Clinics in Surgery

Research Article
Published: 19 Nov, 2019

A Mobile App for Wound Cleansing

Jose Ronaldo Alves, Geraldo Magela Salome, Rosimar Aparecida Alves and Flavio Dutra Miranda Dutra*

Department of Surgery, Sapucai Valley University (UNIVAS), Brazil

Abstract

Objectives: To develop a mobile application (app) to assist health professionals in the cleansing of wounds. The app aids in the evaluation of the wound and recommends wound cleansing procedures according to the wound characteristics.

Methods: A contextualized instructional design was used in the development of a mobile app. A literature search was carried out to identify relevant studies for its construction. The development of the mobile app included the selection of multimedia app tools, definition of the navigation structure, planning of the environment configuration, and building of an environment for downloading the app to the mobile device.

Results: The literature search yielded 15 articles. A mobile app was created with an easy-to-use graphic interface. The application stores the patient's demographic and clinical information, health professional's information, clinical evaluation of the wound, and recommends wound cleansing procedures and cleansing agents.

Conclusion: The mobile app may be used in clinical practice to assist health professionals in the cleansing of wounds and in the selection of nursing interventions according to the different types of tissue, as well as in nursing education.

Keywords: Mobile application; Software; Therapeutic irrigation; Debridement

Introduction

The use of computational technologies in education and health care practice has improved the teaching-learning and theory-practice relationships as they are adapted to the needs of patient management and contemporary educational models. Virtual learning environments have shown that interactivity favors the learning process, improving the quality and safety of the health care delivered [1-3]. The current trend towards the use of mobile devices may be attributed to their ease of use, ability to provide access to the Internet, and the integration of multiple functions through different applications (apps). An app is a software with a specific function and able to assist us in certain tasks. Mobile devices are important tools because a large number of students and professionals have one almost always available due to their portability. The use of apps for preventive, therapeutic, diagnostic, and educational purposes in the health field is innovative and generates interest and motivation in learning [4]. The nursing professional plays an important role in the selection of products and procedures for wound management. Wound cleansing allows the health professional to inspect and evaluate the type of tissue and amount of exudates present in the wound bed. The cleansing process should remove the bacteria from the wound bed without the need for antiseptics [5,6]. The use of proper materials and techniques is necessary for an adequate wound cleansing, which is the first step in wound care [7,8]. The choice of the cleansing technique and cleansing agents should be based on scientific evidence. It is also important for the professional to have access to the institution's protocols of wound management. Evidence-based recommendations for the use of appropriate materials and protocols contribute to the decision-making process in clinical practice [9-11]. However, our experience shows that many health professionals perform wound cleansing inadequately and sometimes use cleansing agents that are toxic, especially to the granulation tissue. There is a lack of protocols in a readily available format for the use of correct techniques and products for wound care management. The development of mobile apps for health professionals who provide care to patients with skin wounds has shown to be a useful strategy for training, diagnosis, and choosing of the therapeutic approach, especially in the light of the theory-practice relationship and in the interrelationships of knowledge and contextualization of learning. 12 Mobile devices hosting applications for health care management have been used more than books and journals by 45% to 85% of health professionals [1,4,13-16]. Thus, the aim of this study was to

Correspondence:
Geraldo Magela Salome, Department of Surgery, Sapucaí Valley University (UNIVAS), Pouso Alegre, MG, Brazil, E-mail: salomereiki@yahoo.com.br

Received Date: *14 Oct 2019*
Accepted Date: *13 Nov 2019*
Published Date: *19 Nov 2019*

Citation:
Alves JR, Salome GM, Alves RA, Miranda Dutra FD. A Mobile App for Wound Cleansing. Clin Surg. 2019; 4: 2662.

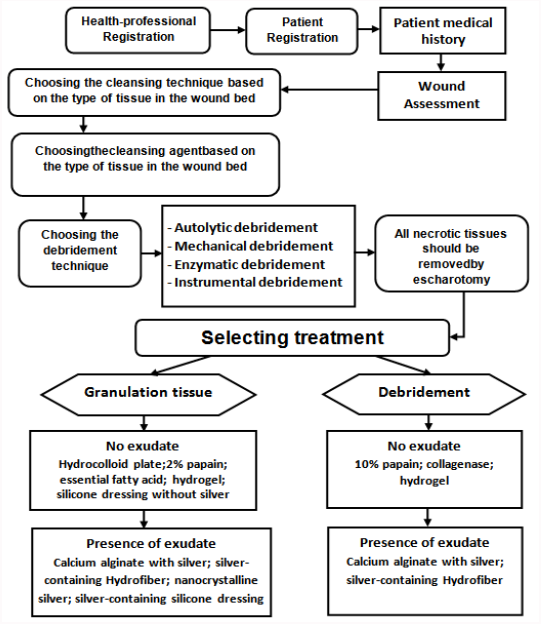

Figure 1: Flowchart for the development of the mobile app for use in wound cleansing.

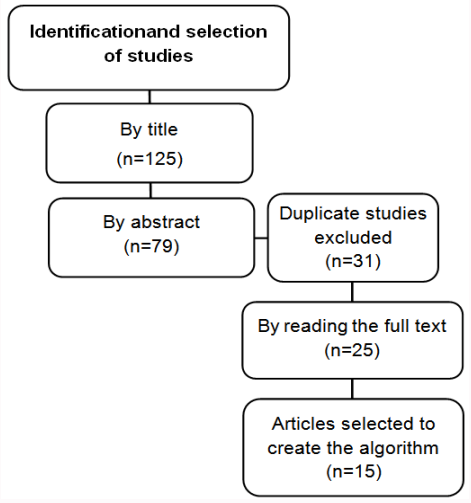

Figure 2: Flowchart of the literature search.

develop a mobile app to assist health professionals in the cleansing of wounds.

Materials and Methods

This descriptive, methodological study was conducted between April and September 2017. The study was approved by the Research Ethics Committee of the Dr José Antônio Garcia Coutinho School of Medical Sciences of the University of Vale do Sapucaí (UNIVÁS), Brazil (approval number 1.046, 148). The Contextualized Instructional Design (CID) methodology was used in the development of the multimedia application. It involves a constructivist proposal, consisting of intentional planning, development, and use of specific didactic strategies, incorporating mechanisms that favor contextualization. For the construction of the algorithms regarding wound cleansing, a literature review was carried out using the following databases: the Cochrane Library, Scientific Electronic Library Online

Figure 3: Display screen showing the graphical interface. (*left*) User registration form; (*centre*) patient registration form; (*right*) access to patient records for a given time period.

(Sci ELO), Latin American and Caribbean Literature in Health Sciences (LILACS), U.S. National Library of Medicine (MEDLINE), International Nursing Index (INI), and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The search was performed using the following descriptors: "mobile applications", "software", "therapeutic irrigation", and "debridement". The inclusion criteria were primary studies directly related to the topic, available as full text, and written in Portuguese, English, or Spanish. The exclusion criteria were books, book chapters, theses, dissertations, monographs, and technical reports, articles that, after reading the abstract, did not meet inclusion criteria, and duplicate publications. The search was not limited to a specific time period. After the abstracts were read, articles describing cleansing techniques, jet irrigation, wound irrigation, debridement techniques, wound assessment, types of dressings used in wound debridement, and types of cleansing agents were obtained and read in full. The technological infrastructure was then defined and a flowchart was created to guide the development of the instrument (Figure 1). The design and development of the app involved the planning and production of content, definition of topics, writing tasks, selection of media, and interface design. The text was organized into topic sections, which were connected by hypertexts. The next steps included the selection of multimedia app tools, definition of the navigation structure, planning of the environment configuration, and building of an environment for downloading the app to the mobile device.

Results

The selection of studies on which the construction of the mobile app was based included 15 articles (Figure 2). To have access to the mobile app, the user has to complete a registration form by entering his or her name, professional identification number, email, and password (Figure 3, left). A new patient is added to the system by providing the patient's name, medical record number, national identification number, and date of birth (Figure 3, centre). The information is then recorded in the mobile app database by pressing the "Send" button. Patient data from all assessments can be accessed by the health professional by choosing the time period of interest (Figure 3, right). Thus, the patient data for the selected time period is displayed, showing the type of wound tissue, wound size, type of wound edge tissue, and type of cleansing technique, cleansing agent, and primary dressing used for wound debridement (Figures 4, left). The wound assessment begins with the professional determining the type of tissue present in the wound bed and clicking on the

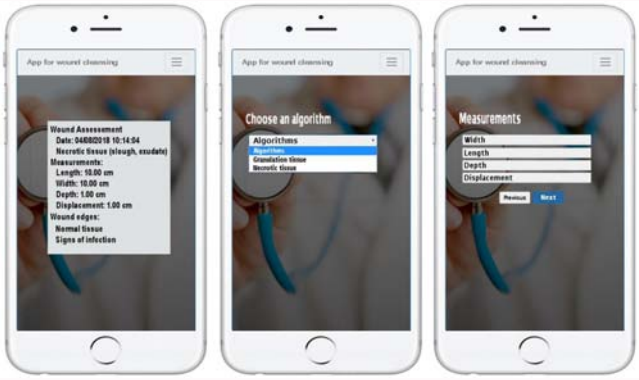

Figure 4: Display screen showing the graphical interface. (*Left*) Sample of a patient record showing the wound characteristics at a given time point; (*centre*) the algorithm for wound cleansing begins with the clinical assessment of the type of wound; (*right*) wound measurements are entered into the system.

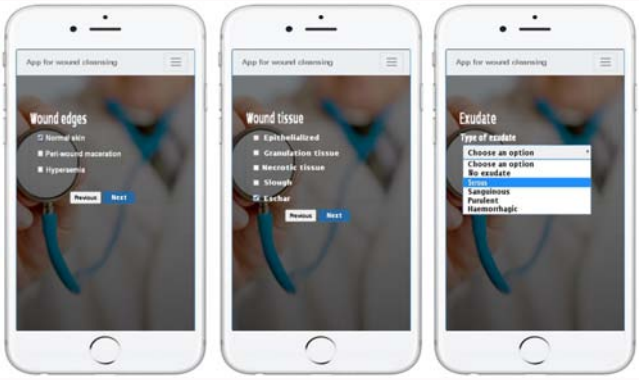

Figure 5: Display screen showing the graphical interface. The user selects the (*left*) type of wound edge; (*centre*) type of tissue in the wound bed; and (*right*) type of wound exudates.

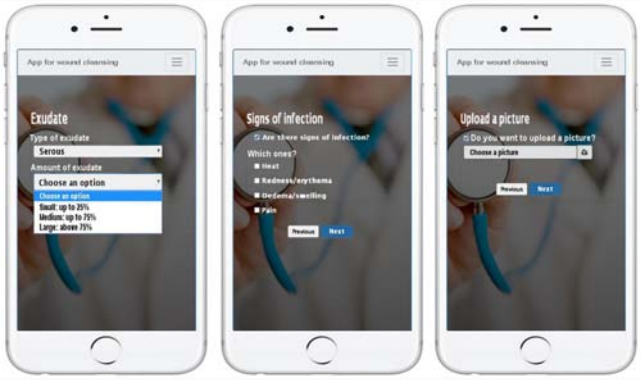

Figure 6: Display screen showing the graphical interface. The user selects the (*left*) amount of exudates present in the wound; (*centre*) signs of infection if present; and (*right*) has the option to upload a picture of the wound for future reference.

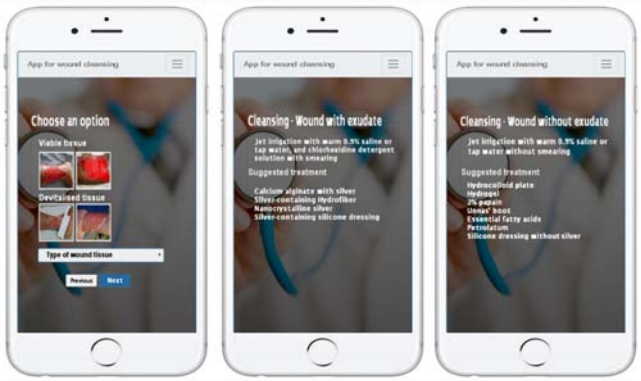

Figure 7: Display screen showing the graphical interface. (*left*) Photographs of wounds with viable and non-viable granulation tissue, and a button to access a description of each type of wound tissue; examples of instructions for the cleansing of wounds with granulation tissue (*centre*) with exudates and (*right*) without exudates.

appropriate button ("granulation tissue" or "necrotic tissue") to access the cleansing protocol (Figure 4, centre). The wound measurements (i.e., width, length, depth, and displacement) are then entered into the system (Figure 4, right). Following, the professional will select the type of tissue found in the wound edges (i.e., normal skin, peri-wound maceration, and hyperemia) and wound bed (i.e., epithelialized, granulation, or necrotic tissue, slough, or eschar, as shown in Figure 5 (left and centre). The type and amount of wound exudates (Figure 5, right; Figure 6, left) and presence of signs of infection, including heat, redness/erythema, edema/swelling, and pain (Figure 6, centre) will also be evaluated. The professional has the option of taking a photograph of the wound and uploading it to the system (Figure 6, right). Photographs of the different types of viable and devitalized wound tissues are provided to assist the professional in identifying what type of tissue is present in the wound. A description of each type of wound tissue is also provided to aid in the identification. After the wound tissue is properly classified, recommended instructions for wound cleansing will be presented, describing cleansing techniques and indicating primary dressings, and cleansing agents to be used according to the type of wound tissue. Figure 7 shows photographs of wounds with viable granulation tissue (Figure 7, left, top) and wounds with granulation and non-viable tissue (Figure 7, left, bottom), as well as a button to access a description of each type of wound tissue. Examples of recommended instructions for the cleansing of wounds with granulation tissue with and without exudates are seen in Figure 7 (centre and right, respectively). Figure 8 shows photographs of wounds with slough (Figure 8, left, top) and necrotic tissue (Figure 8, left, bottom), and a selection button for the user to indicate the type of tissue found in the wound. A sample of recommended instructions for the cleansing of wounds with necrotic tissue is depicted in Figure 8 (right), including a menu with buttons leading to the description of each debridement technique (enzymatic, autolytic, mechanical, or instrumental debridement). The application for registration of the mobile app software was made to the Brazilian National Institute of Industrial Property, Ministry of Development, Industry and Foreign Trade. Currently, the mobile app in Brazilian Portuguese is freely available at https://ceosware.com/app-limpeza.

Discussion

A mobile app for wound cleansing was created in Brazilian-Portuguese language for Android mobile devices using Android Studio, made available by Google. The mobile app will also be made available for the operating system iOS in a near future. It is freely available for download on the Internet and will probably be used on a large scale, both in the urban and rural areas in Brazil, because it can be operated either online or offline. The main advantage of developing educational tools is the possibility of their use by many individuals (students and professionals) [17]. The app has a user-friendly graphical interface.

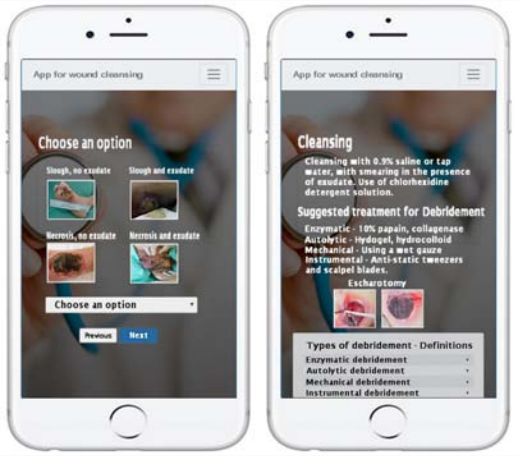

Figure 8: Display screen showing the graphical interface. (*left*) Photographs of wounds with slough and necrotic tissue, and an option button to select the type of wound tissue; (*right*) sample of instructions for the cleansing of wounds with necrotic tissue and a menu with buttons to access the description of each type of debridement.

The project interface consists of a database composed of 4 registers containing the (1) patient's demographic and clinical information, (2) health professional's information, (3) clinical evaluation of the wound, and (4) the therapeutic interventions performed. Record keeping is one of the most important forms of communication of the health professional. It establishes an effective communication among health professionals involved in the patient care; serves as the basis for the elaboration of a care plan; is a source of information for the evaluation of the care provided; serves to monitor the evolution of the patient; is a legal document, both for the patient and nursing team regarding the provided care; and contributes to the nursing audit, teaching, and research in nursing [18-20]. The systematic recording of wound assessments and the types of dressings used in the treatment is a fundamental element to ensure quality nursing care. The intervention documentation has to be clear and precise, without omitted data. The assessment of the wound and evaluation of its evolution require criteria and instruments that facilitate the annotation of the wound characteristics and factors affecting wound healing. It is important for professionals to use standard procedures [12]. The implementation of protocols for wound prevention and treatment is essential, as well as the formation of an interdisciplinary team (e.g., plastic surgeon, nurse, nutritionist, and physiotherapist) to deliver patient-centered care [18-20]. The mobile app developed in this study allows the wound type and size, wound tissue, type and amount of exudates, and wound location to be recorded in the system. Health professionals need to make decisions based on the knowledge of skin anatomy, physiology of wound healing, and factors that affect wound repair. These professionals have to know the types of wounds and different forms of treatment available, and develop the ability to evaluate the clinical aspects of the wound, including tissue loss, wound location and size, characteristics of the wound edges, and the presence of exudates, pain, and signs of infection [10,20]. The mobile app also presents options for therapeutic interventions, such as wound cleansing techniques and use of cleansing agents and primary dressings, based on the type of wound bed tissue. Saline solution or tap water, when applied with adequate pressure to the wound surface, is sufficient to remove debris, bacteria, foreign bodies, and loose devitalized tissues from the wound bed, according to the guidelines of the Wound, Ostomy and Continence Nurses (WOCN) Society [19,21,22]. Wounds with granulation tissue should be cleansed using the jet irrigation technique, which removes debris without causing trauma to the wound. Optimum cleansing pressure ranges from 4 psi to 15 psi. A 20 ml syringe coupled to an 18-G needle (or 40 × 12 needle) provides an irrigation pressure of approximately 9 psi, which is sufficient to remove material adhering to the wound surface [22,23]. The cleansing procedure for wounds with devitalized tissue involves the use of 0.9% saline solution or tap water, smearing, and primary dressings for wound debridement. The professional may choose among the different debridement techniques, such as the enzymatic debridement with 10% papain and collagenase, autolytic debridement using hydrogel and hydrocolloid plate, instrumental debridement such as escharotomy. Debridement is the removal of non-viable tissue present in the wound surface and is part of the autolytic and physiological processes of wound healing under normal and adequate conditions. Neutrophils and macrophages act in the inflammatory phase, digesting and removing cellular debris. The natural process of debridement, however, becomes insufficient with the accumulation of devitalized tissue in the wound. The increased demand for phagocytic cells slows down the healing process. Thus, debridement is an essential element for the success of a topical therapy, reducing the bacterial load of the wound to prevent infections and aiding in the visualization and evaluation of the wound [20,22,24]. Instrumental debridement consists of removing necrotic tissue using a scalpel, scissors, laser, or another cutting instrument [8,24,25]. Mechanical debridement or smearing is the removal of necrotic tissue with the application of a mechanical force [25]. Enzymatic debridement is the topical application of enzymatic debriding agents directly on the necrotic tissue; and the autolytic debridement and the use of synthetic dressings that lead to the natural breakdown of the devitalized tissue with the aid of enzymes commonly present in wound fluids [20,25].

Mobile apps can be a tool for interactivity and exchange of information among health professionals. Interactivity is an important factor to consider when developing a mobile app, which allows users to exchange experiences and pose questions in real time when connected to the Internet [26-28]. The mobile app is expected to be very useful in the cleansing of wounds in clinical practice and nursing education, providing information for nursing professionals regarding wound cleansing technology.

Conclusion

This study described the planning and development of a mobile app for the cleansing of wounds. The validity and reliability of the application have yet to be tested in further studies. This app may be used in clinical practice to assist health professionals in the cleansing of wounds and in the selection of nursing interventions according to the type of tissue present in the wound, as well as in nursing education.

References

1. Langemo D, Spahn JG. A Multimodality imaging and software system for combining an anatomical and physiological assessment of skin and underlying tissue conditions. Adv Skin Wound Care. 2016;29(4):155-63.
2. Holanda VR, Pinheiro AKB. Development of a hypermedia system for interactive teaching of sexually transmitted diseases. J Nurs UFPE. 2015;9(2):781-9.
3. Moura D, Silva TRP, Barreto BMF, Camacho ACLF, de Oliveira; BGRP. Evaluation of the interactive blog on wound repair and nursing care. J Res Fundam Care 2013;5(3):202-210.
4. Perreira FGF, Silva DV, Sousa LMO, Frota NM. Building a digital

application for teaching vital signs. Rev Gaucha Enferm. 2016;37(2):59015.

5. Rodrigues C, Silva D. Wound cleansing: techniques and solutions. J Tissue Regen Healing. 2012;1:25-31.

6. Santos E. The effectiveness of cleansing solutions for wound treatment: a systematic review. Rev Enf Ref 2016;9:133-44.

7. Carvalho MRF, Salomé GM, Ferreira LM. Construction and validation of algorithm for treatment of pressure injury. J Nurs UFPE. 2017;11(10):4171-83.

8. Cunha DRD, Salomé GM, Massahud MR Jr, Mendes B, Ferreira LM. Development and validation of an algorithm for laser application in wound treatment. Rev Lat Am Enfermagem. 2017;25:2955.

9. Almeida AS, Moreira CNO, Salomé GM. Pressure ulcer scale for healing no acompanhamento da cicatrização em pacientesidosos com úlcera de perna. Rev Bras Cir Plast. 2014;29(1):120-7.

10. Espírito Santo PF, Almeida SA, Silveira MM, Salome GM, Ferreira LM. Use of the Pressure Ulcer Scale for Healing tool to evaluate the healing of chronic leg ulcers. Rev Bras Cir Plast. 2013;28(1):133-41.

11. Leite AP, de Oliveira BG, Soares MF, Barrocas DL. Use and effectiveness of papain in the wound healing process: a systematic review. Rev Gaucha Enferm. 2012;33(3):198-207.

12. Galvão ECF, Püschel VAA. Multimedia application in mobile platform for teaching the measurement of central venous pressure. Rev Esc Enferm. 2012;46:107-15.

13. Oliveira TR, Costa FMR. Development of a reference mobile application on vaccination in Brazil. J Health Inform. 2012;4(1):23-7.

14. Dantas UIB, Santos SR, Brito SS, Virgolino JLB. Perceptions of the managers about the application-treaty for health. J Nurs. 2013;7(2):438-44.

15. Vitoriano AM, Dell'Acqua MCQ, Silva CPC, Silva Oliveira J, e Castro MCN. Software evaluation to pressure ulcer risk and evolution in intensive terapheutic care. J Nurs. 2016;10(7):2369-75.

16. Tibes CM, Cherman EA, Souza VMA, Evora YDM, Zem-Mascarenhas SH. Image processing in mobile devices to classify pressure injuries. J Nurs. 2016;10(11):3840-7.

17. Strand H, Fox-Young S, Long P, Bogossian F. A pilot project in distance education: nurse practitioner students' experience of personal video capture technology as an assessment method of clinical skills. Nurse Educ Today. 2013;33(3):253-7.

18. Gardona RGB, Ferracioli MM, Salomé GM, Pereira MTJ. Assessing the quality of records in the dressing charts, performed by nursing. Rev Bras Cir Plast. 2013;28(4):686-92.

19. Gonçalves MBB, Rabeh SAN, Nogueira PC. Topical therapy for chronic wounds: recommendations for evidence-based practice. Rev Estima 2014;12(1):42-9.

20. Salomé GM, Bueno JC, Ferreira LM. Multimedia application in a mobile platform for wound treatment using herbal and medicinal plants. J Nurs. 2017;11(11):2533-40.

21. Ratliff CR, Bryant DE, Dutcher JA. Guideline for prevention and management of pressure ulcers. WOCN clinical practice guideline. 2003;2.

22. Kelechi TJ, Johnson JJ; WOCN Society. Guideline for management of wounds in patients with lower-extremity venous disease: an executive summary. J Wound Ostomy Continence Nurs. 2012;39(6):598-606.

23. Martins EAP, Meneghin P. Evaluation of three techniques for cleaning infected surgical site with using saline. Cienc Cuid Saude. 2012;11(l):204-10.

24. Anghel EL, DeFazio MV, Barker JC, Janis JE, Attinger CE. Current Concepts in Debridement: Science and Strategies. Plast Reconstr Surg. 2016;138(3):82-93.

25. Santos ICRV, Oliveira RC, Silva MA. Surgical debridement and the legal responsibilities of nurses. Texto Contexto. 2013;22(1):181-92.

26. Ventola CL. Mobile devices and apps for health care professionals: uses and benefits. PT. 2014;39(5):356-64.

27. Cunha JB, Dutra RAA, Salomé GN, Ferreira LM. Computational system applied to mobile technology for evaluation and treatment of wounds. J Nurs. 2018;12(5):1263-1272.

28. Salomé GM, Ferreira LM. Developing a mobile app for prevention and treatment of pressure injuries. Adv Skin Wound Care. 2018;31(2):1-6.