

## **APPLICATION DEVELOPMENT TO SUPPORT THE DIAGNOSIS OF NURSES IN THE CARE OF SURGICAL PATIENTS**

Jociani Gonçalves Paschoal<sup>1</sup> 

Mirian Fioresi<sup>1</sup> 

Maria Edla de Oliveira Bringuento<sup>1</sup> 

Sheila Coelho Ramalho Vasconcelos Morais<sup>2</sup> 

Cândida Caniçali Primo<sup>1</sup> 

Lorena Barros Furieri<sup>1</sup> 

<sup>1</sup>Universidade Federal do Espírito Santo, Programa de Pós-Graduação em Enfermagem. Vitória, Espírito Santo, Brazil.

<sup>2</sup>Universidade Federal de Pernambuco, Programa de Pós-Graduação em Enfermagem. Recife, Pernambuco, Brazil.

### **ABSTRACT**

**Objective:** to develop a mobile application to support nurses' diagnostic reasoning in the care of surgical patients

**Method:** this is applied research with technological production, carried out in a hospital in the metropolitan region of Espírito Santo, from September 2018 to December 2019. The study was divided into four stages: theoretical content elaboration through an integrative literature review of the main signs and symptoms observed in patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries, and cross-mapping between the signs and symptoms found in the literature review and NANDA International nursing diagnoses; development of 10 case studies that foster clinical and surgical situations elaborated according to nursing diagnoses mapped according to Lunney's framework; assessment of case studies by experts using content validity index; and application construction in partnership with a graphic design expert by the User-Centered Design method.

**Results:** the application *CuidarTech® Cirúrgico* presents four navigation options: 1) "Nursing Process" - displays theoretical contents; 2) "Nursing diagnoses and actions" - with nursing diagnoses and interventions to assist patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries; 3) "Case studies" - brings 10 validated studies to training clinical reasoning; and 4) "Credits" - executing team.

**Conclusion:** the application is an unprecedented technology and constitutes an interactive support in the care and teaching of nurses' Nursing Process and clinical reasoning.

**DESCRIPTORS:** Mobile applications. Nursing process. Postoperative care. Educational technology. Nursing.

**HOW CITED:** Paschoal JG, Fioresi M, Bringuento MEO, Morais SCR, Primo CC, Furieri LB. Application development to support the diagnosis of nurses in the care of surgical patients. *Texto Contexto Enferm* [Internet]. 2022 [cited YEAR MONTH DAY]; 31:e20210412. Available from: <https://doi.org/10.1590/1980-265X-TCE-2021-0412en>

## DESENVOLVIMENTO DE APLICATIVO PARA APOIAR O RACIOCÍNIO DIAGNÓSTICO DO ENFERMEIRO NO CUIDADO AO PACIENTE CIRÚRGICO

### RESUMO

**Objetivo:** desenvolver um aplicativo móvel para apoiar o raciocínio diagnóstico do enfermeiro no cuidado ao paciente cirúrgico

**Método:** trata-se de uma pesquisa aplicada com produção tecnológica realizada num hospital da região metropolitana do Espírito Santo no período de setembro de 2018 a dezembro de 2019. O estudo foi dividido em quatro etapas: elaboração de conteúdo teórico através da realização de revisão integrativa de literatura dos principais sinais e sintomas observados em pacientes no pós-operatório de cirurgias gastrointestinais, torácicas, de cabeça e pescoço, e mapeamento cruzado entre os sinais e sintomas encontrados na revisão de literatura e os diagnósticos de enfermagem da NANDA Internacional; desenvolvimento de 10 estudos de caso que simulam situações clínico-cirúrgicas elaborados de acordo com os diagnósticos de enfermagem mapeados conforme referencial de Lunney; avaliação dos estudos de caso por especialistas utilizando índice de validade de conteúdo; e construção do aplicativo em parceria com especialista em design gráfico pelo método do Design Centrado no Usuário.

**Resultados:** o aplicativo “CuidarTech® Cirúrgico”, apresenta quatro opções de navegação: 1) “Processo de Enfermagem” 0 exibe conteúdos teóricos; 2) “Diagnósticos e ações de enfermagem” - com diagnósticos e intervenções de enfermagem para assistência a pacientes em período pós-operatório de cirurgias gastrointestinais, torácicas, de cabeça e pescoço; 3) “Estudos de caso” - traz 10 estudos validados para treinamento do raciocínio clínico; e 4) “Créditos” - equipe executora.

**Conclusão:** o aplicativo é uma tecnologia inédita e constitui um suporte interativo na assistência e ensino do processo de enfermagem e do raciocínio clínico do enfermeiro.

**DESCRITORES:** Aplicativos móveis. Processo de enfermagem. Cuidados pós-operatórios. Tecnologia educacional. Enfermagem.

## DESARROLLO DE APLICACIONES PARA APOYAR EL RAZONAMIENTO DIAGNÓSTICO DE LAS ENFERMERAS EN EL CUIDADO DEL PACIENTE QUIRÚRGICO

### RESUMEN

**Objetivo:** desarrollar una aplicación móvil para apoyar el razonamiento diagnóstico de las enfermeras en el cuidado del paciente quirúrgico

**Método:** se trata de una investigación aplicada con producción tecnológica realizada en un hospital de la región metropolitana de Espírito Santo de septiembre de 2018 a diciembre de 2019. El estudio se dividió en cuatro etapas: Elaboración del contenido teórico a través de una revisión integradora de la literatura de los principales signos y síntomas observados en pacientes en el postoperatorio de cirugías gastrointestinales, torácicas, de cabeza y cuello, y el mapeo cruzado entre los signos y síntomas encontrados en la revisión de la literatura y los diagnósticos de enfermería de la NANDA Internacional; desarrollo de 10 casos prácticos que simulan situaciones clínico-quirúrgicas elaboradas según los diagnósticos de enfermería mapeados según el marco de Lunney; evaluación de estudios de casos por expertos utilizando un índice de validez de contenido; y construcción de la aplicación en colaboración con un especialista en diseño gráfico utilizando el método de Diseño Centrado en el Usuario.

**Resultados:** la aplicación CuidarTech® Cirúrgico tiene cuatro opciones de navegación: 1) “Proceso de Enfermería” - muestra contenido teórico; 2) “Diagnósticos y acciones de enfermería” - con diagnósticos e intervenciones de enfermería para el cuidado del paciente en el postoperatorio de cirugías gastrointestinales, torácicas, de cabeza y cuello; 3) “Estudios de Caso” - trae 10 estudios validados para entrenar el razonamiento clínico; y 4) “Créditos” - equipo ejecutor.

**Conclusión:** la aplicación es una tecnología inédita y constituye un soporte interactivo en la asistencia y enseñanza del proceso de enfermería y del raciocinio clínico de los enfermeros.

**DESCRIPTORES:** Aplicaciones móviles. Proceso de enfermería. Cuidado postoperatorio. Tecnología educacional. Enfermería.



## INTRODUCTION

Patient care in the postoperative period should be performed through the Nursing Process, which consists of a systematic method of interrelated steps that provide efficient, safe and scientifically supported nursing care<sup>1</sup>. During this period, patients may present numerous physiological alterations that, if not controlled, can result in complications and damage, prolonging hospitalization and consequently increasing hospital costs<sup>2</sup>.

The assessment of clinical conditions, the recognition of the main problems and the planning of nursing actions allow identifying nursing diagnoses that will guide the execution of care and the implementation of actions for qualified care, reflecting positive results in patient safety<sup>1</sup>.

However, it is still observed that nurses face difficulties in implementing the Nursing Process in clinical practice, among other factors, due to the limitations of technical-scientific knowledge, lack of professional qualification and the partial execution of some stages of the Nursing Process, in addition to lack of training<sup>1-3</sup>.

Among the strategies for professional updating is the use of tools such as educational technologies that mediate and streamline the processes of learning and teaching, enable active learning methods and can be applied in teaching about the Nursing Process<sup>4-5</sup>.

Using mobile applications allows innovation in the teaching-learning approach, providing easy-to-access theoretical content through audiovisual resources that allow interaction with users and greater motivation to learning<sup>5-9</sup>.

In literature searches and application stores, there are few educational courses or technologies for training and teaching the Nursing Process to surgical patients. Added to the importance of carrying out the Nursing Process and using technologies in the current scenario, this study aims to develop an application to support nurses' diagnostic reasoning in the care of surgical patients.

## METHOD

This is applied research with technological production, carried out in a hospital in the metropolitan region of Espírito Santo, from September 2018 to December 2019. The study was conceived in four stages, as described in Figure 1: theoretical material elaboration; case study development; case study assessment; and mobile application construction. The User-Centered Design method was used to elaborate the application. The study was approved by a Research Ethics Committee.



**Figure 1** - Study development steps. Vitória, ES, Brasil, 2019.

In the first stage, an integrative literature review was performed to identify the signs and symptoms presented by patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries. Searches in the Latin American and Caribbean Literature in Health Sciences (LILACS) and Medical Literature Analysis and Retrieval System online (MEDLINE) and US National Library of Medicine National Institutes of Health (PubMed) databases were carried out from October to December 2018. The Descriptors in Health Science (DeCS), “postoperative care”, “signs and symptoms” and “nursing”, in Portuguese, English and Spanish versions, were used. To cross the descriptors in pairs, the Boolean operator AND was used. The research question emerged: what are the main signs and symptoms present in patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries?

Articles available in full, published between 2008 and 2017, in Portuguese, English or Spanish and that addressed the signs and symptoms present in patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries were included.

After applying the inclusion criteria, 15,874 articles were found. Titles were read to exclude studies that did not address the theme, and 145 articles were selected. After reading the abstract, 7 repeated articles and 72 for not presenting the signs and symptoms were eliminated, resulting in 66 articles for complete reading. Of these, 36 articles were eliminated because they did not answer the guiding question, resulting in 30 articles. In addition to the search in databases, the reference lists of selected articles were used.

Next, a cross-mapping was performed, which consists of a method of data analysis by comparing terms and reference classifications for nursing practice. The signs and symptoms found in the review and in the Nanda International (NANDA-I) taxonomy nursing diagnoses were mapped. The rules used to carry out the cross-mapping were: 1) using the context of the NANDA-I nursing diagnoses classification; 2) ensuring the meaning of the terms and expressions found in the review; 3) comparing the review terms with diagnostic concepts, defining characteristics, related and risk factors; and 4) map the diagnoses in the NANDA-I domains<sup>10</sup>.

Based on the mapped diagnoses, nursing interventions/activities were selected according to the correlations presented in the book *NOC and NIC Linkages to NANDA-I and Clinical Conditions: Nursing Diagnoses, Outcomes, and Interventions (NANDA, NOC, and NIC Linkages)* and based on the researchers' experience. This material composed the set of diagnoses and interventions for patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries present in the application<sup>11</sup>.

Then, the diagnoses were related to the three major categories of Basic Human Needs (BHN), as proposed by Horta: psychobiological, psychosocial and psychospiritual needs<sup>12</sup>. For this organization within the needs, the descriptions of each BHN and correlated with the signs and symptoms or definition of diagnostic titles were assessed.

In the second stage, ten case studies were prepared, based on the main author's experience, which simulate surgical clinical situations presented by adult patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries. Each case study is related to one of the nursing diagnoses listed in the first stage.

Case studies were developed by adopting Lunney's eight assumptions or objectives: 1) represent the typical situation of patients that nurses diagnose and manage in clinical surgical situations; 2) be clearly written; 3) reflect patients' situations in clinical occurrences; 4) require the need for intellectual capacities analogous to those used in natural clinical settings; 5) contain at least four evidences in order to confirm a highly accurate diagnosis; 6) contain at least two evidence to deny an alternative diagnosis that would be assessed as low on a precision scale; 7) encourage nurses to consider diagnosis at various levels of precision, from high to low; 8) allow diagnoses to be performed constantly by nurses who follow diagnostic reasoning principles<sup>13</sup>.

In the third stage, the process of content assessment by judges occurred. Nursing Care Systematization Committee (COMISAE - *Comissão de Sistematização da Assistência de Enfermagem*) members of a public hospital in southeastern Brazil were invited, since they are nurses with care and management practice with surgical patients and have the ability to use NANDA-I taxonomy. Judges who, during the study period, were away from the institution on leave or vacation were excluded.

Contact with judges was carried out in person by sending an invitation letter, and, upon agreement, they signed the Informed Consent Form (ICF). The judges received two instruments for completion: 1) judge characterization; 2) case study assessment. The characterization instrument was composed of the variables as follows: sex, age, degree, time since graduation, time working

in care, study of the Nursing Process in undergraduate courses and use of NANDA-I, NIC, NOC classifications in professional practice.

Case studies were assessed in: (1-) definitely not an objective measure; (0) undecided; or (1+) definitely an objective measure<sup>14</sup>. A 14-day deadline to return the material was established.

Data were collected in September 2019 and stored in Excel spreadsheets, Microsoft® 2010. The information obtained was analyzed by descriptive statistics. To assess the degree of agreement among judges, the Content Validity Index (CVI) was adopted, which is obtained by adding the number of cells that received the score of (+1) divided by the total number of cells. The objectives of the case studies with  $CVI \geq 0.80$  were considered valid<sup>15</sup>.

In the fourth stage, due to technology specificity, a partnership was made with a graphic design expert to construct the application. In this step, the mobile application was elaborated using the User-Centered Design method<sup>9</sup>. The theoretical material prepared in the previous steps was used to design the application's conceptual map and for each screen's content. Meetings were held between the team of researchers and the graphic design to align the application's conceptual map and functionalities. The method used to prepare the application has, among its foundations, the participation of users in its execution. In this regard, periodic meetings were held with the team of developers and designers to define the application's functionalities, flows, design and layout. When the implementation and prototyping alternatives were generated, the team carried out tests and corrections. Throughout the application construction process, meetings were held to partially present its development, and immediate adjustments were made, providing improvement in technology. The application is available for free on Play Store for Android mobile phones.

## RESULTS

From the integrative literature review, 30 articles, a book and a manual of practices were found, resulting in 32 materials for the survey of signs and symptoms, resulting in 134 terms that, after the exclusion of repetitions, obtained 49 signs and symptoms. The most frequent were: pain, which appeared in 42.9% of studies; nausea, in 20.4%; vomiting, 18.4%; weight loss and anxiety, in 10.2%; hypotension, edema, change in appetite, delayed gastric emptying, diarrhea and constipation, in 6.1%.

In the cross-mapping between the signs and symptoms and NANDA-I terms, 61 diagnoses were identified, arranged in eight domains: Security/Protection; Activity/Rest; Elimination and Exchange; Nutrition; Perception/Cognition; Self-Perception; Coping/Stress Tolerance; and Comfort. Diagnoses were not listed in the following domains: Sexuality; Health Promotion; Roles and Relationships; Life Principles; and Growth/Development. From the identification of diagnoses, 664 nursing interventions/activities were selected in the Nursing Interventions Classification (NIC) for postoperative nursing care.

Ten case studies were built, with an average of 150 words (122-184 words), with four multiple-choice alternatives.

To assess case study content, 15 nurse judges participated. These were mostly female (86.7%). The mean age was 60 years. Regarding the degree, 86.7% were experts and 13.4% held a master's degree. All judges had been trained for more than 4 years, with an average time of training and service of 11.3 years. All judges studied the Nursing Process during their undergraduate course. Regarding the use of classifications in professional practice, all used NANDA-I (100%), less than half used the Nursing Interventions Classification (NIC) (46.66%) and only 13.3% used the Nursing Outcomes Classification (NOC). The judges assessed each of the 8 assumptions/objectives in all case studies, and the CVI result is shown in Table 1.

Case studies 1 and 5 had CVI equal to 0.73 in objective 6 and case study 10 had CVI equal to 0.67 in objective 5. Thus, they were reformulated according to judges' suggestions. All case studies had a global CVI greater than 0.80.

**Table 1-** Content assessment description of the 10 case studies according to Lunney's 8 assumptions, according to the degree of agreement among judges by the Content Validity Index (CVI) and the global Content Validity Index. Vitória, ES, Brazil, 2019.

Objective	Case studies (CVI*)									
	1	2	3	4	5	6	7	8	9	10
1 - Represent a typical situation of patients that nurses diagnose and manage in clinical surgical situations	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.93
2 - Be written clearly	0.93	1.00	1.00	1.00	0.93	1.00	0.93	1.00	1.00	0.93
3- Reflect patient situations in clinical occurrences	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	1.00	1.00
4 - Require the need for intellectual capacities analogous to those used in natural clinical environments	0.93	0.93	1.00	0.93	0.93	1.00	1.00	1.00	1.00	0.93
5 – Have at least four pieces of evidence in order to confirm a highly accurate diagnosis	1.00	0.93	1.00	0.93	0.93	1.00	0.93	1.00	0.93	0.67
6 – Have at least two pieces of evidence to deny an alternative diagnosis that would be assessed as low on a precision scale	0.73	0.93	0.87	0.87	0.73	0.93	0.93	0.93	0.80	0.80
7- Encourage nurses to consider the diagnosis at various levels of precision from high to low	0.80	0.87	0.93	0.87	0.87	0.93	0.87	0.87	0.93	0.80
8 - Allow nursing diagnoses to be diagnosed constantly by nurses who follow principles of diagnostic reasoning	1.0	0.93	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00
<b>Global CVI</b>	<b>0.92</b>	<b>0.94</b>	<b>0.96</b>	<b>0.95</b>	<b>0.92</b>	<b>0.96</b>	<b>0.95</b>	<b>0.97</b>	<b>0.95</b>	<b>0.88</b>

\*CVI: Content Validity Index.

The application *CuidarTech® Cirúrgico* was designed to provide users with case studies of surgical clinical situations, creating the opportunity to improve diagnostic reasoning. Furthermore, it allows quick access to a list of diagnoses with its main nursing interventions that represent the care practice to patients in the postoperative period of gastrointestinal, thoracic, head and neck surgeries.

The application has four navigation options: “Nursing Process”; “Nursing Diagnoses and Actions”; “Case Studies” and “Credits”. The “Nursing Process” option displays theoretical content essential for its execution: Nursing process, Theory of Basic Human Needs, NANDA-I, NIC, NOC and International Classification for Nursing Practice (ICNP®) and links from the official websites of nursing taxonomies. The contents were elaborated based on updated references of the nursing classifications (Figure 2).

Option “Diagnosis and Actions of nursing” contains a list of 61 nursing diagnoses arranged according to BHN, 57 related to Psychobiological Needs and four to Psychosocial Needs, not being identified Psycho-Spiritual Needs. In addition to this, there are 664 nursing interventions. When selecting the nursing diagnosis, users view the concept of the diagnosis and, if desired, can click on “View Actions”. By clicking this button, a list appears with the main nursing interventions for the selected diagnosis, as observed in the example of nursing diagnosis “Self-Care Deficit: Bathing” (Figure 3).

Regarding nursing classification, the proposed application uses diagnoses and interventions based on the Standardized Language System (SLP) of nursing, according to ISO 18.104: 2014<sup>14</sup>,

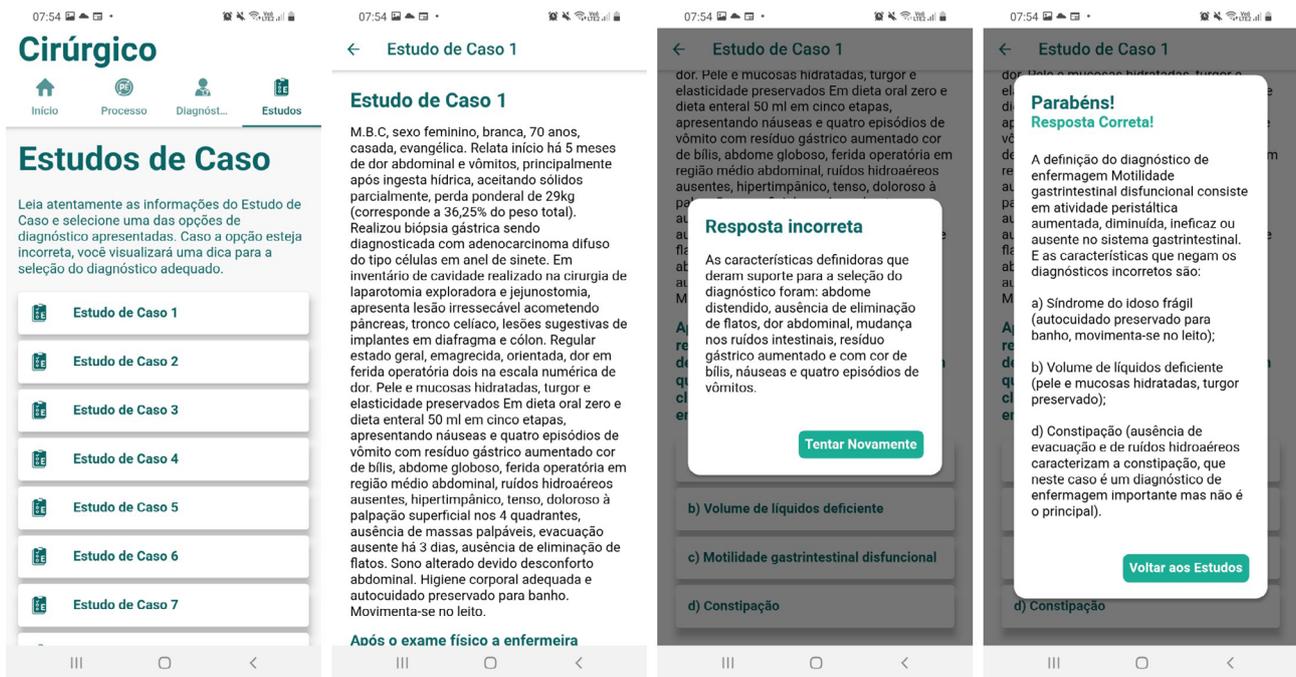


Figure 2 - Main menu and Nursing Process of *CuidarTech® Cirúrgico* function. Vitória, ES, Brasil, 2019.

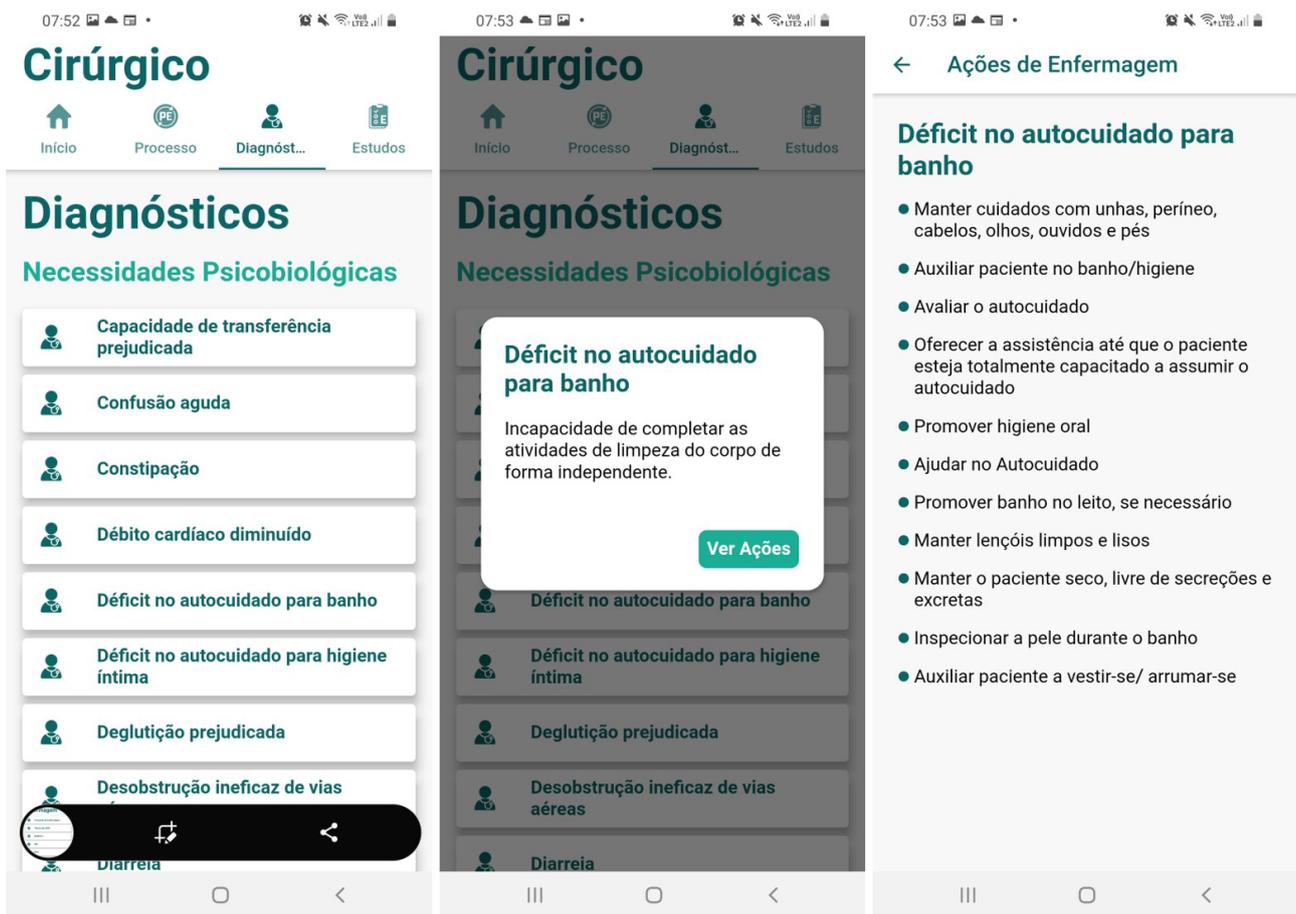


Figure 3 - Diagnostic functionality and nursing actions of *CuidarTech® Cirúrgico*. Vitória, ES, Brasil, 2019.

which is adequate to support electronic documentation and assist in the formation of diagnostic expressions and nursing actions. Thus, the structure of the diagnoses proposed in the application contains title, with focus and judgment or clinical finding, which can be found in NANDA-I and ICNP®. Similarly, nursing actions can be found in ICNP® and in the NIC.

In interface “Case Studies”, 10 case studies are available for diagnostic reasoning training. The case studies have four alternatives for selecting the main nursing diagnosis. After selecting the answer, the application indicates whether the chosen alternative is correct or incorrect. When the option selected is incorrect, a screen opens with the defining characteristics that support the choice of the correct diagnosis, aiding in diagnostic reasoning. When choosing the correct answer, a screen opens with the concept of the diagnosis and the defining characteristics that deny the incorrect diagnoses. Thus, the application aims to train the diagnostic reasoning for nurses and undergraduate nursing students. Figure 4 depicts the case studies’ functionalities. In item “Credits”, there is information from the team responsible for preparing the application and its content.



Figure 4 - Case studies’ functionalities of *CuidarTech*® *Cirúrgico*. Vitória, ES, Brasil, 2019.

## DISCUSSION

Several applications have been developed in health and nursing for use in care, management, teaching of students, permanent education of nurses and education in health for patients<sup>4-9</sup>. *CareTech*® *Cirúrgico* is an educational and care technological innovation because it is the first application to support nurses’ diagnostic reasoning in patient care in the postoperative period of gastrointestinal, thoracic, head and neck surgeries through the availability of diagnoses, nursing interventions and case studies to solve typical situations of these patients.

Mobile technologies provide easy access to information and knowledge, are available 24 hours a day and assist in the execution of tasks. With the complexity of patients and the great work demand of nurses, the development of technologies that optimize time and make work agile during care practices is increasingly desired. Additionally, technologies support the realization of the Nursing Process, improving care and teaching practices<sup>5-9</sup>.

*CuidarTech® Cirúrgico* brings comprises diagnoses and interventions that enable the Nursing Process development and registration, improving team communication and quality in care, providing greater visibility, autonomy and construction of professional identity of nursing<sup>9,15-16</sup>.

Contemporary nursing practice, focusing on results and complex analysis of multiple patient conditions, requires clinical reasoning. Reasoning improvement is a challenge for health professionals, as it requires the use of various teaching and continuing education strategies<sup>17-18</sup>.

The process of clinical reasoning in elaborating nursing diagnoses, both using ICNP® 1.0 and NANDA-I, leads nurses to formulate similar diagnoses for clinical problems identified in patients. It should be considered that standardized terminologies, such as NANDA-I, ICNP® and NIC, follow the categorical structure of ISO 18.104:2014<sup>15,19</sup>.

Case studies are widely used in Brazil and in several countries for improving reasoning, supporting professional training, promoting autonomy and critical analysis of phenomena in their real context, providing sources of evidence, reflection and search for alternatives to solve problems. Aligned with this issue, *CuidarTech® Cirúrgico* brings 10 case studies integrated with the standardized language systems of nursing for training nurses<sup>17,20</sup>. A study in which educational software was developed using case studies showed an improvement in the accuracy of nursing diagnoses, helping in the teaching-learning process and allowing more appropriate interventions, providing greater patient safety<sup>21</sup>.

Clinical case studies also assist in professional training. By establishing priorities, they support the development of cognition, communication, procedures and teamwork skills. In the Nursing Process, using case studies by nurses facilitates the understanding of nursing diagnoses and interventions, contributing to improving cognitive abilities, because cases provide examples of diagnostic reasoning principles<sup>13,21</sup>.

## CONCLUSION

*CuidarTech® Cirúrgico* allows nurses, through the use of smartphones, quick access to diagnoses and nursing interventions specific to patients in the postoperative period, assisting in the execution of the Nursing Process. In the application, nursing diagnoses are linked to the main interventions. This connection provides nurses with agility in the selection of nursing diagnoses and interventions, favoring diagnostic and therapeutic reasoning and the execution of the Nursing Process, contributing to patient safety and strengthening professional practice through the use of standardized terminologies.

In addition to supporting diagnostic reasoning in the care of surgical patients, case study functionality is an innovative and dynamic strategy that enables nurses to train in the identification of relevant information, improving diagnostic reasoning skills.

Social impacts can be professional qualification and improvement in the quality of nursing care, promoting patient safety. It also allows, if the technology is used in the academic environment, improvement of undergraduate teaching, with the consolidation of the Nursing Process.

The study presented as a limitation the need to assess the technology developed with nurses from surgery units and the absence of measuring the impact of the product. Thus, in the future, it is proposed to develop an implementation study of the elaborated technology.

## REFERENCES

1. Ribeiro OMPL, Martins MMFPS, Tronchin DMR, Forte ECN. Implementation of the nursing process in Portuguese hospitals. *Rev Gaúcha Enferm* [Internet]. 2018 [cited 2021 Jun 5];39:e2017-0174. Available from: <https://doi.org/10.1590/1983-1447.2018.2017-0174>
2. Alhayyan A, McSorley S, Roxburgh C, Kearns R, Horgan P, McMillan D. The effect of anesthesia on the postoperative systemic inflammatory response in patients undergoing surgery: a systematic review and meta-analysis. *Surg Open Sci* [Internet]. 2019 [cited 2021 Dec 29];2(1):1-21. Available from: <https://doi.org/10.1016/j.sopen.2019.06.001>
3. Lotfi M, Zamanzadeh V, Valizadeh L, Khajehgoodari M, Rezaei ME, Khalilzad MA. The implementation of the nursing process in lower-income countries: an integrative review. *Nurs Open* [Internet]. 2019 [cited 2020 Sep 11];7(1):42–57. Available from: <https://doi.org/10.1002/nop2.410>
4. Silveira MS, Cogo ALP. The contributions of digital technologies in the teaching of nursing skills: an integrative review. *Rev Gaúcha Enferm* [Internet]. 2017 [cited 2020 Oct 9];38(2):e66204. Available from: <https://doi.org/10.1590/1983-1447.2017.02.66204>
5. Oliveira ARF, Alencar MSM. The use of health applications for mobile devices as sources of information and education in healthcare. *Rev Digit Bibliotecon Ciênc Inf* [Internet]. 2017 [cited 2020 Apr 14];15(1):234-45. Available from: <https://doi.org/10.20396/rdbci.v15i1.8648137>
6. Santos TR, Soares LG, Machado LDS, Brito NS, Palácio MAV, Silva MRF. Use of mobile applications in the teaching-learning process in nursing graduation. *Rev Baiana Enferm* [Internet]. 2021 [cited 2021 Jul 10];35:e37136. Available from: <https://doi.org/10.18471/rbe.v35.37136>
7. Mota NP, Vieira CMA, Nascimento MNR, Bezerra AM, Quirino GS, Félix NDC. Mobile application for the teaching of the International Classification for Nursing Practice. *Rev Bras Enferm* [Internet]. 2019 [cited 2021 Jul 10];72(4): 1020-7. Available from: <https://doi.org/10.1590/0034-7167-2018-0751>
8. Silva AMA, Mascarenhas VHA, Araújo SNM, Machado RS, Santos AMR, Andrade EMLR. Mobile technologies in the nursing area. *Rev Bras Enferm* [Internet]. 2018 [cited 2020 Apr 15];71(5):2570-8. Available from: <https://doi.org/10.1590/0034-7167-2017-0513>
9. Araujo JL, Sant'anna HC, Lima EFA, Fioresi M, Nascimento LCN, Primo CC. Mobile app for nursing process in a neonatal intensive care unit. *Texto Contexto Enferm* [Internet]. 2019 [cited 2020 May 10];28:e20180210. Available from: <https://doi.org/10.1590/1980-265X-TCE-2018-0210>
10. Tosin MHS, Campos DM, Andrade LT, Oliveira BGRB, Santana RF. Nursing interventions for rehabilitation in Parkinson's disease: cross mapping of terms. *Rev Lat Am Enfermagem* [Internet]. 2016 [cited 2020 May 11];24: e2728. Available from: <https://doi.org/10.1590/1518-8345.0689.2728>
11. Johnson M, Moorhead S, Bulechek G, Butcher H, Maar M, Swanson E. *Ligações NANDA - NOC - NIC: condições clínicas suporte ao raciocínio e assistência de qualidade*. 3rd ed. Rio de Janeiro, RJ(BR): Elsevier; 2012. 435 p.
12. Camacho ACLF, Joaquim FL. Reflections based on Wanda Horta on the basic instruments of nursing. *J Nurs UFPE on line* [Internet]. 2017 [cited 2022 Feb 8];11(Suppl 12):5432-8. Available from: <https://doi.org/10.5205/1981-8963-v11i12a23292p5432-5438-2017>
13. Lunney M. *Pensamento crítico e diagnósticos de enfermagem: estudos de caso e análise*. Porto Alegre, RS(BR): Artmed; 2004. 384 p.
14. Cunha CM, Almeida Neto OP, Stackfleth RS. Principais métodos de avaliação psicométrica da validade de instrumentos de medida. *Rev Aten Saúde* [Internet]. 2016 [cited 2020 Feb 20];14(49):75-83. Available from: <https://doi.org/10.13037/ras.vol14n49.3671>

15. Marin HF, Peres HHC, Dal Sasso GTM. Categorical structure analysis of ISO 18104 standard in nursing documentation. *Acta Paul Enferm* [Internet]. 2013 [cited 2019 Sep 25];26(3):299-306. Available from: <https://doi.org/10.1590/S0103-21002013000300016>
16. Adamy EK, Zocche DAA, Almeida MA. Contribuição do processo de enfermagem para construção identitária dos profissionais de enfermagem. *Rev Gaúcha Enferm* [Internet]. 2020 [cited 2019 Jan 10];41(esp):e20190143. Available from: <https://doi.org/10.1590/1983-1447.2020.20190143>
17. Carvalho EC, Oliveira-Kumakura ARS, Morais SCR. Clinical reasoning in nursing: teaching strategies and assessment tools. *Rev Bras Enferm* [Internet]. 2017 [cited 2020 Feb 10];70(3):662-8. Available from: <https://doi.org/10.1590/0034-7167-2016-0509>
18. Jerônimo IRL, Campos JF, Peixoto MAP, Brandão MAG. Use of clinical simulation to improve diagnostic reasoning in nursing. *Esc Anna Nery* [Internet]. 2018 [cited 2019 Sep 11];22(3):e20170442. Available from: <https://doi.org/10.1590/2177-9465-EAN-2017-0442>
19. Tannure MC, Salgado PO, Chianca TCM. Mapeamento cruzado: títulos diagnósticos formulados segundo a CIPE® versus diagnósticos da NANDA Internacional. *Rev Bras Enferm* [Internet]. 2014 [cited 2020 Jun 10];67(6):972-8. Available from: <https://doi.org/10.1590/0034-7167.2014670616>
20. Hara CYN, Aredes NDA, Fonseca LMM, Silveira RCCP, Camargo RAA, Goes FSN. Clinical case in digital technology for nursing students' learning: an integrative review. *Nurse Educ Today* [Internet]. 2016 [cited 2019 Nov 5];38:119-25. Available from: <https://doi.org/10.1016/j.nedt.2015.12.002>
21. Almeida MA, Lucena AF, Nomura ATG, Graeff M, Chies N, Pruinelli L. Development of a nursing diagnosis educational software program. *Rev Gaúcha Enferm* [Internet]. 2021 [cited 2022 Jan 26];42:e20190283. Available from: <https://doi.org/10.1590/1983-1447.2021.20190283>

## NOTES

### ORIGIN OF THE ARTICLE

This study is part of a dissertation - *Tecnologia educacional como facilitadora do raciocínio diagnóstico do enfermeiro no cuidado ao paciente cirúrgico*, presented to the Graduate Program in Nursing, *Universidade Federal do Espírito Santo*, in 2019.

### CONTRIBUTION OF AUTHORITY

Study design: Paschoal JG, Furieri LB, Primo CC.

Data collection: Paschoal JG, Furieri LB, Primo CC.

Data analysis and interpretation: Paschoal JG, Furieri LB, Primo CC, Fioresi M,

Discussion of results: Paschoal JG, Furieri LB, Primo CC, Bringunte MEO, Fioresi M, Morais SCR.V.

Content writing and/or critical review: Paschoal JP, Furieri LB, Primo CC, Bringunte MEO, Fioresi M, Morais SCR.V.

Review and final approval of the final version: Paschoal JG, Furieri LB, Primo CC, Bringunte MEO, Fioresi M, Morais SCR.V.

### FUNDING INFORMATION

This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES - *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*) - Financing Code 001, in partnership with the Federal Council of Nursing.

### APPROVAL OF ETHICS COMMITTEE IN RESEARCH

Approved by the Ethics Committee in Research *Hospital Universitário Cassiano Antônio de Moraes*, Opinion 2.986.217/2019 and CAAE (*Certificado de Apresentação para Apreciação Ética - Certificate of Presentation for Ethical Consideration*) 96592518.2.0000.5071.

### CONFLICT OF INTEREST

There is no conflict of interest.

### EDITORS

Associated Editors: Bruno Miguel Borges de Sousa Magalhães, Monica Motta Lino.

Editor-in-chief: Roberta Costa.

### HISTORICAL

Received: November 25, 2021.

Approved: March 31, 2022.

### CORRESPONDING AUTHOR

Jociani Gonçalves Paschoal

jociani18@gmail.com

