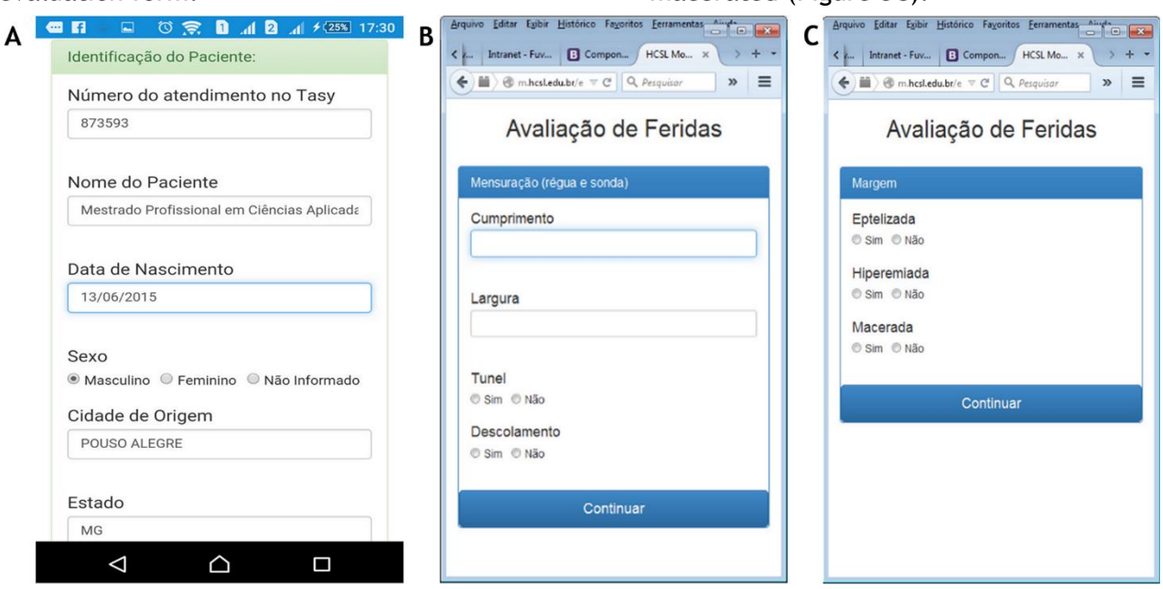

Figure 3. Examples of application screens showing the forms of (A) patient identification and (B and C) wound evaluation. Pouso Alegre (MG), Brazil, 2017.

Professionals should also check if the wound bed shows granulation or devitalized tissue (Figure 4A), the type and amount of exudate (Figure 4B), if the wound has signs of infection and, if so, what are these signs (i.e. heat, flushing, edema, pain, among others) (Figure 4C).

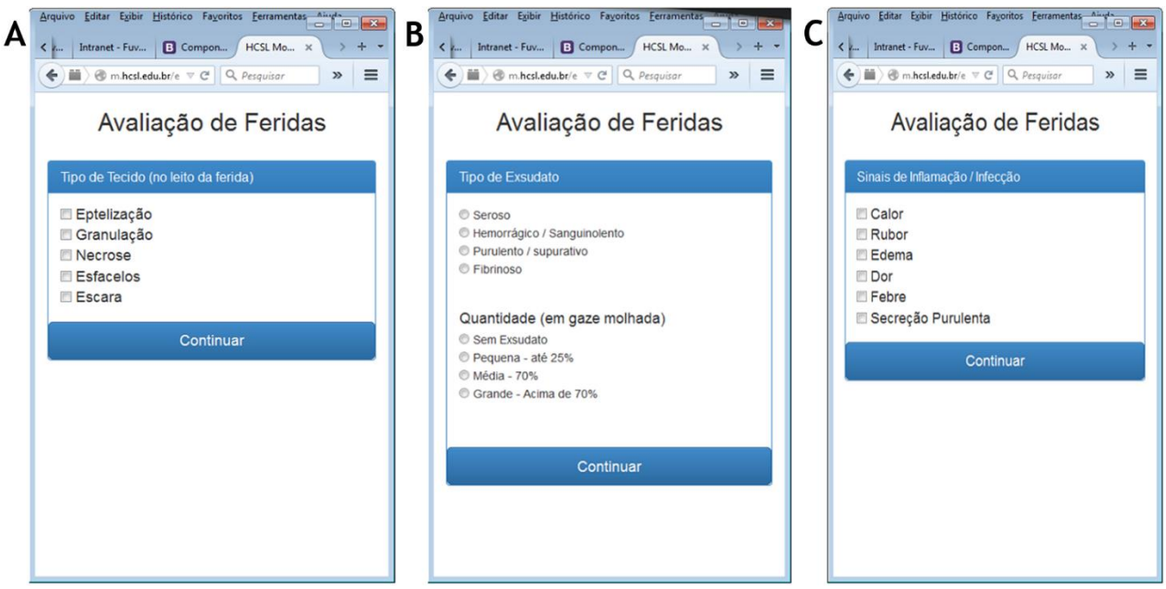

Figure 4. Examples of application screens showing the evaluation (A) of the wound bed, (B) type of exudate and (C) signs of infection. Pouso Alegre (MG), Brazil, 2017.

After evaluation of the wound, the application presents therapeutic proposals according to the type of devitalized tissue (sloughing, eschar or necrosis) or granulation tissue, with and without the presence of exudate. (Figures 5 and 6).

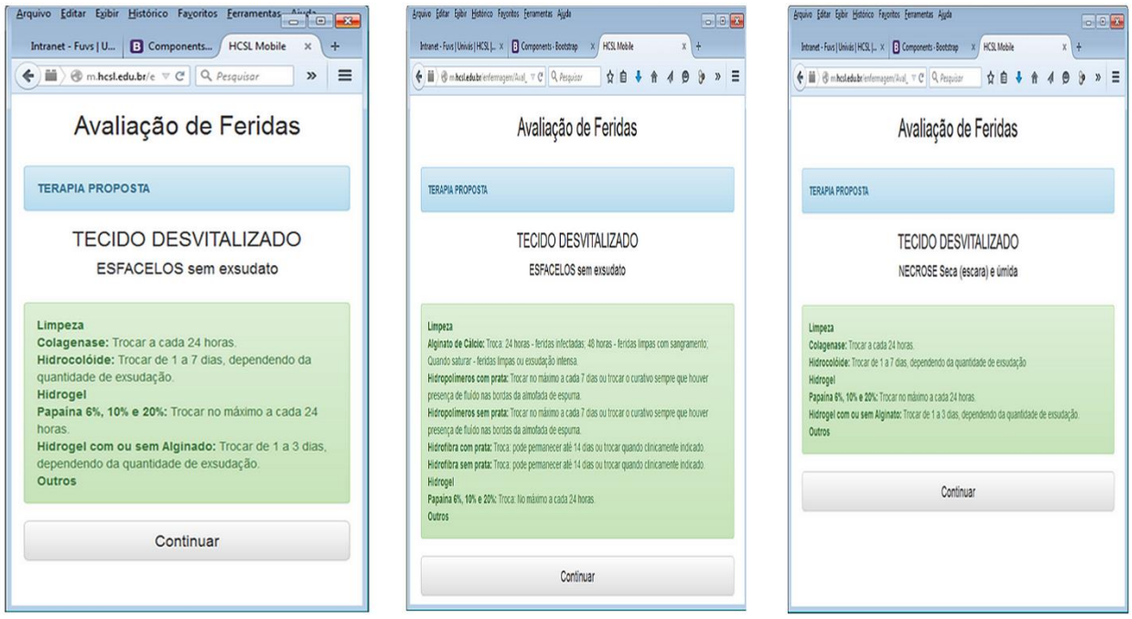

Figure 5. Examples of application screens showing therapeutic proposals for the treatment of wounds with devitalized tissue. Pouso Alegre (MG), Brazil, 2017.

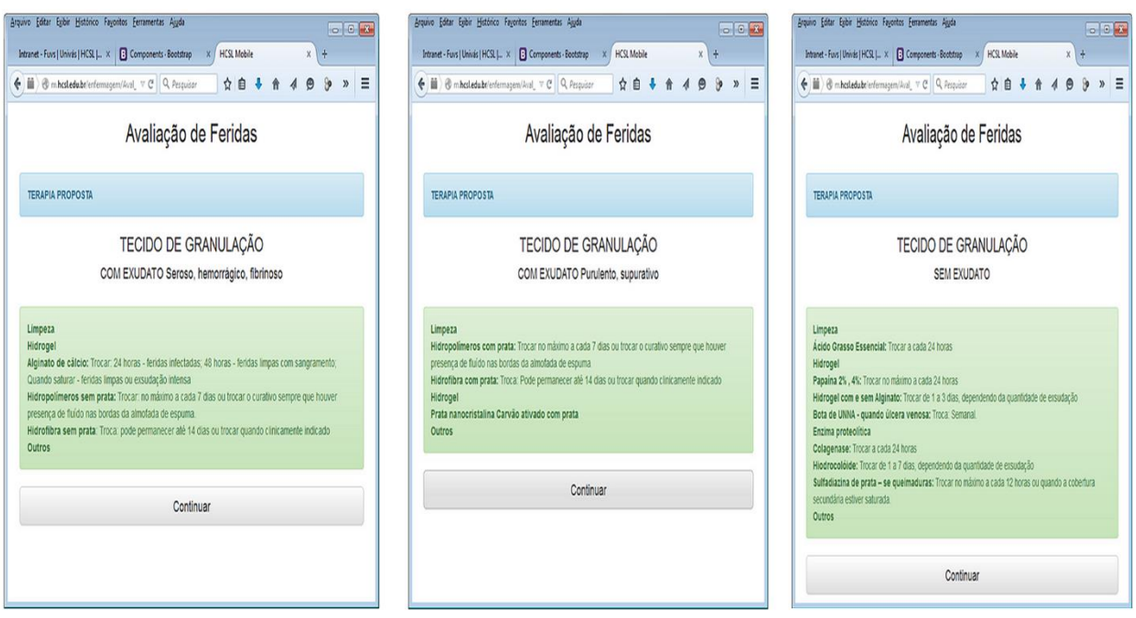

Figure 6. Examples of application screens showing therapeutic proposals for the treatment of wounds with granulation tissue. Pouso Alegre (MG), Brazil, 2017.

The multimedia application on the mobile platform for evaluation and treatment of wounds was registered at the National Institute of Industrial Property (Ministry of Development, Industry and Foreign Trade), under protocol number BR51-2016.00.11.34-3, and is available free of charge on the Internet at the link: http://intranet.fuvs.br/Enfermagem/Aval_Feridas_1.asp

DISCUSSION

Assistance to patients with wounds begins with a thorough evaluation and recording of data, always bearing in mind that each patient and each injury is unique, and this step must be performed before choosing any therapeutic approach.[20]

Wounds are often cared for in different ways, by different professionals and in an unsystematic way. The exchange of dressings is often not specified in the patient's chart and the systematic evaluation of the wounds is not performed, hampering the analysis of their progress. Health professionals need to evaluate the wounds to judge their evolution, and the evaluation should contain objective measures, periodically reassessed since the initial evaluation.[5,20]

The use of a software to evaluate and follow-up the evolution of wounds favors the systematic record of care, enables the continuity of care and contributes to the quality of the care provided. Systematic treatment of wounds minimizes healing time and allows the analysis of costs and benefits of the treatment used.

Guidelines, protocols, booklets, online courses and applications that provide healthcare professionals with guidelines for wound evaluation are necessary because adequate documentation enables successful treatment and the follow-up of injuries. The lack of standardization in data records can lead to the use of different techniques in the treatment of the same wound, using procedures that are more convenient at the moment but that may hamper the cicatrization process.[21,23]

The mobile application emerges as an innovative technology for nursing care through its application via mobile device and interaction with other computers through integrated and planned wireless networks. Parallel use of mobile computing and the access to this type of network can greatly assist health professionals in their daily practice.[24]

The choice for the theme evaluation and treatment of wounds for the creation of an application stemmed from reflections on the difficulties that professionals face in assessing and choosing optimal coverage to promote wetness and healing. The application created has all the necessary items to evaluate a wound (wound measurement, checking of tissue type, exudate, amount of exudate, signs of inflammation and/or infection) and suggests types of coverage to be used in the treatment.

With a mobile device it is possible to access, collect and document information about patients on their own bed, performing steps of the Nursing Process and monitoring the need for mobility of professionals in patient care actions. It is also possible to reduce the time spent in documenting activities and the likelihood of loss of information that is stored on the device itself, and not on printed forms. This promotes the combination of factors, such as flexibility and dynamism, which contribute to improving the productivity of nursing care.[25]

An instrument for evaluation of wounds was developed with a strategic process to choose products that aid in healing. The treatment of wounds is a process that has become increasingly complex due to the wide variety of products and coverages available in the market. The elaboration of an algorithm should be strongly based on the literature and clinical evidence in order to provide technical, clinical, administrative and financial subsidies, always aiming at improving patient care and at the best results for the institution.[26]

The assessment of a wound includes the description of its clinical characteristics, specifying its location, size, aspect, characteristics of the skin surrounding it and of the exudate. The evaluation of patients with wounds should be global, systematized and interdisciplinary, clarifying the diagnosis, type of wound and factors that interfere in wound healing.[26]

In a study aimed at evaluating a mobile device application that allowed the recording of data for the systematization of nursing care in a neonatal intensive care unit, the authors concluded that the main contributions of the software were: agility in developing and documenting the systematization; freedom of movement; standardization of the evaluation of newborns; optimization of time spent with bureaucratic activities; possibility of retrieving information; reduction of physical space occupied by records; and flexibility in the recording activities performed by nurses because the collection of data can be done at bedside.[26]

In the assessment wounds, professionals need to make fundamental decisions based on knowledge of the skin anatomy, principles of tissue repair physiology, and factors that interfere with it. These professionals must know the types of wounds and the various forms of treatment and be able to observe the loss of tissue, the clinical aspect of the injury, its location and dimensions, presence of exudates, characteristic of the skin surrounding the wound, pain and signs of infection.[3,8,27]

In a study evaluating an Application for Pressure Ulcer Indicator (APUI)[17], the authors concluded that the software can be used by nurses for both management and care purposes. The study allowed to verify that the developed application facilitated the management of the injury and the clinical practice of nurses in an intensive care settin.[17,28-29]

It is important to point out that tools for wound evaluation should be both easily accessible to professionals and inexpensive. As limitations, we can cite that the application depends on devices that have Internet access and available network for its proper functioning. This research has as a future perspective the validation of this application by nurses.

CONCLUSION

This study made it possible to describe the stages of the planning and development of a multimedia application in mobile platform for evaluation and treatment of wounds. The steps adopted indicate that this application is very useful in the clinical practice of evaluation of injuries, in the choice of therapeutic approach, and in the teaching of nursing with the use of technology.

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