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**ORIGINAL ARTICLE**

# APP TO GUIDE NURSES ON THE ASSESSMENT AND TREATMENT OF COMPLEX SURGICAL WOUNDS

Victória Karolina Santos Santana[1]; Fernando Conceição de Lima[2]; Taís dos Passos Sagica[3]; Nancy de Souza Felipe de Nazaré[4]; Camila da Silva Vale Coelho[5]; Alzinei Simor[6]; Mary Elizabeth de Santana[7]; Clarissa Porfírio Mendes[8]

**Highlights:**
(1) Technological development exerts a positive influence on the professional practice.
(2) The app is sensitive to nurses' reality in wound care.
(3) Systematic wound care reduces healing time to a minimum.

## ABSTRACT

Wound treatments have advanced considerably with the expansion of therapeutic possibilities, treatment techniques and technological innovations for the care of skin lesions. This study aims at developing a mobile app to guide nurses in the assessment and treatment of complex surgical wounds. This is a methodological and descriptive study with a qualitative approach developed in a High-Complexity Oncology Center from the state of Pará. It was developed in two stages: initially, by identifying the target audience's main needs through semi-structured interviews that were analyzed following Bardin's method and using the Iramuteq software. The second stage consisted in the technological production itself, according to Contextualized Instructional Design (analysis, design and development). The interviews with the participants supported and justified creating the "*Pense Feridas*" ("Think Wounds") app. Aiming at good usability, the following topics were included on the main screen: concepts and classifications, complications, wound assessment, updates and references. These categories present secondary screens with pertinent and updated information on each topic. In addition, the software features a "Surgical wounds" icon where the professionals can add patient and wound information to indicate the best care standard, including coverage and dressing changes. This study made it possible to produce an app that is sensitive to the reality of nurses who deal with the assessment and treatment of patients with complex surgical wounds every day. Its implementation may favor systematic care recording and care continuity.

**Keywords:** nursing care; surgical wound; technology.

[1] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0003-2379-8353
[2] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0002-9418-3711
[3] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0002-6871-0100
[4] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0003-1408-9598
[5] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0002-6231-852X
[6] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0002-3848-5467
[7] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0002-3629-8932
[8] Universidade do Estado do Pará – Uepa. Belém/PA, Brasil. https://orcid.org/0000-0001-6488-718X

## INTRODUCTION

The term “wound” is characterized as rupture of the skin cover or loss of its continuity, and can affect from its superficial to its deep layer. Wounds can be caused both by intrinsic factors such as infections, chronic and vascular ulcers, metabolic distortions or neoplasms and by extrinsic ones such as accidental injuries due to trauma or intentional lesions caused by the surgical procedure itself[1].

Surgical Wounds (SWs) are considered intentional, acute, of sudden onset, usually performed with approximation of the edges due to surgical suture and healing by first intention. SWs become complex when they present infection, seroma, hematoma, dehiscence and/or interruption of their healing[2].

Wound treatments have advanced considerably with the expansion of therapeutic possibilities, treatment techniques and technological innovations for the care of skin lesions. These technologies have stood out in the health area, as they are tools to support clinical decision-making by the professionals and to provide greater safety and dynamics in the practice[3]. In Nursing, apps allow computerized care planning and favor administrative instrumentation, care quality, communication, interaction with the patients and clinical skills, promoting care quality and effective courses of action[4].

In this context, nurses play a fundamental role in SW assessment and treatment, which requires training, knowledge and experience. However, divergent or conflicting interpretations are not uncommon during the process, especially due to difficulties standardizing care. In a hospital environment, injuries are treated by several professionals[5].

Thus, technological development exerts a positive influence on the professional practice[6]. Therefore, creating a mobile app to guide nurses on SW assessment and treatment may assist in analyzing and defining courses of action and care measures, enabling learning to be contextualized, harmony between theory and practice and knowledge correlations.

In this sense, an answer to the following research question is sought: “Which content do nurses consider important to be included in an app on the assessment and treatment of complex surgical wounds?”. Therefore, this study aims at developing a mobile app to guide nurses on the assessment and treatment of complex surgical wounds.

## METHODOLOGY

This is a methodological and descriptive study with a qualitative approach, based on software engineering and developed in a High-Complexity Oncology Center (*Centro de Alta Complexidade em Oncologia*, Cacon) from the state of Pará with the objective of developing a mobile app to guide nurses on the assessment and treatment of complex surgical wounds. It was developed in two stages, namely: 1) Exploratory: identification of the target audience’s main needs; and 2) Technological production.

The first stage corresponded to the analysis carried out between March and June 2021, aiming to identify nurses’ main needs regarding the care of patients with complex surgical wounds. Sampling was for convenience with the following inclusion criteria: participants holding a Nursing degree, regardless of gender or work shift and with experience in Surgical Clinic and treatment of complex surgical wounds for over six months. The subjects excluded were those that were on maternity/paternity/sick leave or on vacation.

An invitation to take part in the study was made, with scheduling outside working hours and in a private environment in a meeting room. Those who accepted were presented the Free and Informed Consent Form (FICF) with explanations about the research objectives; the participants read and signed this form in two copies.

Semi-structured interviews were used as data collection technique; they consisted in two blocks of questions and covered the characterization of the participants (gender, age and schooling) and of the Nursing care measures for complex surgical wounds (assessment of the clinical and psychosocial conditions of patients with surgical wounds; dressing evaluation and indication process; difficulties encountered in the assistance provided; contribution of the app to Nursing care; and content suggestions for the mobile app).

The Voice Recording Authorization Form was also presented, thus ensuring the participants' right to accept or refuse recording of the interviews. In cases of refusal, the researchers transcribed the interviews in real-time; for those who accepted, the audios were deleted after transcribing the testimonies. Codes identified with the letter "P" were used (referring to the term "participant"), followed by a numerical sequence: P1, P2, P3, P4.

After having transcribed all interviews in full, the data were analyzed using Bardin's Content Analysis technique[7] and following three phases: 1) Pre-analysis; 2) Exploration of the material; and 3) Processing and interpretation of the results.

The Iramuteq (*Interface de R pour les Analyses Multidimensionnelle de Textes et de Questionnaires*) software, version 0.7 alpha 2 (created by Pierre Ratinaud), was used in the second phase of the analysis, as it allows statistical analysis of the text *corpus* and maintaining an intrinsic relationship with the research problem, including the data collection, treatment, analysis and interpretation stages. It was decided to use the Descending Hierarchical Classification (DHC) method to see the outstanding terms[8]. Words with a frequency equal to or greater than the mean value recorded (three) were considered relevant. The classes were represented by the most significant words, using the Chi-square test (p-value<0.001).

The second stage consisted in the technological production itself and was conducted in August 2021 based on the findings from the interviews, combined with a search in the national and international literature. The Contextualized Instructional Design (DIC) model was followed for this purpose. It describes a Constructivist proposal and plans and contextualizes the content and tools available through Information and Communication Technologies (ICTs), incorporating mechanisms and processes that favor contextualization and flexibility of the content/instruction in its different stages[9].

Three DIC stages were followed: I) Analysis (referring to the first stage of this study); II) Design: definition of content, visual aesthetics, screen navigation structure and functional organization of the app; and III) App development: production and coding in computer language. Stages 2 and 3 had the participation and technical support of a professional in the Computer Science and Graphic Design areas, under supervision by the researchers.

The app interface aims at interaction, autonomy and ease of use in all its commands. The first objective is to validate the content and record it, so as to make the software available for free download on the Android platform.

This research was approved by the institution's Research Ethics Committee (*Comitê de Ética em Pesquisa*, CEP) under opinion No. 4,575,736 and followed the rules set forth in Resolution No. 466/2012 of the National Health Council.

## RESULTS

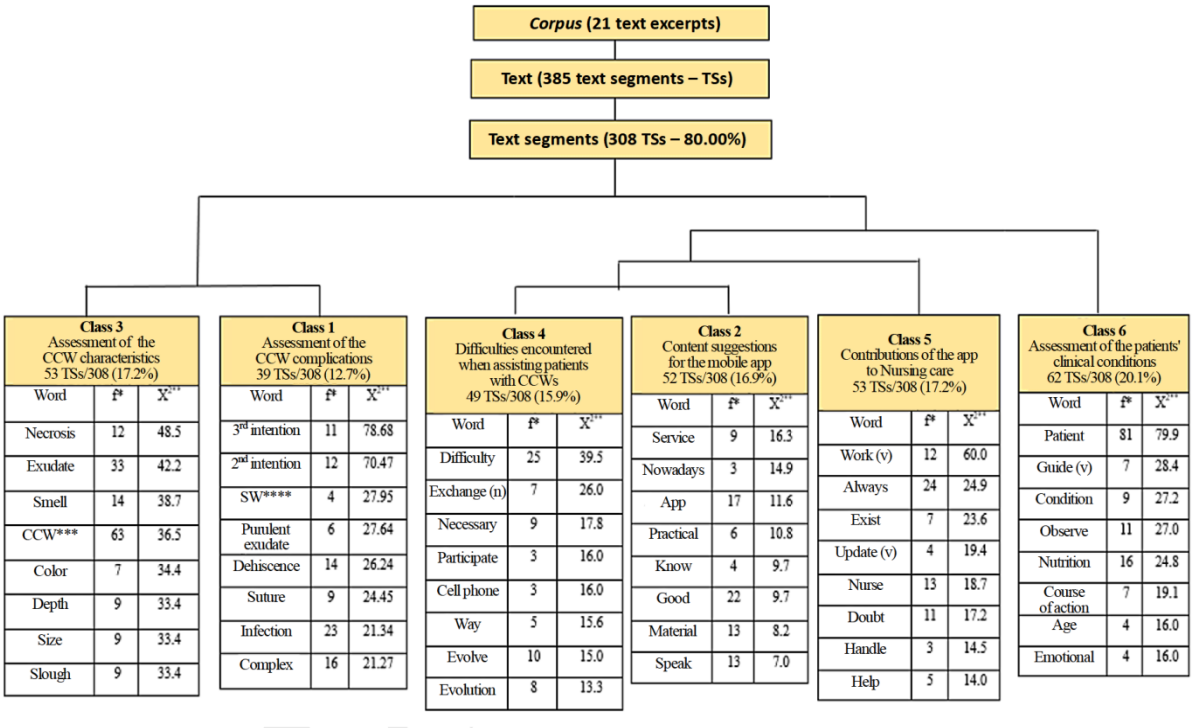
The sample of this study was comprised by 19 nurses and 3 nursing residents, totaling 21 participants. According to Table 1, most of the participants were women (90.47%) and the predominant age group was 41-50 years old (47.61%). As for schooling, most of the participants held graduate degrees (90.47%) and their time in the profession was between 1 and 10 years (42.86%).

Table 1 – Characterization of the study participants. Belém (PA), Brazil, 2023

| Characteristics | N | % |
|---|---|---|
| **Gender** | | |
| Male | 2 | 9.52 |
| Female | 19 | 90.47 |
| **Age (years old)** | | |
| 21-30 | 1 | 4.76 |
| 31-40 | 5 | 23.81 |
| 41-50 | 10 | 47.62 |
| 51-60 | 5 | 23.81 |
| **Schooling** | | |
| Undergraduate level | 2 | 9.52 |
| Graduate level | 19 | 90.47 |
| **Time in the profession (years)** | | |
| 01-10 | 9 | 42.86 |
| 11-20 | 7 | 33,33 |
| 21-30 | 5 | 23.81 |
| **Total** | 21 | 100 |

Source: Prepared by the authors.

Regarding the analysis of the interviews, the text *corpus* consisted of 21 texts with 385 segment numbers analyzed, out of which 308 segments were classified; in other words, 80.00% of the *corpus*. The Descending Hierarchical Classification presented in Figure 1 shows the categorization into six classes with their respective proximity relationships, which are described below.




Key: *f = Frequency; **$X^2$ = Chi-square; ***CSW = Complex Surgical Wound; ****SW = Surgical Wound

Figure 1 – Descending Hierarchical Classification (CHD) dendrogram. Belém (PA), Brazil, 2023.

Source: Prepared by the authors.

## Assessment of the CSW characteristics (class 3) and complications (class 1)

The nurses considered it relevant to assess the CSW characteristics and to indicate the products that would be used according to each classification.

> There's this pre-surgery moment when the patient has a neoplastic lesion; we apply a dressing and, after the surgery, we must know the indication and the appropriate product to use (P2).
>
> Knowing the composition of each dressing, knowing what each component is for, so it is important to know what type of wound you're going to use it on (P11).

It was also indicated that the process of assessing and indicating wound coverings should be dynamic and consider the professional caregiver's theoretical and practical knowledge and the characteristics of each surgical wound, as described in the testimonies:

> It's precisely because of the exudate, healing stage, depth, diameter, infection. I think all of this needs to be evaluated (P9).
>
> Exudate, wound size, depth, diameter, evolution time of this wound, smell, characteristics of this exudate, such as appearance and quantity (P11).
>
> In a surgical wound we need to evaluate skin structure, hydration, excellence of the stitches, and whether it is by first, second or third intention (P13).

The nurses listed exudate and smell as the main problems inherent to complex surgical wounds. However, assessment of an injury goes beyond these components and it is necessary to evaluate characteristics such as infection signs, pain, edges, margins, size and depth, which were rarely reported by the participants.

> The exudate issue must be considered (P1).
>
> I think it's more of an exudate issue (P3).
>
> ...assessing a wound is important and the types of products we can use for each kind of wound according to the exudate types, which are also important, because we rely more on this to be able to use a product and analyze the evolution of a patients' healing (P9).

## Assessment of the patients' clinical conditions (class 6)

The synthesis-idea of this class is organized around the nurses' holistic assessment of the patients, with an analysis of their lifestyle and of the environment that surrounds them, which can directly or indirectly influence hospitalization time in a patient affected by complex wounds.

> Each patient is an individual, a person whose mood, physiological state and emotional aspect vary, which can exert an influence, so they must also be assessed (P18).
>
> I think the main point for doing this healing is the psychological state issue and, if necessary, we can also call the Psychology service to provide this support, as we also know that when a patient is emotionally frail, everything makes it easier for things not to improve because the immune system will be depressed, there will be problems (P16).
>
> Whether the patient is on a self-care regime or not, whether they have comorbidities, especially diabetes, which is a type of comorbidity that significantly impairs healing in any type of wound. I usually tell them that wound care is 50% the team with medications, with dressing products, with dressing techniques, and 50% the patient maintaining a good diet, nutrition with plenty of protein and balanced eating because everything will work together (P15).
>
> If a patient is weakened, we work a lot with immunocompromised subjects. This can also be detrimental sometimes because it can complicate wounds due to their immunosuppression, but then we look at the patient's condition and nutritional state. Sometimes, it is the patient's nutritional state that hinders treatment (P17).

> First, it's nurses' daily assessment actions, also assessment of components regarding nutrition, because the nutritional part encompasses a lot, the medical part with antibiotics, the part with the team of technicians with proper handling, proper use of materials, all of this is a multidisciplinary assessment that we do (P19).

## Difficulties encountered when assisting patients with CCWs (class 4)

The difficulties encountered in assisting patients with surgical wounds are also mentioned, especially lack of specific materials to provide good-quality assistance in treating injuries.

> The difficulty we have with dressings is that we sometimes use what we have and it's not always the most appropriate choice (P7).
>
> ... one of the difficulties is this, but we don't always have these products available here, you know? (P2).

It was also reported that difficulty recording and monitoring and absence of a specific instrument hinder meeting the needs of patients with surgical wounds.

> We also don't have the habit of following-up, of recording (P5).
>
> It wouldn't be difficult to evaluate but rather to describe, as there's no instrument to control this evolution (P2).

It was observed that, given the various materials for coverings and dressings, a thorough assessment is necessary to list these products for treating surgical wounds:

> See how many times a patient is exchanging the dressing, because there's often no point in putting a very expensive cover on a lesion when the patient says he changes the dressing several times a day, there'll be waste of material (P5).
>
> Here we have to evaluate which dressing to use because these materials are expensive and we can't use them all the time, no matter how much a patient needs them (P8).

Another aspect emphasized reflects the need for updating and for teaching courses on wound treatment assessment and topical therapy, as a wide range of materials is constantly emerging and not knowing this can exert an impact on a patient's healing.

> I really find it difficult to decide what to use, so my difficulty today is having this update (P2).
>
> I find it difficult, to say the least; it's been 5 years since I took a refresher course and I don't remember the institution offering it again in those 5 years (P21).
>
> ...So much so that I never took a course, either outside or here (at the hospital) (P9).

## Contributions of the app to Nursing care (class 5)

The interviewees' testimonies also allowed knowing the contributions of creating a mobile app for Nursing assistance to the care of surgical wounds.

> Ah, I think it's really important because the apps are always up-to-date and you have timely guidance when you need it to assess and treat some wound (P9).
>
> If we had an app that would help us assess wounds, it'd make our routine much easier, speed up the process and optimize time, it'd be great (P11).
>
> It'd be really cool because we always have our cell phones at hand, so it'd be very useful to improve the assessment (P20).

## Content suggestions for the mobile app (class 2)

This item indicates the nurses' suggestions for content and features that they deem necessary to be included in the app for treating complex surgical wounds.

> The app would already indicate some basis for each wound classification at the end, as if it were those alternative issues in which it already gives suggestions. It'd be interesting and very practical (P6).
>
> Type of injury, whether there's exudate or not, materials available for each type of injury, types of dressing, which of these dressings need to be exchanged and time until the next change, proper handling of these materials (P15).
>
> I think that if I'm going to do a dressing, I want to know what new things I can use in dressings (P17).
>
> I think the app has to provide options according to the keywords we write in the description (P19).

## Technological production

The mobile app aims at mediating the care practices in charge of nurses, increasing the chances for successful healing of complex wounds in patients undergoing various types of surgeries. It was called "*Pense Feridas*".

After analyzing the exploratory phase with due support from the available literature, a script was created in which the subject matters were defined, namely: concept of surgical wounds, classifications, healing phases, factors that interfere with healing, assessment, and updates.

App design and development took place through the following phases: app sketching - texts, images, drawings that ease its understanding; wireframes and storyboard (the wireframe is a sketch for each the app screens and the storyboard is the way in which these pages communicate with each other, or the flow between each of the app screens); back-end (it is the programming that is not seen, but which the app needs to work properly); evaluation of the App model (checking the app ideas and creation process); construction of the app; final design of the screens; tests; and necessary adjustments.

Aiming at good usability, the following topics were included in the main screen: concepts and classifications, complications, wound assessment, updates and references (Figure 2).

These categories present secondary screens with relevant and up-to-date information on the topic. In addition, the software displays the "Surgical wounds" icon where the professional can add patient and wound information, so that the best treatment standard for coverage and dressing changes can be indicated, as shown in Figure 3.

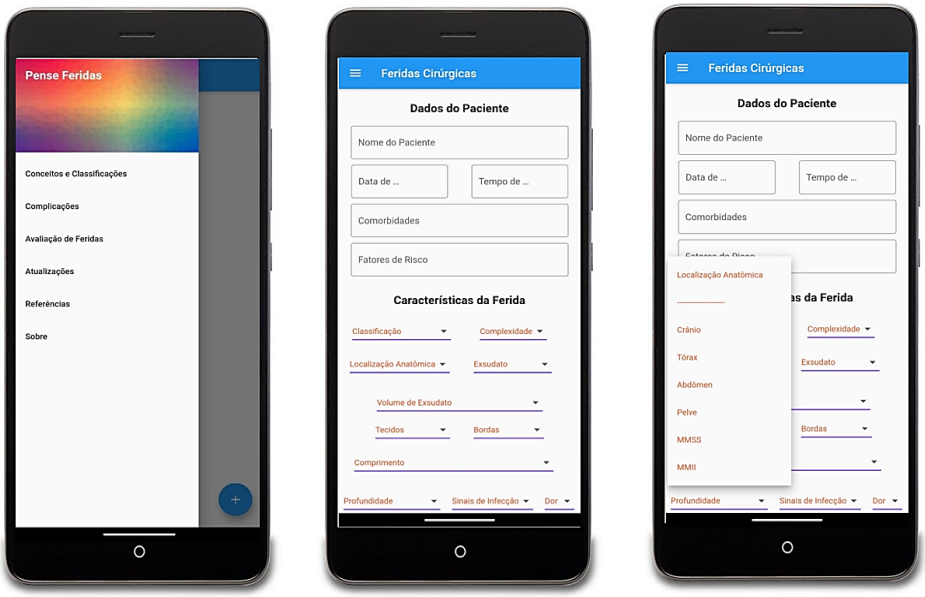



Figure 2 – Home screen and screens for describing the patients' characteristics in the "*Pense Feridas*" app.

Source: Prepared by the authors.

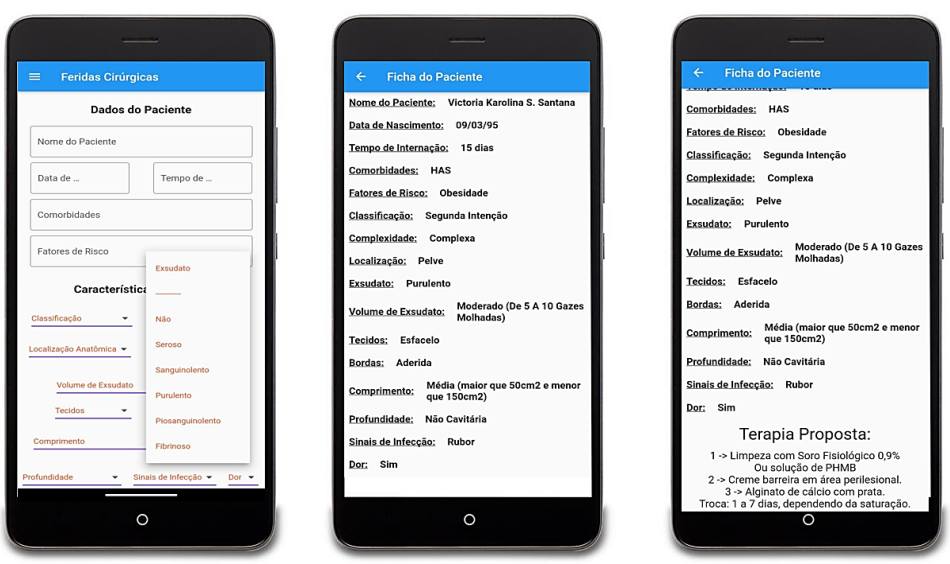



Figure 3 – Example showing how to fill in the patients' characteristics with the therapy proposed by the "*Pense Feridas*" app.

Source: Prepared by the authors.

In addition, the app makes it possible to retrieve any information from a daily assessment, as well as to view improvements or setbacks in healing of an injury, enabling changes in courses of action.

## DISCUSSION

Assessing surgical wounds in hospitalized patients is essential for proper management of injuries, considering that all treatments are the result of constant assessments according to each period of the healing process[10]. In addition, Nursing technical and scientific knowledge is crucial to implementing treatments satisfactorily[11].

Therefore, it is indicated that it is necessary to evaluate and examine whether there are local factors that modify the physiological evolution of the healing process with each dressing change, such as presence of purulent exudate and inflammatory signs (which are indicative of infection, as it causes tissue destruction, which delays collagen synthesis and impairs epithelialization)[12].

It is noted that a dressing should promote healing; however, if not properly made, it can prolong this process and worsen the condition. A dressing should maintain high humidity between its interface and that of the wound, remove excess exudate, provide gas exchange, allow thermal insulation, be free from external wound contamination and allow its removal without causing trauma to the lesion[13].

It is understood that it is important to assess wound parameters such as size, depth, appearance and pain to monitor the evolution of a healing process, as these measurements provide objective data on progression of the treatment used and indicate new therapeutic measures[14].

It is indicated that aspects such as location, extension (length and width, depth or tunneling), exudate (quantity, appearance and smell), bed (type of tissue exposed and classification, when applicable), margins (regular or not, macerated, hyperkeratosis and epithelialization), perilesional skin (integrated, injured, dry, hyperpigmented, hyperemia and phlyctema) and pain lead to a resolute clinical judgment regarding wound treatments[10].

For being a multifactorial process, it is not only necessary to consider local aspects during the assessment but also systemic ones such as wound etiology, nutritional issues and comorbidities that

may interfere in the process. It becomes imperative to examine all patients in a comprehensive way, given that their clinical conditions will have implications for the assessment[2].

The importance of Nursing professionals assessing a user's psychosocial status is highlighted, as socioeconomic level is a predictive agent of the healing progress, given that lower professional levels are associated with worse healing prognoses, while anxiety and depression cause changes in the immune response[15].

It is to be acknowledged that wounds are a multidisciplinary problem that demands effective actions from the entire team involved in patient care, reducing the risks associated with the development of wounds and the costs related to their treatment[16].

In order to promote these work processes, nurses apply skills such as communication, teamwork capabilities and negotiation (among others) to promote adequate care for patients with surgical wounds[12].

The reports obtained in this study show that lack of specific coverage materials hinders wound assessment and treatment, using observation alone, a resource that does not demand any burden from hospital institutions. However, without disregarding its essentiality and relevance, it is worth considering that it is important to employ instruments that support more complete specific data in order to obtain more precise information in the assessment[17].

It is noted that an assessment instrument may be accessible and clearly applicable; however, analyzing a lesion may generate discordant judgments for the same wound. An erroneous interpretation may lead to serious repercussions such as defining inadequate courses of action, causing complications and delayed healing[1].

The current work market demands more qualified professionals with higher scientific and technical knowledge levels. In this interim marked by transformations and changes, continuing education emerges as an important means for professionals to acquire knowledge and improve it[18].

The importance of continuing education in Nursing is evidenced with the objective of providing favorable care to the patients. With a continuing education program it is possible to assess the knowledge level regarding the techniques performed by nurses and the need to improve the work process and reflect on it[19].

The use of computer technologies in the educational and health fields is renewing teaching--learning and theory-practice in health, as they are shaped to the needs inherent to safe patient care and current educational modalities[20].

In an applied methodological research study that uses software, these technologies allow dynamics in developing and documenting systematization, enabling freedom of movement, standardizing the evaluation, optimizing time in carrying out bureaucratic activities, retrieving information, reducing the physical footprint of records and making recording activities more flexible for nurses, as data collection can be conducted at the bedside[21].

The contemporary trend towards using cell phones comes from their real-time availability, aesthetics and access to information, in addition to gathering several functionalities through apps. These devices have already become practically unanimous in the Brazilian technology market, especially with the use of app software that has transformed and innovated the way in which we live and communicate[22].

This app has a specific purpose and enables assistance in a specific activity. Mobile devices are important tools, as most of the population owns one and they are always available, taking into account their portability[23].

Care for patients with wounds begins with an assessment and recording of all data obtained from the medical history, which should be done before choosing any therapeutic method. Apps offer these features because they support wound assessments and promote adequate recording, successful treatment and monitoring of the evolution of injuries[24].

Construction of an app for this purpose must be closely supported by scientific evidence in order to provide technical, clinical, administrative and financial support, aiming to improve patient care and achieve better results for institutions[24].

The app was developed to be used by Nursing professionals to assess complex surgical wounds and propose topical treatments based on each patient's assessment. Thus, it can be employed at any time when it is necessary to monitor a surgical wound that presents some compromise degree by first, second and third intention.

This contributes to increasing patient safety, in order to avoid prolonged hospitalizations, reinforce nurses' autonomy and include the patients in their recovery process, providing them with the information required to preserve their health and even avoid other surgical complications.

It is noted that the study was limited to the app creation process, lacking content validation and application in a representative sample of the target population for face validation, thus requiring the development of complementary studies.

## CONCLUSIONS

Development of this study made it possible to produce an app that is sensitive to the reality of nurses who deal with the assessment and treatment of patients with complex surgical wounds every day. Its implementation may favor systematic care recording and care continuity. In addition, it enhances the quality of this care. Systematic wound care reduces healing time to a minimum and allows analyzing the costs and benefits of the treatments used.

In this context, health technologies can extend beyond other dimensions, allowing professionals to rethink the work process and its dynamics with the objective of improving the quality of the services provided to the users.

As implications for the practice, the research showed that studies like this can be developed in other performance areas such as Adult and Neonatal Intensive Care Units, Surgical Inpatient Units and Care in the Basic Health Network. The need to conduct more studies that computerize Nursing care and add new technologies to these professionals' routine is highlighted.

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**Authors' contributions**

**Victória Karolina Santos Santana:** Conceptualization. Data curation. Formal analysis. Investigation. Methodology. Software Visualization. Writing – original draft.

**Fernando Conceição de Lima:** Methodology. Writing – original draft

**Taís dos Passos Sagica:** Methodology. Visualization. Writing – original draft.

**Nancy de Souza Felipe de Nazaré:** Formal analysis. Investigation. Writing – original draft.

**Camila da Silva Vale Coelho Formal analysis**: Formal analysis. Investigation. Writing – original draft.

**Alzinei Simor:** Supervision. Validation. Writing – review & editing

**Mary Elizabeth de Santana:** Supervision. Validation. Writing – review & editing

**Clarissa Porfírio Mendes:** Project administration. Supervision. Validation. Writing – review & editing

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**Corresponding author**
Taís dos Passos Sagica
Universidade do Estado do Pará – Uepa
Escola de Enfermagem
Magalhães Barata. Av. José Bonifácio, 1289 – Guamá, Belém/PA, Brasil. CEP 66065-362
thaispassos12@gmail.com

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