DEVELOPMENT OF SOFTWARE FOR SYSTEMATIZATION OF NURSING CARE FOR PATIENTS WITH HEART DISEASE

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ABSTRACT

Cardiovascular disease is the leading cause of morbidity and mortality in developed countries and has been one of the leading causes of morbidity and mortality in Brazil. Thus, nurses must be able to recognize and interpret clinical signs of cardiovascular changes. The objective of this study is to describe the development of a prototype *software* for application in the Nursing Process in medical and surgical clinic units that care for cardiac patients. Technological development study, which consists of building and developing *software*. To this end, an integrative review was carried out regarding the use of care technologies for nursing in patients with heart disease. The bibliographic research carried out on the platforms did not show any scientific article that contemplates the systematization of nursing care in patients with heart disease through mobile applications. Thus, the elaboration of the mobile application was carried out by searching in specialized bibliography of standardized nursing languages linked to the surgical and clinical conditions

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of cardiac patients, through the stages of modeling, navigation design, abstract interface design and implementation. The construction of the application followed rigorous elaboration methods, based on a safe theoretical framework and may be important in the context of nurses' professional activities.

Keywords: Nursing. Systematization of Nursing Care. Cardiopathy. Software.

INTRODUCTION

Cardiovascular disease (CVD) is the main cause of morbidity and mortality in developed countries (Zäo *et al*, 2019), and has been one of the main causes of morbidity and mortality in Brazil, which in addition to generating functional disabilities in affected individuals, generate a high cost in hospitalizations and hospital services for the health system (Gomes *et al*, 2023).

The causes that lead to CVD are associated with several factors, however, the classic risk factors stand out, such as: hypertension, smoking, obesity, sedentary lifestyle, diabetes mellitus, family history, and especially coronary artery disease (CAD) (Précoma *et al*, 2019).

Thus, nursing professionals must be able to recognize and interpret clinical signs, early diagnostic methods of cardiovascular alterations during the admission, evaluation, and client care process (Domingos; Silva; Oliveira, 2021).

Nursing is a science (Cofen, 2017), and it is inserted in the complexity of care, its actions must be based on scientific theories and evidence, which aim at the quality of this care, and obtain expected results, which mainly promote the integrality of the individual (Nascimento *et al*, 2022).

The Systematization of Nursing Care (NCS) is the method responsible for the organization of work, in terms of the method itself, personnel and instruments, enabling the operationalization of the Nursing Process (NP) (Cofen, 2024; Almeida *et al*, 2023).

The Nursing Process (NP) is organized into five interrelated and interdependent stages: Nursing Evaluation; the Nursing Diagnosis; Nursing Planning; the Implementation of Nursing, and the Evolution of Nursing. And within the planning stage, the prioritization of nursing diagnoses, the determination of expected results and nursing prescription should be included. The NP should be based on Theories, Care Models, Standardized Language Systems, evidence-based protocols, and other instruments with conceptual theoretical structures, validated for risk assessment, prediction, explanation, description and prescription that serve as a basis, applied deliberately and systematically in all socio-environmental contexts in which Nursing care occurs (Cofen, 2024).

Over the last few years, there has been an increase in the use of technological innovations in health care (Vitoriano *et al*, 2023). With regard to technologies, we can say that they are instruments, methods, procedures, equipment and techniques used in the production of health services and/or products, and in relation to Nursing, these services, technological products, sublimate care practices, interpersonal relationships and management of work processes within health services (Lima *et al*, 2024).

Technologies are essential for a health system, and must ensure safety, quality, efficiency, and cost-effectiveness based on quality scientific evidence (Silva; Elias, 2019). Thus, this study aims to describe the development of a prototype *software* for the application of the Nursing Process in medical and surgical clinic units that care for patients with heart disease.

METHODOLOGY

TYPES OF STUDY

It is a study of technological development of a *software* called SAEcardio.

LITERATURE RESEARCH

First, an integrative review of the national and international literature on the use of assistive technologies was chosen. The PICo strategy was used to delimit the research question, in which P corresponds to Population, I to Interest and Co to Context, thus, in this study P is nursing, I is nursing technologies and care, and Co is heart disease, in sequence, the following question was structured: What technologies have been developed for nursing care in patients with heart disease?. The inclusion criteria were: research on mobile technology built or used in nursing care for heart disease. The exclusion criteria were: dissertation/thesis, editorial, abstracts in annals, case report, literature review article or studies that are not available in full. The search for articles was performed in the following databases: Medical Literature Analysis and Retrieval System online (Medline), Latin American and Caribbean Literature on Health Sciences (LILACS) and Nursing Database (BDENF). Advanced searches were carried out using the Health Sciences Descriptors (DeCS) and Medical Subject Headings (Mesh), the following cross-references were made using the Boolean operator AND and also using its alternative terms: nursing, nursing care, technologies/technology, smartphone and cardiopathy.

In addition, specific books for the area of cardiology nursing were evaluated, as well as the standardized nursing languages (NANDA, NIC and NOC) for the elaboration of care plans according to the clinical and/or surgical condition of patients with heart disease.

CONSTRUCTION OF THE APPLICATION

To build the application called SAEcardio, 4 steps were followed by (Zambalde, 2001; Rossi, 1996): 1) modeling, 2) navigation design, 3) abstract interface design, and 4) implementation. The first stage consisted of the conceptual elaboration for the domain of the problem presented, allowing to define how the hypermedia will be structured in order to

facilitate the understanding, discussion and approval of a system. Thus, at this stage, the contents and the form of presentation to the target audience were defined.

From the choice of structure and contents, the structuring of access was carried out for the fluidity of the user's navigation through the application, with the definition of menus, indexes, itineraries and images as well as their organization within the application, thus completing the second step of the construction of the tool.

In the third step, the appearance of the system and specification of the interface that the user can view and actions of each click were defined. After this phase, the detailed review of the previous processes is carried out, the implementation for the *Android*, iOS and *Windows platforms began* through the Powerapps application. Here, all the generated content is transformed into the executable application.

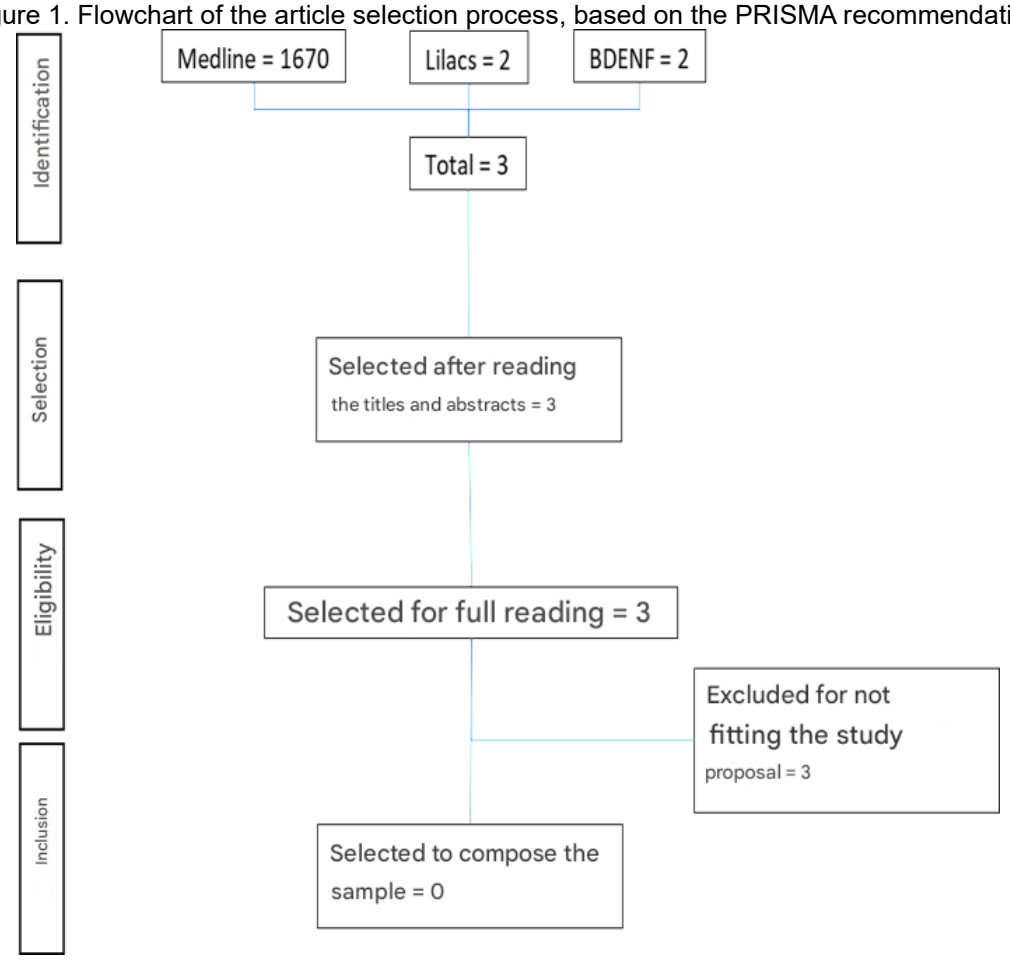
RESULTS AND DISCUSSIONS

LITERATURE REVIEW

The search phases were followed and described based on the flowchart of the recommendation Main Items for Reporting Systematic Reviews and Meta-analyses (PRISMA), as can be seen in Flowchart 1.

Initially, in the identification phase, 1674 articles were found, of which 1670 were in Medline, 02 in LILACS, and 02 in BDENF. In the selection phase, the refinement of the findings was carried out, in which it was done from the reading of the titles and abstracts, selecting 0 articles following the inclusion and exclusion criteria and eliminating the repeated articles. Thus, 1671 studies were excluded and 5 were selected. Of these, 02 were excluded by repetition. The remaining 03 articles were read in full and it was found that these articles presented disagreement regarding the proposal of this study. None of the articles presented a mobile technology that answered the initial research question. Information was found on patient monitoring, general guidelines and protocols on treatment and monitoring of cardiac complications and other pathologies, educational tools, but none addressed NCS, care for heart disease and technologies. This result, in line with the prevalence of heart diseases in Brazil, is being considered to support the importance of building the NCS mobile application for nursing care in a hospital environment for patients with heart disease. After reviewing the literature, none of the articles found presented a mobile technology that met the initial research question.

Figure 1. Flowchart of the article selection process, based on the PRISMA recommendation.



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DEVELOPMENT OF THE SAECARDIO SOFTWARE

The results are presented following the construction steps described in the methodology. In the first stage, we chose to model the application based on the stages of the nursing process according to clinical heart diseases and surgical heart diseases. Access to the stages of the nursing process according to the clinical and/or surgical characteristics of heart disease was the most complex part of the application planning, as it was necessary to define sets of information and interrelationships between diagnoses, expected results and nursing interventions. For this definition, a search was carried out in specialized books on cardiology nursing that contemplate the links between the standardized nursing languages (NANDA, NOC and NIC) with the clinical and/or surgical condition of patients with heart disease, as can be seen in Table 1.

Table 1. Literatures selected to compose the stages of the nursing process

Stage	Findings in the literature
Diagnosis	• Taxonomia and NANDA-I 2021-2023 (NANDA INTERNATIONAL, 2021) • Medical-Surgical Nursing Treaty (HINKLE, Janice L.; CHEEVER, Kerry H.; OVERBAUGH – 2023)

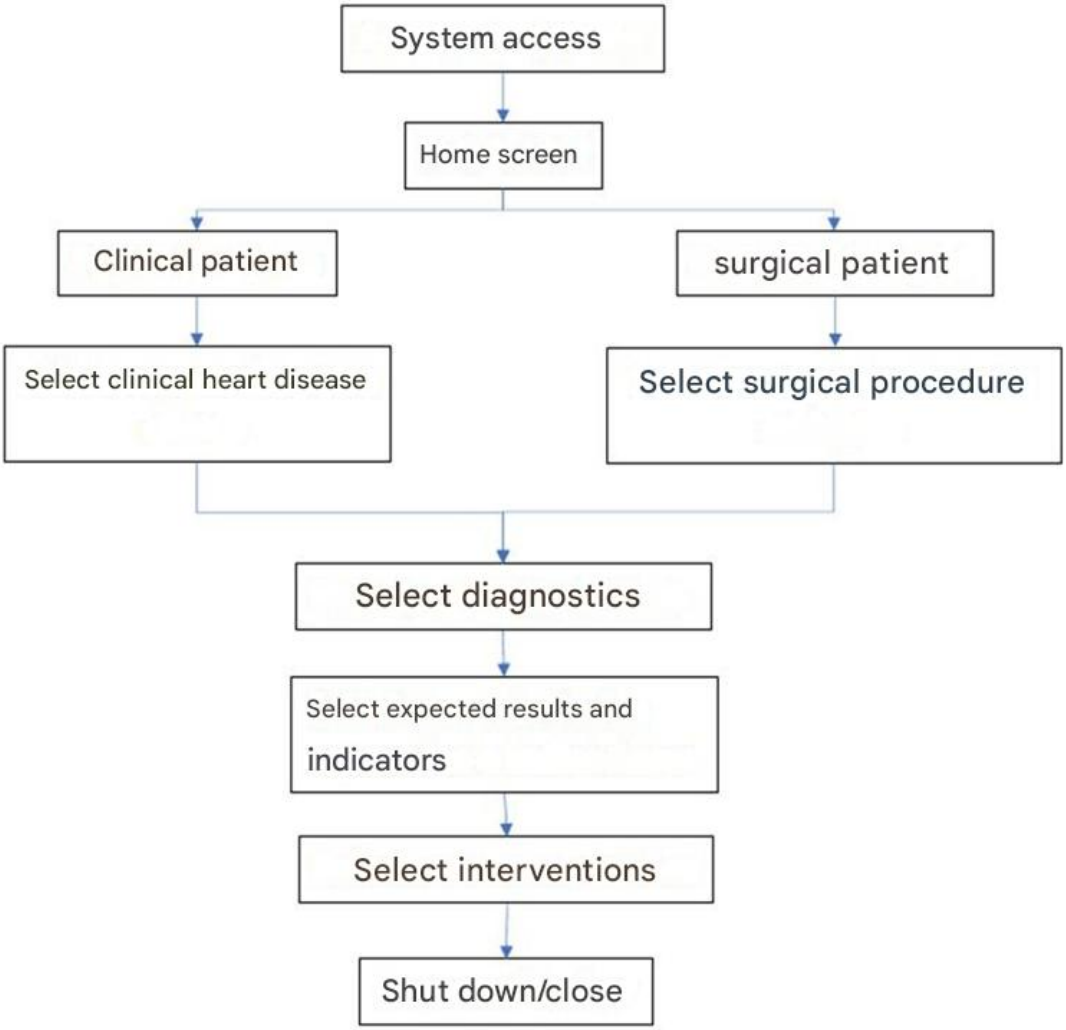
Expected results	• NOC - Classification of Nursing Outcomes (MOORHEAD, Sue - 2020) • Patient classification system: identification of the care profile of patients in the hospitalization units of the HU-USP (FUGULIN, Fernanda Maria Togeiro; GAIDZINSKI, Raquel Rapone; KURCGANT, Paulina - 2005) • APACHE II, data accuracy and outcome prediction (Goldhill, A Sumner - 1998) • Evaluation of agreement in the application of the Braden Scale interobserver (NMB Rogenski, P Kurcgant - 2012) • Evaluation of pressure ulcers through the application of the pressure ulcer scale for healing (Silveira, Stefy Letícia Pessoa; Silva, Grazielle, Roberta Freitas da; Moura, Elaine Cristina Carvalho; Rangel, Elaine Maria Leite; Sousa, Jairo Edielson Rodrigues Barbosa de – 2013) • Hospital anxiety and depression scale: a study of criterion validity and reliability with patients in the preoperative period (Marcolino, José Álvaro Marques; Mathias, Ligia Andrade da Silva Telles; Son, Luiz Piccinini; Guaratini, Alvaro Antônio; Suzuki, Fernando Mikio; - Alli, Luis Augusto Cunha – 2007) • Medical-Surgical Nursing Treaty (HINKLE, Janice L.; CHEEVER, Kerry H.; OVERBAUGH – 2023)
Interventions	• NIC - Classification Of Interventions from Enfermage (Butcher, Howard K – 2020) • Medical-Surgical Nursing Treaty (HINKLE, Janice L.; CHEEVER, Kerry H.; OVERBAUGH – 2023)

Source: prepared by the authors

Thus, 20 NANDA diagnoses, 19 expected NOC results, and 31 NIC interventions were used. Based on the important information in the previous phase, the navigation project was elaborated, which contained the menus that made up the application, with the respective texts, images and the form of organization. A file was built in Powerpoint as a form of sketch of the application, where each page represented a navigation screen, with its respective screen change action buttons and icons. The next stage was the elaboration of the Abstract Interface, in which the definition of the appearance model and screen prototypes for selection were carried out. At this stage, image and text attachments were made in their specific usability and user experience tabs.

Figure 2 shows the flowchart of the software that characterizes the complete functioning of the system in the approach and care of patients with heart disease.

Figure 2. Flowchart of the software for heart patients



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The app's home screen includes the "clinical patients" and "surgical patients" menus (Figure 3).

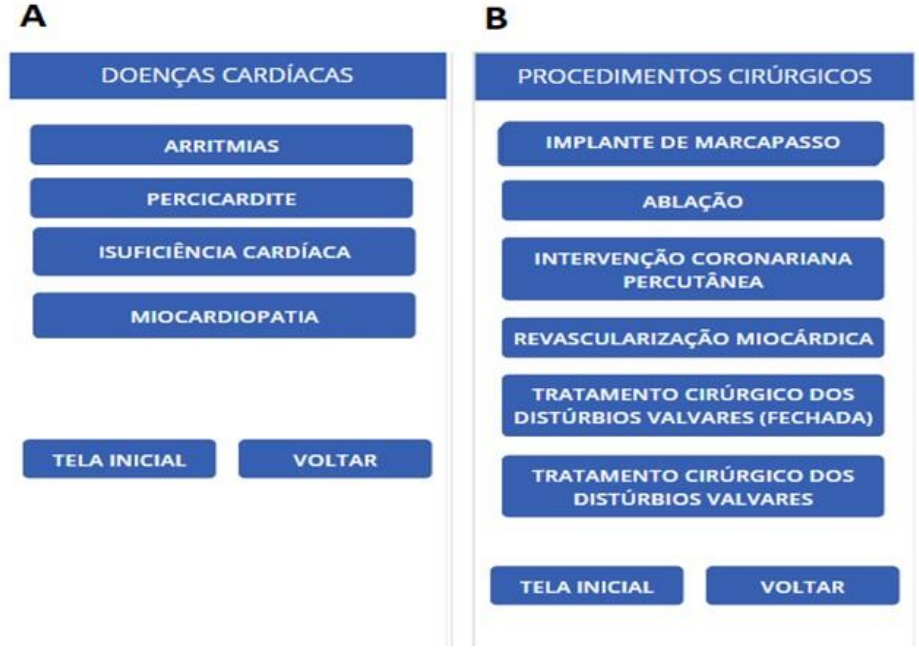
Figure 3. App home screen

Source: prepared by the authors

The "clinical patients" menu presents a screen in which the most common heart diseases (arrhythmias, pericarditis, heart failure and cardiomyopathy) are identified, and the "surgical patients" menu presents a screen in which the main surgical procedures are identified, according to the heart disease presented by the patient (pacemaker implantation, ablation, percutaneous coronary intervention, myocardial revascularization, surgical treatment of valve disorders) as can be seen in the Figure 4A and 4B, respectively.

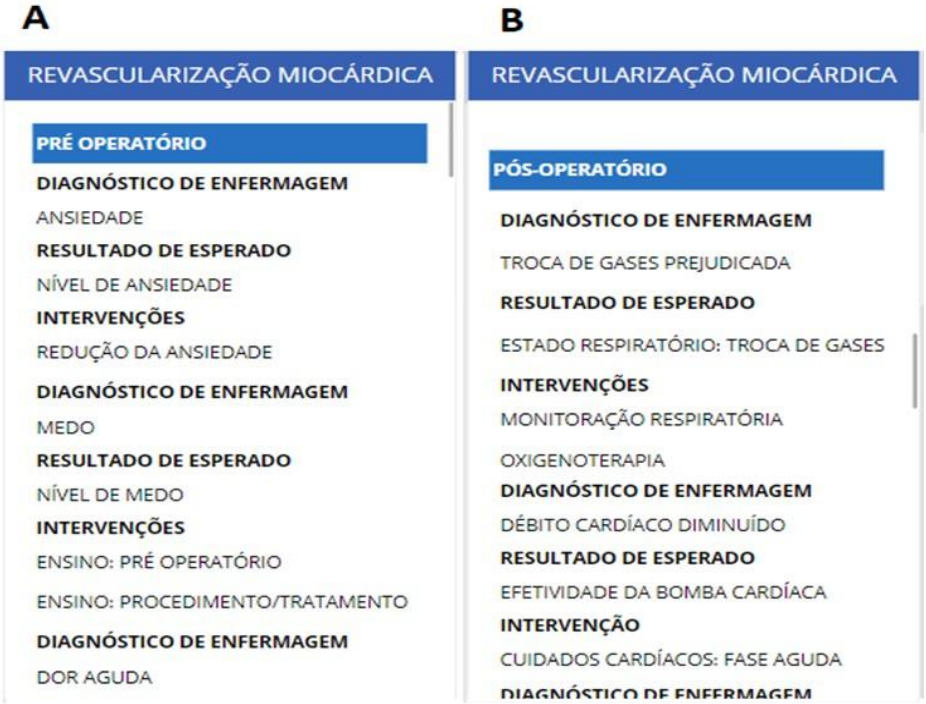
By clicking on the heart disease or surgical procedure, the nurse will be forwarded to a screen in which he/she will present the nursing diagnoses (ND) aligned with his/her expected results and interventions, and for the surgical condition, the NCS was divided into the pre- and postoperative period (Figure 5).

Figure 4. Screen with submenus for heart diseases (A) and surgical procedures (B)



Source: prepared by the authors

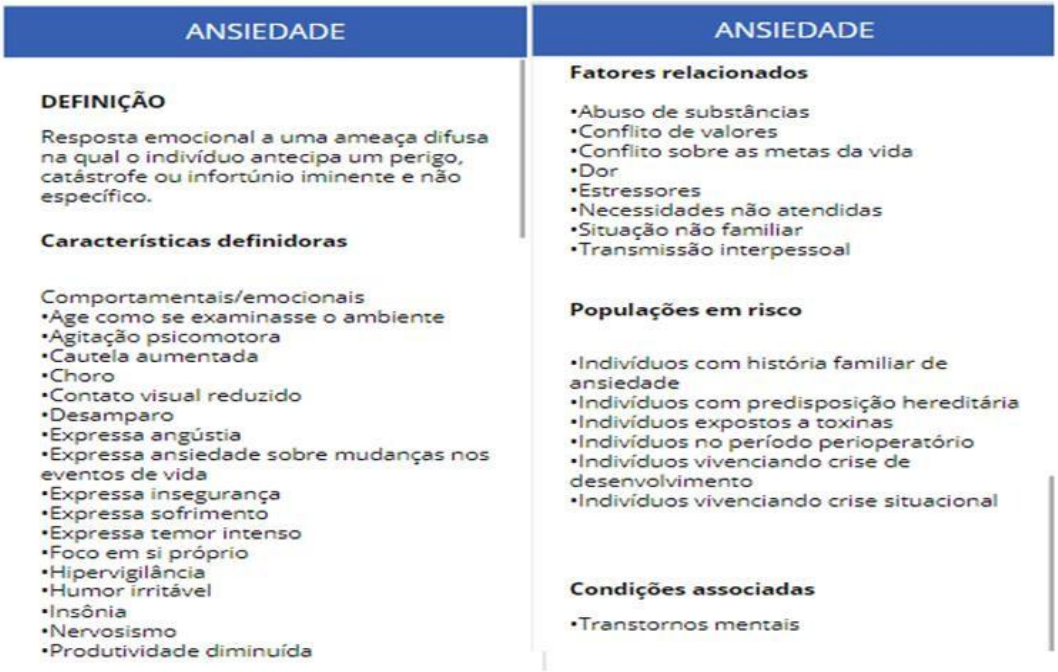
Figure 5. Screen presenting the "myocardial revascularization" procedure with the nursing diagnoses, expected results and interventions for the preoperative (A) and postoperative (B) periods.



Source: prepared by the authors

In practice, by clicking on the title(s) priority diagnosis(s) according to the nurse's clinical judgment, the system will present the list of defining characteristics, related factors, risk factors, associated condition, risk population for each selected ND, enabling a better formulation of ND appropriate to the patient's clinical conditions, which is shown, in Figure 6, for the ND Anxiety.

Figure 6. Presentation screen of the nursing diagnosis according to the standardized language NANDA.

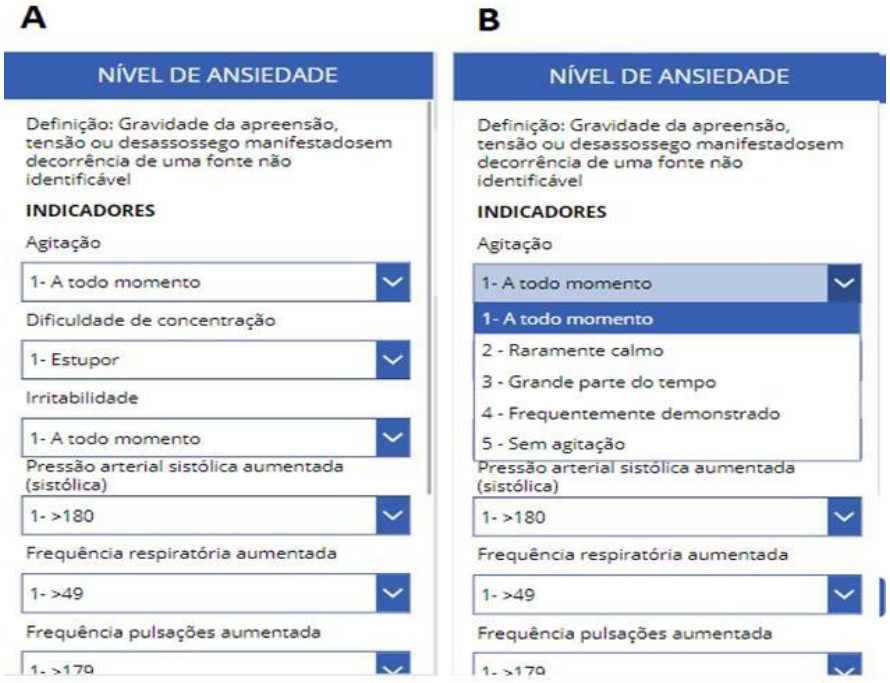


Source: prepared by the authors

After selecting the NDs, it is possible to select the Expected Result (ER) of the NOC classification for the ND, as well as their respective health indicators and identification of the gradation or target score of the RE, as shown in figure 7.

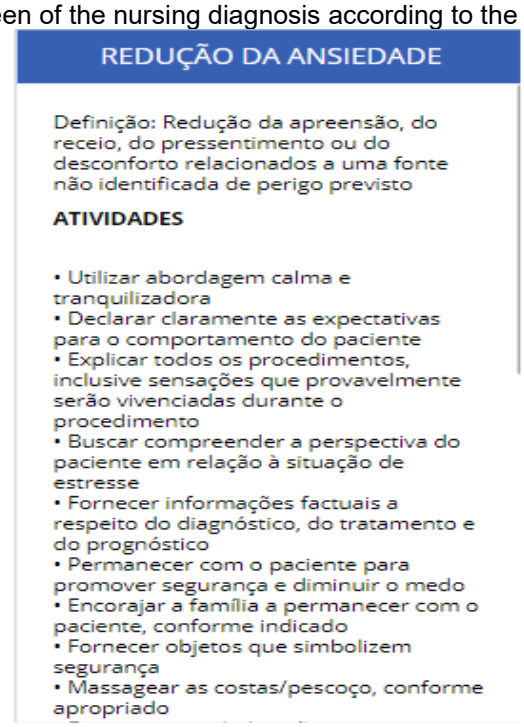
After the RE stage, the nurse will have access to the nursing prescription selected from the NIC classified, corresponding to the corresponding ND and RE (figure 8).

Figure 7. Presentation screen of the expected nursing result according to standardized NOC language. 5B – classification of the health indicator.



Source: prepared by the authors

Figure 8. Presentation screen of the nursing diagnosis according to the standardized language NIC.



Source: prepared by the authors

The SAEcardio was programmed in order to allow the consultation of NDs, ERs and Interventions by morbidity and surgical procedure. After finishing the modeling, navigation project and abstract design of the interface, the implementation stage began, in which the application was dispensed with for the WEB format, being possible to access it on different operating systems (iOS, Android or Windows) as long as it has internet access. In this step, the application was tested by each team member to verify its execution.

The construction of the SAEcardio application followed a rigorous elaboration method, contemplating relevant information in the main scientific platforms regarding nursing care for patients with heart diseases in a hospital environment, through technical and scientific language. The SAEcardio is based on a safe theoretical framework and can be considered a valid tool in which it can contribute to the improvement of nurses in order to improve the quality of care, providing guidance, standardized language and autonomy to the professional.

In the SAEcardio application, the main Nursing Diagnoses (ND) were gathered, directed to organic and psychic responses related to the main cardiovascular alterations, during nursing care for patients in clinical hospitalization and/or pre and post-surgery. Thus, 67 real NDs, 39 risk NDs, with 132 nursing interventions, and 106 expected outcomes were listed (Ferro *et al*, 2024).

The terminologies of nursing, a taxonomy of the Nursing Diagnoses (NDs) of NANDA International Inc. (NANDA-I), is a reference of wide notoriety within the context of nursing,

and allows us to interpret, evaluate and make clinical judgments about human responses, and their eventual alterations under the health/disease process, and helps in the definition of NDs, identifying risks, complications, changes in the biopsychosocial health status of the person, the family, and the community (Santana *et al*, 2021).

In a study carried out in a hospital in Minas Gerais, the adaptation and validation of the SIPETI software, initially aimed at intensive care, which was modified to SIPECLIN, was evaluated, aiming to support nurses in the Nursing Process in clinical and surgical hospitalization units. Adaptation and validation occurred in three stages: 1) training of nurses and researchers, 2) registration of patient data, diagnoses, prescription and results, 3) inclusion of sociodemographic information, anamnesis, risk scales (Braden, Morse and Katz) and adjustments in the data to better adapt to the clinical patient (Domingos *et al*, 2019).

Another similar study was carried out in a hospital in the northern region of Brazil, where the INFOSAE software was developed, which proposed to computerize the Nursing Process in the bedside medical clinic unit, the participating nurses stated that they already applied the NP methodology in their clinical practice, and received previous training to use the *software*. Its main diagnoses were based on the Nanda-I Taxonomy, 64 of them based on Basic Human Needs (BHN), 49 on Psychobiological needs, 13 on Psychosocial and 2 on Psychospiritual, as well as 54 RE, and 64 Nursing interventions, according to the literature "NANDA, NIC, NOC Connections", after using the system by the participating nurses, were incorporated into the system; the Braden pressure injury risk assessment scales, and Fugulin patient classification, increasing the level of relevance and acceptability of the new technology in hospital nursing care (Silva *et al*, 2018).

In a University Hospital in Southern Brazil, an educational application was developed to train newly admitted nurses, trainees and graduate students on computerized NP. The project had the participation of nurses (n=3), professors (n=3), graduate students (n=3) and computer scientists (n=1). The construction of the application occurred in three stages: 1) elaboration and validation of case studies for adult, child, clinical, oncological and obstetric audiences, 2) development of the software with incremental methodology, and 3) approval and validation of the *software* by specialists, students and university professors. The evaluation considered usability, handling, visual aesthetics, interactivity, relevance of the cases to nursing practice, reliability of the NDs and possibility of data editing. Research has shown that the app has improved students' clinical reasoning and accuracy in nurses' application of NDs in clinical practice (Almeida *et al*, 2021).

CONCLUSION

The SAEcardio prototype software in the mobile bedside mode represents innovative and easy-to-apply computerized technology. In summary, nurses will be able to apply the NCS more quickly, allowing an overview of the main ND, NO and nursing interventions, condensing the three standardized languages, with the advantage of applying the most complete nursing process. The intended goal was successfully achieved, with the application being accessible on any of the four main current platforms (mobile, tablet, *desktop* and *web*). The advantages of the SAEcardio software are that it can be used as a stand-alone tool or complement to its environment, allowing for dynamism and being able to incorporate innovations and updates at any time, whenever necessary.

The use of the NCS software represents a great contribution to cardiology nursing in hospitals that do not yet have a computerized system for the application of the NP, because it allows it to be implemented in a hospital environment in which the NCS is already being applied, both in systems with or without computerization of the data.

As limitations, we can highlight the lack of literature that contemplates the Systematization of nursing care with standardized language in mobile applications for patients with heart disease. This finding leads us to admit how scarce the undertaking was in the research process in the daily health service practices for patients with these morbidities. Thus, it is also suggested that a validation study of SAEcardio in a hospital environment dedicated to the care of clinical and surgical heart disease patients is also suggested.

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