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Research Article

Applying mHealth for Assessment of Complex Wounds: Insights from a Focus Group

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Background. It is a reality of care praxis that it is difficult for healthcare professionals to assess and monitor the local status of wounds objectively and regularly. This study aims to identify the minimum data required to evaluate patients with complex wounds to be incorporated into mHealth. *Methods*. Descriptive qualitative study, based on thematic analysis, using the online focus group technique. An intentional sample was selected, and two separate sessions were held, attended by 6 experts and 7 nurses. The data were coded by two researchers, with a deductive method, using NVivo software. *Results*. 5 themes emerged which are described as follows: assessment of patients with complex wounds, distinctive criteria based on the type of wound, flowcharts for approaching patients with wounds, characteristics of a mobile application focused on wound care, and alerts to be included in a mobile health application dedicated to wound treatment. The theme *characteristics of a mobile application for approaching the patient with wounds* raised 4 subthemes: (1) image, (2) communication, (3) decision-making, and (4) safety. *Conclusion*. The use of wound assessment tools provides data capable of generating quality care outcome indicators. These serve as good practice guides, enhancing health gains, whether they are economic or quality-of-life improvements.

1. Introduction

Chronic, complex, or hard-to-heal wounds constitute a significant burden on the quality of life of patients and place a considerable strain on healthcare systems due to their high human and financial costs [1, 2]. Wounds that fail to reduce in size after a month of targeted and appropriate treatment are likely to become complex [3–7]. Despite this, a consensus on what precisely constitutes a chronic wound is yet to be established [8]. The ongoing challenge of understanding and managing these wounds continues to perplex healthcare professionals and caregivers, due to their rising prevalence and the intricate care they necessitate [9].

Patients with wounds can be found across various healthcare settings, under the care of diverse professional groups. Each of these groups brings their unique clinical experiences and evaluative methods to the table. A structured and correctly managed wound care protocol can yield numerous benefits [10]. These include quicker healing times, minimized physical, emotional, and socioeconomic impact of complex wounds, lessened workload for healthcare providers, cost-effective treatments, and enhanced satisfaction for both healthcare professionals and patients upon

the achievement of anticipated outcomes [10]. However, wound management often lacks standardization, both within institutions and more broadly in the wider healthcare landscape, including among specialists in the field. Healthcare professionals, particularly nurses who provide care for patients with wounds, often grapple with intricate and demanding decisions [11–13]. The difficulty of healthcare professionals in evaluating and monitoring, in an objective and regular way, the local state of the wounds is a reality of the praxis of caring for the patient with a wound [9]. However, the result obtained with the different therapeutic interventions can only be measured by monitoring and characterizing the state of the wound, thus allowing to infer the effectiveness of the established plan [14–16].

Although there are several tools for evaluating a patient with a wound, there is no consensus on the set of data to be collected, which leads to a lack of standardization and variable criteria, making it impossible to make a correct diagnosis, collect and compare data, and monitor the progress of healing of the wound and the effectiveness of the treatment [9, 17].

Assessment of the patient and documentation of the wound are fundamental interventions to determine the possible causes, establish the diagnosis, determine the severity of the injury, monitor the healing progress of the wound, minimize pain, promote wellbeing, prevent complications and recurrence, as well as contributing to communication between healthcare professionals and the patient and their family [14–16]. A timely, systematic, accurate, and evidence-informed assessment must be part of the therapeutic plan in the care of patients with wounds [5, 15]. In this way, integrating an assessment with the minimum necessary data into a technological tool enables health gains, promotes safety in action, and reduces risks as well as improves patient-centered care.

The global and growing use of smartphones, as well as mobile applications in the health area, has shown promising results in the context of the prevention and treatment of patients with wounds and several tools have emerged that are accessible in any care context [18].

Telemedicine, telehealth, and electronic health or eHealth (directly related concepts and terms often used interchangeably) are defined as the remote use of information and communication technologies. These technologies enable the exchange of valid information, aiding in the diagnosis, treatment, monitoring, and prevention of diseases or injuries. They also foster research, evaluations, and health education for caregivers, contributing to the wellbeing of individuals and communities [19, 20]. Electronic health includes many other concepts related to mobile health (mHealth), smartphones (s-health), or wireless (u-health) [21]. mHealth is defined as mobile devices (mobile phones, smartphones, tablets, or electronic readers) for wireless communication to support public health and clinical practice [22], and applications (apps) refer to software programs developed for use on mobile devices with Android, iOS, or other operating systems to provide solutions for an individual or collective problem [23].

Electronic tools assist in evaluating individuals, monitoring wound healing progress, and assessing intervention effectiveness, thus aiding in decision-making for healthcare professionals [24]. Some systems solely store data, offer local wound assessments, facilitating comparisons and ensuring data reliability, albeit without providing direct decision-making recommendations, termed as indirect decision support [25, 26]. Clinical decision support systems, provide interactive software support by combining patient data with a knowledge base to generate specific recommendations. While they do not replace healthcare professionals, these systems streamline processes, reduce costs, and errors, and improve patient care safety [27, 28].

The use of an app for evaluating and monitoring wound areas has proven to significantly decrease care time by healthcare professionals. A study in a specialized wound care unit involving ten nurses reported a reduction of 27 care hours per day compared to traditional methods of manual record-keeping and area measurement (using a ruler). The study also highlighted improved discussions among the multidisciplinary team through imaging and a decrease in clinical errors [29]. In addition to aiding the decision-making process of healthcare professionals either directly or indirectly, decision support systems can be employed by patients with wounds and their informal caregivers. These systems offer numerous advantages such as enhancing knowledge about treatments and potential complications, building surveillance skills, encouraging self-care, and alleviating anxiety related to treatment [30].

It poses a challenge to establish a minimum dataset for evaluating a patient with a wound [9] and there is a recognized need for these data to be incorporated into mHealth. This integration can encourage health professional adherence and facilitate data collection from the patient [24]. This study aims to identify the minimum data required to evaluate patients with complex wounds to be incorporated into mHealth.

2. Materials and Methods

2.1. Research Design. This is a qualitative, descriptive study, based on thematic analysis that utilizes the online focus group technique. The aim is to foster discussion and generate information and insights about the clinical data model related to patient evaluation. In addition, it seeks to establish the necessary requirements for the development of an mHealth application dedicated to wound care.

The data obtained through the focus group are enriched by capturing expressions and linguistic nuances that other techniques fail to apprehend, thereby combining the advantages of nondirective interviews and participant observation [31]. We opted for the online modality due to the various benefits it presents, such as (i) ease of access to participants from various contexts and geographical locations; (ii) schedule flexibility; (iii) participant comfort; (iv) security and nonintrusion; (v) engagement and convenience; and (vi) cost and time reduction [31–34]. However, being aware of the potential limitations of this modality, we took measures to minimize them. This includes ensuring in

advance access to necessary resources, such as equipment (smartphone, tablet, or a computer with a stable Wi-Fi connection, a device with a camera, and headphones) and the digital platform (Zoom), as well as providing a practice session. We maintained a keen eye on nonverbal communication, with the presence of a moderator and two facilitators and observers to assist in interpretation and ensure coherence between verbal and nonverbal communication. The confidentiality of the participants was preserved by requesting the use of a virtual background and an individual, distraction-free space during the sessions.

The research adhered to the guidelines outlined in the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [35], ensuring a thorough and transparent reporting of the key study elements.

2.2. Population and Sampling. The study population consisted of nursing caregivers for patients with complex wounds and experts in wound care and tissue viability. The selection of expert participants was based on nationally renowned healthcare professionals in the care of patients with wounds associated with scientific societies, who met the predefined criteria. The choice of nurse caregivers enables to address the needs/opinions of professionals who care for patients with wounds but who have no advanced formation of the topic. It was based on the diversity of professional contexts and different regions of the country.

An intentional sample of 16 participants was selected, consisting of two groups: 8 experts in wound care and tissue viability, and 8 nursing caregivers for patients with complex wounds. The selection criteria for the experts were advanced training, at least ten years of professional experience, and a minimum of five years of experience providing care to patients with wounds.

For the remaining nurses, the criteria included at least 3 years of professional experience, working in a context where they care for patients with wounds, and not having specific training in the area.

An invitation was sent to twice as many participants via email, to reach the established minimum number.

Individuals were invited via personalized emails which introduced the research team, outlined the study objectives and the goals of the focus group, and included an invitation to participate in a Zoom meeting lasting not more than one hour and thirty minutes. Attached to the invitation were the informed and clarified consent terms, as well as a participant form.

Six experts participated in the focus group session, with an average age of 43 years. Among them, 83.3% were male and 16.7% were female; there were two doctors and 4 nurses; two members held postgraduate qualifications in wound care and tissue viability; 5 had scientific publications in the field of tissue viability; and all were trainers in this topic. The professional context of the participants consisted of three individuals working in a hospital setting, two in homecare, and one in a clinical consultation environment.

Seven nursing caregivers participated in the corresponding focus group, with an average age of 36 years. All participants were female, four had more than 10 years of professional experience and three had between one to 10 years of professional experience. In their degree programs, 42.9% of nurses underwent training in wounds and tissue viability, and all of them indicated a keen interest in the subject. The professional context of the participants consisted of two working in a hospital setting and five in homecare.

2.3. Data Collection Method. Two remote sessions were scheduled on April 6th and 7th, 2022, with each group, which took place outside of the participants' working hours. For these sessions, we prepared a presentation with slides, detailing the study's objective, the guidelines to be followed, and the guiding questions. These questions were designed not only to collect data on the evaluation of patients with wounds but also relevant information for the development of the app.

We encouraged participants to contribute additional ideas or raise questions during and after the discussion. Regarding the guiding questions for the discussion, the first was in the SurveyMonkey® online questionnaire format, and the following were open-ended questions:

(1) Considering the overall evaluation of a patient with chronic or complex wounds, within each domain (patient's clinical history, wound clinical history, local wound assessment, and performed treatment), how relevant is the presented subdomain? Answer using a Likert scale: (1) not relevant at all, (2) slightly relevant, (3) indifferent, (4) relevant, (5) very relevant, or I do not know (0):

   (a) User's clinical history domain: sex, age, follow-up reason, type of unit, skin phototype, associated diseases (diabetes, autoimmune diseases, congestive heart failure, oncological disease, peripheral neuropathy, anemia, malabsorption syndrome, peripheral arterial disease, peripheral venous disease, deep vein thrombosis, hypertension, chronic respiratory disease, chronic kidney disease, chronic liver disease, connective tissue diseases, obesity, stroke, endocrine diseases, neurodegenerative diseases, and others), medication in use (chemotherapy, corticosteroids, nonsteroidal anti-inflammatory drugs, immunosuppressants, anticoagulants, vasopressors, and others), tobacco consumption (last 12 months) and alcohol consumption (daily), allergies and sensitivities, weight, height, involuntary kilos lost in the last 3 to 6 months, analytical values of hemoglobin and plasma albumin, capillary glucose, blood pressure, overall quality of life, wound's impact on quality of life, and presence of other factors delaying healing, such as systemic infection, resistance to antimicrobials, malnutrition, dehydration, radiotherapy, stress, pressure, friction, shear, incontinence,

immobility, sedentarism, and/or nonadherence to the performed treatment.

(b) Wound clinical history domain: wound recurrence, wound origin, wound type, evaluation of the pedal and posterior tibial pulses, ankle-brachial pressure index value, wound's existence time, anatomical location, and the presence of other factors that delay healing, such as the presence of continuous trauma in the wound bed, hypoxia, and/or decreased tissue perfusion.

(c) Local wound assessment domain: shape, exudate (type and color, consistency, and quantity), odor, tissues reached or category of pressure ulcer, dimensions (length, width, and depth), topographic changes (undermining, fistulas, and tunneling) with location and extension, types and percentage of tissues in the wound bed, presence of epithelial tissue, characteristics of the edges, characteristics of the perilesional skin, surrounding skin (hydration, temperature, and sensitivity), signs and symptoms of infection and/or biofilm (stalled wound, increased exudate, very red and friable granulation tissue, presence of necrotic or devitalized tissue, increase in wound size, intense odor, and increase in temperature among others) and pain during treatment.

(d) Performed treatment domain: cleaning, debridement, applied dressing material, complementary and adjuvant therapies, fixation, and frequency of treatment.

(2) Which subdomains do you consider most specific for evaluating a patient with pressure ulcers, venous leg ulcers, arterial leg ulcers, neuropathic diabetic foot ulcers, and ischemic diabetic foot ulcers?

(3) Considering the various mnemonics that exist to support decision-making: TIME, DIM + E, TIMERS, MOIST, ASSESSMENTS, MEASURE, ABCESS, TIME clinical decision support tool (. . .), do you believe that any data, issue, or information that is not addressed should be included?

(4) What features do you consider important for an app in the approach to a patient with a wound?

(5) Considering that the teams have different levels of knowledge, different clinical experiences, and skills, and that the patient with a wound is scattered across different types of healthcare, what alerts do you think are important for an app to inform the user, in the approach to a patient with a wound?

The mediator (RM) and observers (PA and PR) are considered experts in wounds and tissue viability, according to the previously established criteria. During the sessions, they took field notes.

2.4. Data Analysis. The interviews were carefully transcribed by the moderator and returned to the two observers for comments and/or corrections. During the transcription of the interviews, we additionally looked for information that was not expressed verbally, but that stood out and revealed additional data that occurred during the interviews and the reactions of the interviewees. We explored the "latent level" of participants' experiences, seeking to uncover the underlying meaning of words [36].

The data coding process engaged two independent researchers (RM and PA), utilizing the deductive method through the NVivo software (QSR International, Melbourne, Australia). For the participant questionnaire, we leveraged a preexisting theoretical structure to aggregate data and reinforce previous knowledge. In open-ended questions, we build knowledge and enhance the predefined themes presented. Following this, the three researchers involved in the sessions collaborated on data interpretation, culminating in the establishment of the five main themes through consensual discussion and member checking. For some themes, given its scope, it was decided to elaborate subthemes, in order to facilitate the understanding of the different data units. Some units were coded into more than one theme, which demonstrates the complexity and articulation of the concepts underlying this theme.

The names assigned emerged from the participants' statements and from the concepts resulting from the theoretical framework. To increase the reliability of the results, all data were coded by two researchers. Any coding discrepancies were reconciled by the consensus of three researchers. This process ensured a rigorous and systematic approach to the analysis of the data collected, supporting the study's conclusions.

When analysing the data and writing the text, we chose to organize some of the themes that emerged from previous knowledge. The verbal expressions and narratives of the participants constitute a body of empirical knowledge that was treated to contextualize and give meaning to the themes. Therefore, we chose to prioritize the sense and meaning of the themes that emerged from the corpus as a whole, rather than particularizing and identifying each speech and its respective author.

2.5. Ethical Considerations. Participants provided their informed consent by signing detailed consent forms, where all their rights were comprehensively explained. Before we started recording the sessions, participants were asked for authorization for audiovisual recording, and verbal consent was given. It was emphasized to all participants that they had the right to withdraw their consent at any time without any detriment. Furthermore, all data were stored in a secure location, protected by access keys, and participants were identified by codes to ensure privacy and confidentiality. Postanalysis, all the collected audiovisual information and characterization surveys from the participants were permanently deleted at the end of the year 2022.

This study was reviewed and approved by the Ethics Committee of the Regional Health Administration of Northern Portugal (Decision reference: CE/2022/13).

3. Results

The interpretation of the data revealed 5 fundamental themes: (1) assessment of patients with complex wounds, (2) distinctive criteria based on the type of wound, (3) flowcharts for approaching patients with wounds, (4) characteristics of an app focused on the wound care, and (5) alerts to be included in a health app dedicated to wound treatment. The diversity of codes emerging from the analysis of the responses underscores the richness of the discussion, reflecting the presence of multiple perspectives within the focus group.

3.1. Theme 1: Assessment of Patients with Complex Wounds. A global assessment tool of the patient with a wound was built, consisting of 4 domains (the patient's clinical history, clinical history of the wound, local assessment of the wound, and treatment performed) and 67 subdomains. The tool was developed by the 3 researchers (RM, PA, and PR), based on an integral and holistic assessment of the patient with the wound and on risk factors for delayed healing, taken from the literature [5, 10, 14, 15, 37–44]. Participants were asked to assess the pertinence of each subdomain. Out of these, 58 were considered relevant or highly relevant, suggesting they should be included in a minimal dataset.

The subdomains that achieved unanimous agreement in both groups were associated pathologies (patient's clinical history), types of tissues in the wound bed (local wound assessment), and debridement (treatment).

The subdomains considered of low relevance or indifferent by the group of nurses were "analytical values of albumin" and "stress." From the group of experts, these were "sex," "type of hospital unit," "skin phototype," "tobacco consumption," "alcohol consumption," "height," "involuntary weight loss in the last 3 to 6 months" and "stress."

The open-ended responses led to the inclusion of additional subdomains as follows: (i) within the domain of the patient's clinical history, the expert group proposed the addition of "support network," "presence of elimination ostomy," and "profession," whereas the nursing group suggested "daily fluid intake," "dietary regime," "previous surgical history," and "patient's expectations regarding healing time;" (ii) within the domain of the wound's clinical history, both groups agreed on adding "cause of the wound" and the nursing group further proposed "previous treatments" and "adverse reactions to previous treatments"; (iii) within the domain of the treatment performed, the expert group suggested the addition of "characteristics of the removed dressing" and "how the dressing behaves during its time on the wound."

The final tool for the global evaluation of a patient with a wound was established with the following minimum data, as illustrated in Table 1.

3.2. Theme 2: Distinctive Criteria Based on the Type of Wound. The second theme focuses on the specific criteria for evaluating each type of wound, with notable input from the expert group.

In the context of ischemic diabetic foot ulcers, participants identified key factors such as intermittent claudication, vascular condition, previous history of surgery, peripheral arterial disease, ankle-brachial index (ABI), recurrence, smoking, glycosylated hemoglobin (HbA1c), nutritional status, physical activity, and self-care. Regarding neuropathic diabetic foot ulcers, relevant codes emerged, including vascular condition, foot deformities, previous history of surgery, ABI, progression of neuropathy, progression of diabetes, HbA1c, recurrence, nutritional status, and self-care.

For arterial ulcers, highlighted criteria included local wound characteristics, previous history of surgery, ABI, vascular condition, associated pathologies, recurrence, and self-care. As for venous leg ulcers, participants mentioned relevant aspects such as local wound characteristics, previous history of surgery, ABI, previous treatment and compression system, nutritional status, and quality of life.

In the case of pressure ulcers, a stronger consensus was observed between the groups, emphasizing the importance of evaluating friction, pressure, shear forces, incontinence, immobility, nutritional status, recurrence, and support network.

> In the group of nurses, one participant added "The big difference between homecare and hospital care will be the support network and self-care to maintain treatment and take care of the dressing, that is, knowing how to take care of yourself with the injury and dressing."

Table 2 summarizes the differentiating criteria by wound type.

3.3. Theme 3: Flowcharts for Approaching Patients with Wounds. This theme arises from the question posed to the participants regarding the use of schemes or mnemonics in the assessment and treatment of patients with wounds. The aim was to assess the importance given to this type of tool, as it facilitates and guides the healthcare professional's approach and provides a fundamental baseline for the standardization of assessment and interventions. The expert group further developed this question, suggesting the subthemes: advantages, disadvantages, and unaddressed information; however, it was a topic little discussed by the participants.

Table 3 presents the subthemes that emerged.

3.4. Theme 4: Characteristics of an App Focused on the Wound Care. This theme focuses on the features and specificities that an app can have to assist healthcare professionals in their approach to patients with wounds. The information was organized into four subthemes highlighting the key characteristics of an app in the approach to patients with wounds. Figure 1 schematically outlines the four subthemes that emerged.

3.5. Theme 5: Alerts to Be Included in a Health App Dedicated to Wound Treatment. The participants were asked about the type of informative or actionable alerts that would be useful

Table 1: Minimum data for global assessment of a patient with a wound.

Domain	Subdomain
User's clinical history	Age
	Support network
	Profession
	Follow-up reason
	Associated diseases
	Medication in use
	Allergies and sensitivities
	Previous surgical history
	Weight
	Daily water intake and diet
	Analytical hemoglobin values
	Capillary glucose
	Blood pressure
	Overall quality of life
	Wound's impact on quality of life
	Expectations of the patient regarding healing time
	Presence of elimination ostomy
	Systemic infection
	Resistance to antimicrobials
	Radiotherapy
	Nonadherence to the treatment performed
	Presence of other factors that delay healing, such as pressure, friction, shear, incontinence, immobility, and/or sedentarism
Clinical history of the wound	Cause of the wound
	Wound recurrence
	Wound origin
	Wound type
	Evaluation of the pedal and posterior tibial pulses
	Ankle-brachial index
	Wound's existence time
	Anatomical location
	Presence of other factors that delay healing, such as the presence of continuous trauma in the wound bed, hypoxia, and/or decreased tissue perfusion
Local assessment of the wound	Shape
	Exudate
	Odor
	Tissues reached or category of pressure ulcer
	Dimensions
	Topographic changes with location and extension
	Types and percentage of tissues in the wound bed
	Presence of epithelial tissue
	Characteristics of the edges
	Characteristics of the perilesional skin
	Surrounding skin
	Signs and symptoms of infection and/or biofilm
	Pain during treatment
Treatment performed	Cleaning
	Debridement
	Applied dressing material
	Complementary and adjuvant therapies
	Fixation
	Frequency of treatment
	Behavior of the dressing removed

for an app to provide to the user during the approach to patients with wounds. The alerts could be used to draw the user's attention to something urgent or relevant, and the focus was not on the type of alert, but rather the content of the alerts. The group of experts added specific action alerts by the type of wound, revealing a possible configuration for creating alerts to be incorporated into the app.

The content of the alerts directed at healthcare professionals mentioned by the nursing group included allergies, number of treatment days, need for reassessments,

Table 2: Differentiating criteria by the type of wound.

	Ischemic diabetic foot ulcers	Neuropathic diabetic foot ulcers	Arterial ulcers	Venous leg ulcers	Pressure ulcers/injuries
Intermittent claudication	X				
Vascular condition	X	X	X	X	
Previous history of surgery	X	X	X	X	X
Peripheral arterial disease	X				
ABI	X	X	X	X	
Toe brachial index	X	X	X	X	
Recurrence	X	X	X	X	X
Smoking	X				
Glycated hemoglobin	X	X	X	X	
Serum albumin	X	X			
Nutritional status	X	X	X	X	X
Body mass index	X	X			
Physical activity	X	X	X	X	
Profession	X	X	X	X	
Self-care	X	X	X	X	X
Foot deformities		X			
Progression of neuropathy		X			
Progression of diabetes		X			
Associated diseases			X	X	
Medication					X
Adherence to treatment				X	
Anatomical location					X
Quality of life				X	
Evaluation of frictional pressure and shear forces					X
Skin frailty					X
Incontinence					X
Immobility					X
Support network	X	X	X	X	X
Care context	X	X	X	X	X
Previous load relief mechanisms	X	X			
Treatment and precompression system			X	X	
Local characteristics of the wound			X	X	

ABI, ankle-brachial index.

Table 3: Theme 3: flowcharts in approaching the patient with a wound.

	Subthemes
Advantages	Compare results Saves time Easy to memorize Guides assessment and interventions Handles records and documentation Simple Systematizes the evaluation
Disadvantages	Too many fulfilling criteria
Information that is not addressed	Therapeutic adherence to protein intake

increase or onset of pain, patient or caregiver doubts, previous history of ulcers, interactions between dressing materials, choice of dressings with the same therapeutic effect (e.g., "*combining two topical antimicrobials*"), and changes to previous treatment (e.g., "*is it really necessary to change the treatment*?").

The expert group suggested general alerts such as referral requests, need for reassessments, number of treatment days, and wound healing rate. The specific actionable alerts for diabetic foot ulcers, arterial ulcers, and venous leg ulcers that emerged were evaluating vascular condition, palpating pulses, performing ABI measurement, referring for further evaluation, and assessing pain. They also added that any changes in wound characteristics should trigger an informative alert to the healthcare professional. One of the experts added contributions regarding the triggering of alerts "*Alerts must be given early, that is, as soon as the diagnosis is made, because if the alert only appears after*

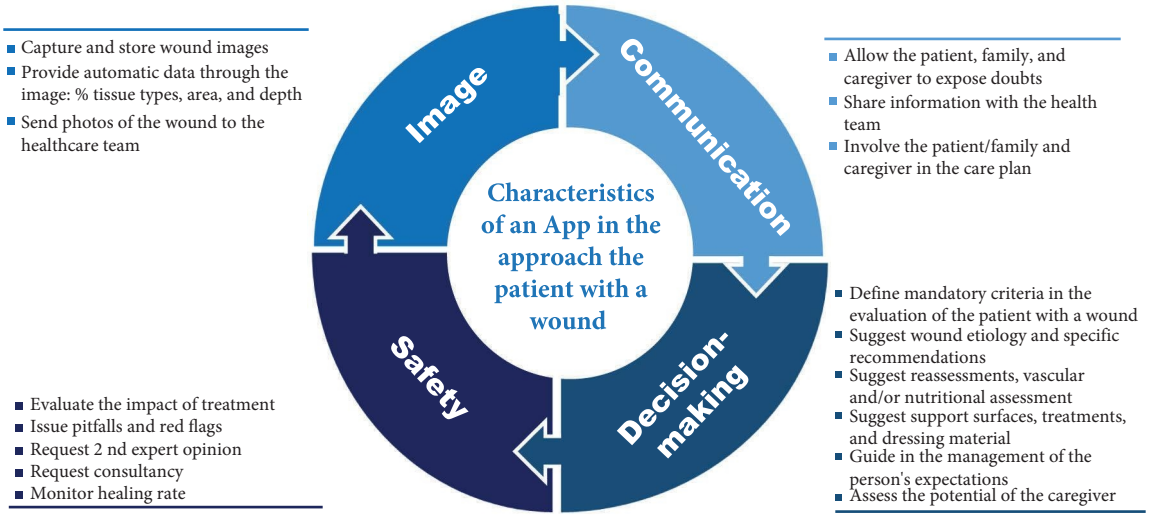

Figure 1: Characteristics of an app in approaching the patients with a wound.

recording the treatment carried out, it may be too late. For example, selecting the diagnosis of leg ulcer, even without knowing the aetiology, *the system must immediately create attention alerts, perform the ABI and perform vascular assessment*."

4. Discussion

This study aimed to identify the minimum data necessary for a comprehensive assessment of patients with complex wounds to be integrated into an mHealth solution. To achieve this, a tool was developed, and an online focus group was conducted to encourage the exploration of diverse perspectives, thereby enriching the developed tool and naming some essential requirements for constructing an mHealth application in the care of patients with complex wounds.

The quality of the group discussion and the observed enthusiasm among participants highlight the advantages of developing tools that provide guidance for a systematic approach and draw attention to critical aspects in the care of patients with wounds. By fostering safe decision-making based on evidence, these tools can contribute to improved patient outcomes. The establishment of a minimum data summary within an mHealth application is expected to facilitate a more consistent and standardized approach to wound assessment, promoting enhanced clinical decision-making and optimizing the quality of care provided to patients with complex wounds.

Stating the group's agreement in qualifying the variables presented in the questionnaire as relevant and very relevant, we can assume that we have built a comprehensive, diversified tool (for various types of complex wounds and contexts) and that it can be a useful instrument for assessing the patients with complex wound. Resulting from the analysis of the participants' speeches, we can find, underlyingly, different concerns, related to the context where they develop the practice of caring for the patient with a wound (context of primary healthcare versus hospital context). The focus on providing the tool with integration/support mechanisms for caregivers also has, in their speeches, a different preponderance, depending on their context of care practice. We consider that it was this assortment of contributions, due to the diversity of responses and homogeneity of the group of participants, which gave a comprehensive and diverse character to the tool that was built, as it was previously mentioned.

We obtained greater divergence in the group of experts, and from the analysis of interactions, we infer that the participants attribute greater relevance to the local assessment of the wound rather than to the global assessment of the patient with the wound, since they exclude the variables of the clinical history of the user of the data collecting tool. This choice of the participants is consistent with what is described in the literature, since the characteristics of the wound have a greater impact on healing than on systemic or demographic factors [45].

The identification of a greater number of characteristics by the group of nurses underscores the significance of an electronic mHealth tool in supporting decision-making for less experienced nurses in wound care. This finding highlights the utility of such a tool in providing comprehensive guidance and support to nurses who may have limited expertise in managing wounds. By incorporating a wide range of essential characteristics into the mHealth tool, it can effectively enhance the decision-making process, promote standardized care practices, and improve patient outcomes.

By obtaining a 100% consensus among the participants, we consider that the subdomains associated with diseases (patient's clinical history), types of tissues in the wound bed (wound assessment), and type of debridement (treatment) are essential in the minimum summary of data.

In the theme of *distinctive criteria based on the type of wound,* the expert group made notable contributions by suggesting more specific criteria for each type of wound. This analysis serves to emphasize the important aspects that should be assessed in each specific wound type and establish the necessary criteria for differential diagnosis to be

incorporated into the mHealth application. The expert group's input highlights the importance of considering these factors when assessing and managing different types of wounds. These criteria provide valuable guidance for healthcare professionals in making accurate diagnoses and implementing appropriate interventions tailored to each specific wound type. Incorporating these criteria into the mHealth application can enhance the accuracy and efficiency of wound assessment and ultimately improve the quality of care provided to patients with complex wounds.

Participants reached a consensus on the significance of evaluating previous surgical history, ABI assessment, nutritional status, support network, care context, self-care, and wound recurrence.

The theme *Flowcharts for approaching patients with wounds* generated less discussion among the group of nurses, as only one participant had prior knowledge of this type of tool. However, the expert group, in addition to being familiar with flowcharts, applied mnemonic devices, stating, for example, that "*mnemonics are only guiding lines but end up helping to systematize wound assessment and approach. I use* TIME an TIMERS (. . .) they *help me choose which agents to use in each intervention area, seeking simplicity, ease of retention, without too many parameters, and in that simplicity, helping me choose a simple and targeted treatment*." Another expert added, "*I always try to evaluate and record using the same sequence to create some evaluation automatisms, save time, avoid information losses, enable evaluation and outcome comparisons*." Flowcharts or acronyms can promote teaching and quick learning in evidence-informed care for the patient with wound, maximizing healing potential and ensuring a comprehensive assessment [46].

In the theme *Characteristics of an app focused on the wound care*, the importance of image stands out, both for the comprehensive assessment of patients with wounds and for incorporation into mHealth applications. The use of digital image systems in wound care has proven advantageous and superior to clinical evaluation, as they have the ability to accurately and consistently measure changes in wound size and healing over time in a standardized manner, thus contributing to decision-making [47, 48]. They also have the advantage of improving the experiences of patients and caregivers by facilitating communication among various healthcare professionals [49]. Systems that allow for wound size assessment through imaging are important not only for monitoring wound progression but also for predicting wound healing [45, 50, 51]. Key characteristics of mHealth applications that emerged from the discussion included the ability to share images, promote communication between professionals and patients/families, support decision-making, and ensure safety in action.

The *Alerts to be included in a health app dedicated to wound treatment* were more focused on vascular assessment, referral, and reassessment, which are commonly recommended for lower limb ulcers [46, 52, 53].

It is important to recognize that implementing a clinical decision support system application has its challenges. Some of the common challenges associated with using decision support systems include lack of flexibility, lack of logical flow, lack of time for data entry, lack of computer skills, resistance to the use of technologies, lack of training, lack of information about system implementation, workplace culture, lack of trust and credibility, constant alerts, lack of interoperability, and frustration when using applications [54, 55]. Furthermore, it is important to consider the need to keep system knowledge constantly updated, as well as deal with the specific vocabulary used and possible changes in the workflow, which can affect the effectiveness and acceptance of these systems [56]. For nurses, we can also add the lack of understanding of the development of knowledge of the decision-support system to support nursing practice and the lack of representation of the nursing process in these systems [57]. It is observed that there is a certain resistance and lack of involvement of professionals about these tools [55, 57].

The use of health information systems facilitates research, data comparison, communication, data-driven decision-making, resource management, result monitoring, error reduction, care safety, and personalized healthcare [58]. These systems also ensure that a high quality of care is provided, since they reduce potential divergences in decision-making, inherent to the different levels of expertise of the different care providers. These benefits can be transversal to the context of the injured patient when using an information system with a minimum summary of data established for the complete assessment of the patient and their wound.

4.1. Limitations. Several limitations should be acknowledged in this study. First, the sample size was smaller than originally intended, which may have restricted the richness and diversity of the discussion among participants. A larger sample size would have allowed for a more comprehensive exploration of perspectives and a deeper understanding of the topic.

Second, it is important to recognize the subjective nature of the discussion. Although efforts were made to promote open and inclusive dialogue, individual opinions and experiences may have influenced the outcomes. It is worth considering the potential impact of bias or personal preferences on the identified themes and subthemes.

In addition, the development of the wound assessment tool was primarily based on existing literature without a systematic review. While the tool was informed by relevant evidence, the absence of a systematic review may have introduced potential gaps or inconsistencies in the selection and inclusion of specific variables. Despite these limitations, this study provides valuable insights into the development of a clinical data model and the potential of digital solutions in wound care.

Participants did not provide feedback on the results, and we only obtained verification from three researchers, which can be considered an aspect to improve in future research.

Another possible limitation of the study refers to the low internal consistency values since we did not reach data saturation, due to the predefined selection of the number of sessions. However, what interested us was the emergence of important themes related to the question and objective of the research.

4.2. Implications for Nursing Practice. This study has contributed to the development of a clinical data model for an integrated assessment of patients with chronic or complex wounds, addressing the specific needs expressed by nurses to support evidence-based decision-making in wound care. This minimum data summary can be integrated into an app to support the nurse's decision-making and the standardized assessment of the patient with a wound.

A structured assessment and adequate management of nursing care provide several benefits to the patient, such as faster healing rates; reduction in the physical, emotional, and socioeconomic impact of complex wounds; reduction in associated costs; and increased nurse and patient satisfaction when achieving expected results [10].

5. Conclusions

The identification of five key themes in this study, namely, the assessment of patients with complex wounds, distinctive criteria based on the type of wound, flowcharts for approaching patients with wounds, characteristics of an app focused on the wound care, and alerts to be included in the mHealth dedicated to wound treatment, provided a comprehensive framework for the development of a digital solution. The theme of characteristics of an app focused on wound care is as follows: image, communication, decision-making, and safety. These subthemes highlight the importance of efficient communication, evidence-based decision-making support, utilization of imaging technologies, and ensuring patient safety within the context of wound care. The utilization of standardized assessment tools and wound monitoring systems not only facilitates the collection of relevant data but also enables the generation of outcome indicators and quality of care measures for patients with chronic or complex wounds. By serving as guides for best practices in wound care, these tools have the potential to improve health outcomes, enhance economic efficiency, and positively impact the overall quality of life of patients with wounds and their caregivers.

The findings of this study contribute to the advancement of evidence-based wound care by establishing a robust clinical data model and highlighting the significance of incorporating digital solutions, such as mHealth applications, in the management of patients with chronic or complex wounds. Further research and development efforts should focus on the implementation and evaluation of such digital interventions to ensure their effectiveness and widespread adoption in clinical practice.

Data Availability

The data used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this article.

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References

[1] J. Cifuentes and S. Guerrero, "Psychosocial factors of patients with venous leg ulcers and their association with healing," *Revista Estima*, vol. 18, pp. 1–14, 2020.

[2] M. Olsson, K. Järbrink, U. Divakar et al., "The humanistic and economic burden of chronic wounds: a systematic review," *Wound Repair and Regeneration*, vol. 27, no. 1, pp. 114–125, 2019.

[3] R. G. Sibbald, J. A. Elliott, R. Persaud-Jaimangal et al., "Wound bed preparation 2021," *Advances in Skin and Wound Care*, vol. 34, no. 4, pp. 183–195, 2021.

[4] K. Woo, E. A. Ayello, and R. G. Sibbald, "The edge effect: current therapeutic options to advance the wound edge," *Advances in Skin and Wound Care*, vol. 20, no. 2, pp. 99–117, 2007.

[5] M. Moura, C. Dowsett, K. Bain, and M. Bain, "Advancing practice in holistic wound management: a consensus-based call to action," *Wounds International*, vol. 11, no. 4, pp. 70–75, 2020.

[6] R. G. Sibbald, L. Goodman, K. Y. Woo et al., "Special considerations in wound bed preparation 2011: an update," *Advances in Skin and Wound Care*, vol. 24, no. 9, pp. 415–436, 2011.

[7] L. Atkin, Z. Bućko, E. C. Montero et al., "Implementing TIMERS: the race against hard-to-heal wounds," *Journal of Wound Care*, vol. 28, no. Sup3a, pp. S1–S50, 2019.

[8] B. M. Kyaw, K. Järbrink, L. Martinengo, J. Car, K. Harding, and A. Schmidtchen, "Need for improved definition of chronic wounds in clinical studies," *Acta Dermato-Venereologica*, vol. 98, no. 1, pp. 157-158, 2018.

[9] S. Coleman, E. A. Nelson, P. Vowden et al., "Development of a generic wound care assessment minimum data set," *Journal of Tissue Viability*, vol. 26, no. 4, pp. 226–240, 2017.

[10] U. K. Wounds, "Best Practice Statement: improving holistic assessment of chronic wounds," *Wounds UK*, 2018.

[11] H. Mombini, B. Tulu, D. Strong et al., "Design of a machine learning system for prediction of chronic wound management decisions," *Designing for Digital Transformation. Co-Creating Services with Citizens and Industry*, vol. 15, pp. 15–27, 2020.

[12] C. S. T. Dowsett and T. Karlsmark, "A focus on the Triangle of Wound Assessment—addressing the gap challenge and identifying suspected biofilm in clinical practice," *Wounds International*, vol. 10, no. 3, pp. 34–39, 2019.

[13] C. Schaarup, L. B. Pape-Haugaard, and O. K. Hejlesen, "Models used in clinical decision support systems supporting healthcare professionals treating chronic wounds: systematic literature review," *JMIR Diabetes*, vol. 20, no. 6, 2018.

[14] S. Baranoski and E. Ayello, *Wound Care Essentials-Practice Principles*, Wolters Kluwer, Alphen aan den Rijn, Netherlands, 4th edition, 2020.
[15] C. Dowsett, K. Protz, M. Drouard, and K. G. Harding, *Triangle of Wound Assessment. Made Easy*, Wounds International, Alphen aan den Rijn, Netherlands, 2015.
[16] L. B. Jørgensen, J. A. Sørensen, G. B. E. Jemec, and K. B. Yderstræde, "Methods to assess area and volume of wounds – a systematic review," *International Wound Journal*, vol. 13, no. 4, pp. 540–553, 2016.
[17] S. Smet, S. Probst, S. Holloway, A. Fourie, H. Beele, and D. Beeckman, "The measurement properties of assessment tools for chronic wounds: a systematic review," *International Journal of Nursing Studies*, vol. 121, Article ID 103998, 2021.
[18] J. Koepp, M. V. Baron, P. R. Hernandes Martins et al., "The quality of mobile apps used for the identification of pressure ulcers in adults: systematic survey and review of apps in app stores," *JMIR Mhealth Uhealth*, vol. 8, no. 6, Article ID e14266, 2020.
[19] S. Pinto, S. Caldeira, and J. C. Martins, "e-Health in palliative care: review of literature, Google Play and App Store," *International Journal of Palliative Nursing*, vol. 23, no. 8, pp. 394–401, 2017.
[20] World Health Organization, "Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth Geneva2010," 2021, https://www.who.int/goe/publications/goe_telemedicine_2010.pdf.
[21] S. Pinto, S. Caldeira, and J. C. Martins, "E-health in palliative care: what do research beginners need to know?" *International Journal of Palliative Nursing*, vol. 22, no. 12, pp. 577–579, 2016.
[22] World Health Organization, *mHealth: New Horizons for Health through mobile Technologies: Second Global Survey on eHealth*, World Health Organization, Geneva, Switzerland, 2011.
[23] National Health System Innovations South East, "App development: an NHS guide for developing mobile healthcare applications: NHS," 2014, https://citcentoolkit.files.wordpress.com/2018/04/98533_nhs_inn_appdevroad.pdf.
[24] D. Beeckman, E. Clays, A. Van Hecke, K. Vanderwee, L. Schoonhoven, and S. Verhaeghe, "A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial," *International Journal of Nursing Studies*, vol. 50, no. 4, pp. 475–486, 2013.
[25] M. Casal-Guisande, A. Comesaña-Campos, J. Cerqueiro-Pequeño, and J. B. Bouza-Rodríguez, "Design and development of a methodology based on expert systems, applied to the treatment of pressure ulcers," *Diagnostics*, vol. 10, no. 9, p. 614, 2020.
[26] K. Kawamoto, C. A. Houlihan, E. A. Balas, and D. F. Lobach, "Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success," *BMJ*, vol. 330, no. 7494, p. 765, 2005.
[27] A. M. Shahsavarani, E. Azad Marz Abadi, M. Hakimi Kalkhoran, S. Jafari, and S. Qaranli, "Clinical decision support systems (CDSSs): state of the art review of literature," *International Journal of Medical Reviews*, vol. 2, no. 4, pp. 299–308, 2015.
[28] A. Abdellatif, J. Bouaud, C. Lafuente-Lafuente, J. Belmin, and B. Séroussi, "Computerized decision support systems for nursing homes: a scoping review," *Journal of the American Medical Directors Association*, vol. 22, no. 5, pp. 984–994, 2021.
[29] H. K. R. Nair, "Increasing productivity with smartphone digital imagery wound measurements and analysis," *Journal of Wound Care*, vol. 27, pp. S12–S19, 2018.
[30] H. Y. Chang, Y. P. Hou, F. H. Yeh, and S. S. Lee, "The impact of an mHealth app on knowledge, skills and anxiety about dressing changes: a randomized controlled trial," *Journal of Advanced Nursing*, vol. 76, no. 4, pp. 1046–1056, 2020.
[31] B. Tran, B. Rafinejad-Farahani, S. Moodie, R. O'Hagan, and D. Glista, "A scoping review of virtual focus group methods used in rehabilitation sciences," *International Journal of Qualitative Methods*, vol. 20, 2021.
[32] S. Dodds and A. C. Hess, "Adapting research methodology during COVID-19: lessons for transformative service research," *Journal of Service Management*, vol. 32, no. 2, pp. 203–217, 2021.
[33] M. Saarijärvi and E.-L. Bratt, "When face-to-face interviews are not possible: tips and tricks for video, telephone, online chat, and email interviews in qualitative research," *European Journal of Cardiovascular Nursing*, vol. 20, no. 4, pp. 392–396, 2021.
[34] N. Daniels, P. Gillen, K. Casson, and I. Wilson, "STEER: factors to consider when designing online focus groups using audiovisual technology in health research," *International Journal of Qualitative Methods*, vol. 18, 2019.
[35] A. Tong, P. Sainsbury, and J. Craig, "Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups," *International Journal for Quality in Health Care*, vol. 19, no. 6, pp. 349–357, 2007.
[36] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, 2006.
[37] C. Dowsett, K. Bain, C. Hoffmann et al., "The Wound Care Pathway-an evidence-based and step-by-step approach towards wound healing," *Wounds International*, vol. 12, no. 3, pp. 78–85, 2021.
[38] S. Guo and L. A. DiPietro, "Factors affecting wound healing," *Journal of Dental Research*, vol. 89, no. 3, pp. 219–229, 2010.
[39] A. Tarricone, K. De La Mata, M. Rothstein, and R. L. Soave, "The effect of wound pH on healing rates in chronic wounds: a literature review," *Journal of the American Podiatric Medical Association*, vol. 110, no. 6, 2020.
[40] H. Khalil, M. Cullen, H. Chambers, M. Carroll, and J. Walker, "Elements affecting wound healing time: an evidence based analysis," *Wound Repair and Regeneration*, vol. 23, no. 4, pp. 550–556, 2015.
[41] K. Anderson and R. Hamm, "Factors that impair wound healing," *Journal of the American College of Clinical Wound Specialists*, vol. 4, no. 4, pp. 84–91, 2012.
[42] C. Hess, "Checklist for factors affecting wound healing," *Advances in Skin and Wound Care*, vol. 24, no. 4, p. 192, 2011.
[43] E. Avishai, K. Yeghiazaryan, and O. Golubnitschaja, "Impaired wound healing: facts and hypotheses for multi-professional considerations in predictive, preventive and personalised medicine," *The EPMA Journal*, vol. 8, no. 1, pp. 23–33, 2017.
[44] R. Marques, M. Lopes, P. Ramos, J. Neves-Amado, and P. Alves, "Prognostic factors for delayed healing of complex wounds in adults: a scoping review," *International Wound Journal*, vol. 20, no. 7, pp. 2869–2886, 2023.
[45] S. K. Cho, S. Mattke, H. Gordon, M. Sheridan, and W. Ennis, "Development of a model to predict healing of chronic wounds within 12 weeks," *Advances in Wound Care*, vol. 9, no. 9, pp. 516–524, 2020.

[46] J. McGuire, E. Love, T. C. Vlahovic et al., "The ABCESS system for chronic wound management: a new acronym for lower extremity wound management," *Wounds*, vol. 32, no. 11, pp. S1–s25, 2020.
[47] N. Santamaria, F. Ogce, and A. Gorelik, "Healing rate calculation in the diabetic foot ulcer: comparing different methods," *Wound Repair and Regeneration*, vol. 20, no. 5, pp. 786–789, 2012.
[48] K. S. Chan, Y. M. Chan, A. H. M. Tan et al., "Clinical validation of an artificial intelligence-enabled wound imaging mobile application in diabetic foot ulcers," *International Wound Journal*, vol. 19, no. 1, pp. 114–124, 2022.
[49] M. R. Friesen, C. Hamel, and R. D. McLeod, "A mHealth application for chronic wound care: findings of a user trial," *International Journal of Environmental Research and Public Health*, vol. 10, no. 11, pp. 6199–6214, 2013.
[50] S. C. Wang, J. A. E. Anderson, R. Evans et al., "Point-of-care wound visioning technology: reproducibility and accuracy of a wound measurement app," *PLoS One*, vol. 12, no. 8, p. e0183139, Article ID e0183139, 2017.
[51] M. Berezo, J. Budman, D. Deutscher, C. T. Hess, K. Smith, and D. Hayes, "Predicting chronic wound healing time using machine learning," *Advances in Wound Care*, 2021.
[52] M. Beaumier, B. Murray, M. A. Despatis et al., "Best practice recommendations for the prevention and management of peripheral arterial ulcers in: foundations of best practice for skin and wound management," *A Supplement of Wound Care Canada*, p. 78, 2020, https://www.woundscanada.ca/docman/public/health-care-professional/bpr-workshop/1690-wc-bpr-prevention-andmanagement-of-peripheral-arterial-ulcers-1921e-final/file.
[53] U. K. Wounds, *Holistic Management of Venous Leg Ulceration*, Wounds UK, London, UK, 2nd edition, 2022.
[54] S. M. Araujo, P. Sousa, and I. Dutra, "Clinical decision support systems for pressure ulcer management: systematic review," *JMIR Med Inform*, vol. 8, no. 10, Article ID e21621, 2020.
[55] C. Borum, "Barriers for hospital-based nurse practitioners utilizing clinical decision support systems: a systematic review," *CIN: Computers, Informatics, Nursing*, vol. 36, no. 4, pp. 177–182, 2018.
[56] E. S. Berner and T. J. La Lande, *Overview of Clinical Decision Support Systems. Clinical Decision Support Systems: Theory and Practice*, Springer New York, New York, NY, USA, 2007.
[57] R. Piscotty and B. Kalisch, "Nurses' use of clinical decision support: a literature review," *CIN: Computers, Informatics, Nursing*, vol. 32, no. 12, pp. 562–568, 2014.
[58] M. Khalifa, "Perceived benefits of implementing and using hospital information systems and electronic medical records," *Studies in Health Technology and Informatics*, vol. 238, pp. 165–168, 2017.