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REVIEW ARTICLE
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DEVELOPMENT OF MOBILE TECHNOLOGIES IN THE FIELD OF NURSING

DESENVOLVIMENTO DE TECNOLOGIAS MÓVEIS NA ÁREA DA ENFERMAGEM

DESARROLLO DE TECNOLOGÍAS MÓVILES EN EL CAMPO DE LA ENFERMERÍA

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ABSTRACT
Identify in the literature studies on the development of mobile technologies in the field of nursing. The study is an integrative review. The survey of articles was carried out from February to April 2022, using the following databases: Latin American and Caribbean Literature in Health Sciences (LILACS), Scientific Electronic Library Online (SciELO) and Database of Nursing (BDENF). The final sample consisted of 17 scientific articles, selected by inclusion and exclusion criteria. The results were presented and discussed in thematic categories. Nursing as the protagonist of the creation of mobile technologies, presented the benefits that apps bring to patients and health professionals. It is relevant to mention the need for further studies on mobile technologies in nursing, to fill gaps and trigger further research, seeking to contribute to technology in Nursing.
Keywords: *Mobile technologies; Health technology; Informatics applied to nursing*.

RESUMO
Identificar na literatura estudos sobre o desenvolvimento de tecnologias móveis na área da enfermagem. O estudo trata-se de uma revisão integrativa. O levantamento dos artigos foi realizado no período de fevereiro a abril de 2022, utilizou-se as seguintes bases de dados: Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Scientific Eletronic Library Online (SciELO) e Base de Dados da Enfermagem (BDENF). A amostra final foi composta por 17 artigos científicos, selecionados pelos critérios de inclusão e exclusão. Os resultados foram apresentados e discutidos em categorias temáticas. A enfermagem como protagonista da criação das tecnologias móveis, apresentou os benefícios que os apps trazem para os pacientes e para os profissionais da saúde. É relevante mencionar a necessidade de novos estudos sobre tecnologias móveis na área da enfermagem, para preencher lacunas e disparara para outras pesquisas, buscando contribuir para a tecnologia na Enfermagem.
Descritores: *Tecnologias móveis; Tecnologia em saúde; Informática aplicada à enfermagem*.

RESUMEN
Identificar en la literatura estudios sobre el desarrollo de tecnologías móviles en el campo de la enfermería. El estudio es una revisión integradora. El levantamiento de artículos se realizó de febrero a abril de 2022, utilizando las siguientes bases de datos: Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS), Biblioteca Científica Electrónica en Línea (SciELO) y Base de Datos de Enfermería (BDENF). La muestra final estuvo compuesta por 17 artículos científicos, seleccionados por criterios de inclusión y exclusión. Los resultados fueron presentados y discutidos en categorías temáticas. La enfermería como protagonista de la creación de tecnologías móviles, presentó los beneficios que las apps aportan a los pacientes y profesionales de la salud. Es relevante mencionar la necesidad de más estudios sobre las tecnologías móviles en enfermería, para llenar los vacíos y desencadenar más investigaciones, buscando contribuir a la tecnología en Enfermería.
Descriptores: *Tecnologías móviles; Tecnología de la salud; Informática aplicada a la enfermería*.

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INTRODUCTION

In the current context, the phenomenon of technologies, especially the use of mobile applications among the world's population, aims to meet people's need for access to information and knowledge, without restriction of time and space, allowing new forms of communication. Such properties embody values that define the new Information Age society. Several studies point to an increase in the use and development of mobile technologies, which are contributing to the construction of a new modality of health care, in which information regarding people's health is timely and ubiquitous[1].

In this way, access to information over the internet has become increasingly faster. Over time, new versions of technology emerge and gain space, especially mobile devices, as they have a more affordable cost for the majority of the population. In addition, they are easier to operate, are multitasking, and portable. Therefore, the mobile device, due to its versatility in offering information sharing, is an ally to *web tools*, whose main trait is collaboration and interactivity. Thus, the applications (*apps*) developed, especially for these devices[2], emerged.

With the emergence of Information and Communication Technologies (ICTs), it has the potential to contribute in an extraordinary way to the improvement of access to quality services, promoting the expansion of autonomy and facilitating the dynamics of the functioning of health services. In addition, mobile computing technology can be used in various aspects of the health area, such as medical and nursing diagnostic support, decision-making, electronic medical records, maintaining the history of exams, diagnoses and consultations, control of drug stocks, bed management, etc.[3].

Specifically, in the area of nursing, it is considered that the tools provided by ICTs, associated with clinical, educational and management practice, require nurses to make efforts to achieve a definition of their role in relation to informatics in nursing. The imminent need for these professionals to reflect and insert themselves in the technological environment of mobile applications, which are strongly present in the cultural, social and economic context of the country, is evident[1].

The benefit of information technology applied to health provides improvement in clinical decision-making, interventions, in addition to patient education and aggregation of knowledge to health professionals. Thus, the use of mobile technology, as support in telemedicine and continuing education programs aimed at health professionals, especially nursing, has been greatly expanding in recent years, from academic centers to scientific innovation, where they focus on various areas of public health.

Based on this assumption, there is relevance both for the construction and use of technologies in the area of nursing, being used in favor of health and for technological innovation, adding to the advancement of new ways of building knowledge and facilitating access to information. In addition, the result will allow the identification of mobile technologies in the area of Nursing, other gaps in the literature and the expansion of knowledge.

In view of the above, the objective of this research is to identify studies on the development of mobile technologies in the nursing field in the literature.

METHODS

The present study is an integrative review, since it is a method whose purpose is to synthesize studies obtained from research on a certain theme or issue that one wants to work on, being constructed in a systematic and comprehensive way, contributing to knowledge. Consequently, the researcher can elaborate an integrative review in different ways and purposes, maintaining and being directed to the definitions and analyses of methods included in the most diverse studies[4].

For Soares, Hoga, Peduzzi, Sangaleti, Yonekura, Silva[5], the integrative review is configured as bringing together studies developed through different methodologies, allowing the logical implementation of the analysis and synthesis of primary data in a critical way, implementing evidence and evaluating the results obtained.

Nurses seek scientific knowledge on a daily basis, and from the perspective of using technologies and contributing to the professional practice of nursing, the following guiding question arose for the development of this research: what are the scientific productions on the development of mobile technologies in the field of nursing?

According to Mendes, Silveira and Galvão[6], for the development of the integrative review, it is necessary to go through six distinct stages, namely: 1) Choice and definition of the theme, objectives, identifying keywords, relating the theme to practice; 2) Establishment of inclusion and exclusion criteria, use of databases, selection of studies; 3) Extraction of information, organization of information, formation of the database; 4) Evaluation of the studies, with the application of statistical analysis, inclusion and exclusion of studies, critical analysis of the selected studies; 5) Interpretation of the results through the discussion of the results, proposals for recommendations, suggestions for future research; 6) Summary of available evidence, creation of a document that describes the review in detail.

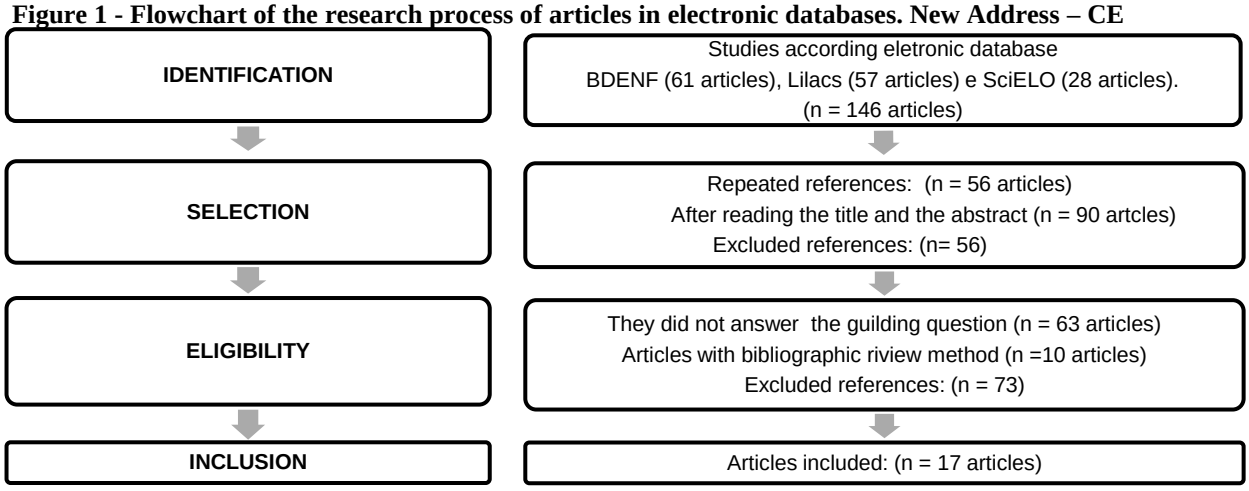
The research was conducted from February to April 2022, using the following databases: Latin American and Caribbean Health Sciences Literature (LILACS), *Scientific Electronic Library Online* (SciELO) and Nursing Database (BDENF), using the descriptors: Mobile technologies; Health technology; Informatics applied to nursing, available in the Health Sciences Descriptors (DeCS). The search for scientific articles was as follows: in each of the electronic databases, one descriptor at a time was inserted in the search tab, thus obtaining the selection of articles according to the descriptor.

The inclusion criteria of the publications selected for the study are: articles that contemplate the proposed objective; articles published in the electronic journals LILACS, SCiELO and BDENF from 2016 to 2021; free online availability of the full text; published in Portuguese and carried out in Brazil. Thus, the exclusion criteria are: repeated articles in the aforementioned electronic databases; articles with an integrative or bibliographic review method; articles that do not answer the problem question; abstracts of papers published in conference proceedings; dissertations; theses or texts from government institutions; studies with secondary data such as reviews, reports or reflections; letters to the editor; editorials; manuals.

Through an active search in the online electronic databases, the selection and evaluation of 17 articles was established, and later a flowchart was constructed, shown in Figure 1, representing how the research process went, from identification to inclusion of

the studies, facilitating understanding. After the selection of the articles, the titles and abstracts were read, seeking to select articles that contemplated the guiding question of this research.

Figure 1 - Flowchart of the research process of articles in electronic databases. New Address – CE



Source: Research data (VHL/ 2016 – 2021).

The analysis and interpretation of the data was carried out in an organized and summarized manner, through the construction of a table containing the following items: article, database, author(s), title, year of publication, research design, mobile technologies produced in the field of nursing. The results were systematized and distributed into thematic categories.

Regarding the ethical aspects, it is noteworthy that the precepts of authorship and the citations of the authors of the scientific productions that constituted this study were respected, and because it is an integrative review, it is not necessary to submit it to the Research Ethics Committee (REC).

RESULTS

The final sample of this review consisted of 17 scientific articles, selected according to the inclusion and exclusion criteria, as shown in Table 1.

The articles describe mobile technologies in the field of nursing for nurses (47%), health professionals (23%), nursing staff (6%), nurses and nursing students (12%), nursing staff (6%) and users (6%).

About 52% of the articles used the methodological study as a methodology, to describe the process and stages of development of mobile technology; and all articles show the construction of mobile technologies in full.

Table 1. Sample characterization according to the article, database, author(s), title, year of publication, research design, and mobile technologies produced in the field of nursing, Fortaleza, Ceará, Brazil, 2022.

CODE	DATABASE	AUTHOR(S)	TITLE	YEAR OF PUBLICATION	RESEARCH DESIGN	MOBILE TECHNOLOGIES PRODUCED IN THE FIELD OF NURSING
01	SCiELO	Silva MG, Sakata-So KN, Pereira EG, Egry EY	Mobile application of the terminological subset for confronting domestic violence against children	2021	Applied Research/ Technological production	CIPE Violence
02	SCiELO	Ferreira DS, Ramos FRS, Teixeira and	Mobile application for the educational praxis of nurses of the Family Health Strategy: ideation and prototyping	2021	Methodological study/ Qualitative	*FracTeam APS*
03	SCiELO/ LILACS/ BDENF	Colodetti R, Prado TM, Bringuente ME, Bicudo SD	Mobile App for Diabetic Foot Ulcer Care	2021	Methodological study	UPDAPP
04	LILACS/ BDENF	Ferreira BB, Silva DM, Neto GR, Medeiros ACT, Trigueiro DRSG	Construction of a computational tool to assist in the coordination of care by primary care services	2021	Methodological research	Electronic medical record
05	SCiELO/ LILACS/ BDENF	Almeida MA, Lucena AF, Nomura ATG, Graeff M, Chies N, Pruinelli L	Development of an educational software for nursing diagnoses	2021	Methodological study	Nursing Diagnosis Educational Software
06	LILACS/ BDENF	Costa VC, Silva KR, Felix LK, Nascimento MM, Pereira EB	Prototyping of an educational game for the prevention of childhood accidents	2021	Descriptive study	Danger Detectives
07	SCiELO	Melo EBM, Primo CC, Romero WG, Sant'Anna HC, Sequeira CAC, Lima EFA, et al.	Construction and validation of a mobile application for the development of nursing history and diagnosis	2020	Methodological study	CuidarTech Semio – Clinical Nursing Examination
08	SCiELO	Mota NP, Vieira CMA, Nascimento MNR, Bezerra AM, Quirino GS, Félix NDC	Mobile App for Teaching Grading International for Nursing Practice	2019	Applied Methodological Research/ Technological production	*CIPE Play*
09	LILACS/ BDENF	Barros WCTS, Dal Sasso GTM, Alvarez AG, Ramos SF, Martins SR	Application for assessing the level of consciousness in adults: technological production in nursing	2019	Technological production study	OMAC
10	SCiELO	Lopes JP, Dias TMR, Carvalho DBF, Oliveira JF, Cavalvante RB, Oliveira VC	Evaluation of a digital vaccine card in nursing practice in the vaccination room	2019	Methodological study	Vaccination in the Palm of the Hand
11	LILACS/ BDENF	Alvim AL, Couto B	Hands Clean – Automatic Rate for Hand Hygiene: Application Development for Infection Controllers	2019	Technological Production Research	Hands Clean

12	SCiELO	Lima JJ, Vieira LGD, Nunes MM	Computerized nursing process: Construction of mobile technology for use in neonates	2018	Methodological/qualitative study	*Natus*
13	SCiELO	Silva Jr MG, Araujo EC, Moraes CRS, Goncalves LHT	*Software* for systematization of nursing care in a hospital inpatient unit	2018	Methodological study	INFOSAE
14	SCiELO/ LILACS/ BDENF	Pereira IM, Bonfim D, Peres HH, Góes RF, Gaidzinski RR	Mobile Technology for Health Research Data Collection	2017	Applied research	Not named
15	LILACS/ BDENF	Silva CPC, Water MCQ, Current JE, Castro MCN, Zornoff DCM	Building the App for the Pressure Ulcer Indicator	2016	Descriptive study	Electronic application for the pressure ulcer indicator (UPIA).
16	SCiELO	Oliveira RM, Duarte AF, Alves D, Furegato ARF	Development of the TabacoQuest application for computerization of data collection on smoking in psychiatric nursing	2016	Applied research	*TabacoQuest*
17	BDENF	Tibes CM, Cherman EA, Souza VMA, Souza VMA, Évora YDM, Zem-Mascarenhas SH	Image Processing on Mobile Devices to Classify Pressure Ulcers	2016	Applied research	Not named

Source: Research data (VHL/ 2016 – 2021).

DISCUSSION

The main results presented by the studies were evidenced in the following thematic categories: 1) Mobile technologies in the area of Nursing for health professionals; 2) Mobile technologies in the area of Nursing for patients and 3) Challenges in the use of information technology applied to health.

1) MOBILE TECHNOLOGIES IN NURSING FOR HEALTHCARE PROFESSIONALS

The success of the development and implementation of a technology is something that does not have only one measure, but several; the dimension of the value chain in the health area, which forms new technologies, whether *hardware* or *software*, *can be highlighted7*. It is plausible to base these applications in our society, where digital culture is evident and at the same time necessary, especially when information processes must be agile[8].

Nursing methods and advances represent tools that make up the knowledge used by professionals in their daily work. For this, it is essential that nurses strive to develop their own understanding, which should be associated with the promotion of quality of life, health management, diseases and the challenges resulting from this reality[9].

According to the authors of article 09, the use of mobile applications is a formidable instrument to instigate the realization of evidence-based practices, promoting critical thinking, dissemination of knowledge, problem solving and the relationship between theory and practice. Due to the fact that it brings benefits and is constantly

growing globally, the creation of innovative technologies in health care favors the quality of care provided[10].

Therefore, ICTs, in the context of health in general, must be used to quickly organize the care model, with its means of storing and sharing crucial information to improve the work process of the health team and, consequently, the patient's health.

Article 15 emphasizes the construction of the *software* for the pressure injury indicator (PPL) and determines the potential of the instrument to meet the unit's demands regarding data organization, improvement of the collection of the PPL indicator through the collection of PPL risk in a systematized way, adequacy of PPL registration and cataloguing, and the condition of monitoring the computerized PPL care indicator[11]. This shows that care practice, associated with information technology, can contribute to the maintenance of care through decision-making based on electronic support systems, which is adept at practicality in the work process[12].

Article 17 accentuates the growing expansion of the use of technologies, providing professionals with greater precision and agility in their work. This research develops an algorithm that assists in decision-making regarding the classification of pressure injuries. As a result, it can be made explicit that the use of mobile applications encompasses multiple uses, being studied, developed and used by health professionals[13]. In addition, for professionals, it is entirely related to patient safety, due to the feasibility of knowledge in an agile and comprehensive way, with current clinical conducts that can facilitate the decision of interventions and improve health care[2].

The electronic medical record is a tool that can be used to exemplify this context of an instrument created and used by multi-health professionals, since it is an ICT resource to produce and make available full information about the patient's health[14]. In this context, article 04 has brought this apparatus as a source of clinical information, a means of communication shared among professionals and as a framework for research (clinical and epidemiological studies, etc.), in addition to promoting the management of services and organization of care[15].

Thinking about the educational innovation of nursing in primary care, article 02 brings relevance to the technological increment for the work of nursing in its different needs and contexts of action, permeating the way of thinking of being cocreative and coproductive of the health care service worker, thus using the tactic in favor of technological development[16].

New approaches to improving health services and the implementation of information and communication technologies are growing rapidly, thanks to the versatility and comprehensiveness of digital tools in healthcare. This scenario offers a vast field of action and lasting opportunities for such initiatives, which are becoming increasingly popular[17].

It also considers the magnitude of the work of nursing in the development and use of technologies, in different contexts and specific demands, which has a positive impact and expands the accessibility of the health system[18].

It is highlighted how much Nursing contributes to the consolidation of knowledge as a science, characterizing care in a multiprofessional context, providing different ways of doing health. Nursing, as a driver and creator of technological innovations in the most

different areas, needs to know about the other professional categories, and how relevant this dynamic of learning exchange is. In addition, it is essential to continuously evaluate these technological resources so that the functionalities are always updated[10].

2) MOBILE TECHNOLOGIES IN PATIENT NURSING

Mobile technologies emerge in this context as a useful and easily accessible alternative for patients, given that these tools are part of the daily life of a large portion of the population. In the reality of nursing, they are allies in the control of disease symptoms, medication adherence and nurse-patient communication[19].

Regarding mobile technologies in the area of nursing for patients, there is a collection of studies with different target audiences, such as hypertensive, diabetic, pregnant women, heart disease, psychiatry, maternal and child, among others. Commonly, mobile technologies come to report, in a digital way, information, guidance and monitoring of patients' health conditions.

Article 10 points to international studies that emphasize the use of mobile devices, which include electronic records, such as people's vaccination history, providing an updated vaccination schedule, with reminders of future vaccines, which improves the population's vaccination coverage rate and provides information to people[20].

As the technologies cover various audiences, article 06 focuses on children from 8 to 10 years of age, developing a critical sense about the common risks in the daily routine that can generate accidents. It illustrates its prevention in an interactive way, through a game; In the construction of the software, virtual environments were used that interact with the player and that can be shared among the platform's user community[21].

On the other hand, there are limitations with regard to the use of these technologies, such as lack of skill in handling the tool on the mobile phone device, difficulty in accessing the internet and the fear of dehumanization in the care provided. Thus, there are recommendations for improving the interactivity between professional/patient/mobile technology, with simple and direct information; better description of the functions, in addition to having a support system for the user's questions and answers[22].

The idea of efficiency and quality, linked to technologies, creates false expectations about the solution of health problems, which diverts the focus from the priorities of the sector and the education of professionals. Thus, it becomes crucial to evaluate aspects such as safety, efficacy, ethics, social impact, and cost-effectiveness. It is essential to prioritize humanized care, since the excessive emphasis on technology often overlaps with care for the individual[23].

A priori, mobile technologies have not come to replace the personal contact between professional and patient, but to complete consultations, exams, diagnoses, in addition to providing opportunities for the empowerment of the patient about their health condition. That is, emphasizing and raising awareness of self-care and its role in one's own quality of life[24].

Thus, it is inevitable that technologies have been shown to be tools that provide effective results in the promotion, prevention, recovery and rehabilitation of patients, in

such a way that the process and the difference in health care can be noticed. Directly or indirectly, the main audience of technologies is patients.

3) CHALLENGES IN THE USE OF INFORMATION TECHNOLOGY APPLIED TO HEALTH

The arrival of new technologies brings with it new needs, sometimes resulting in an increase in workload, requiring multidisciplinary knowledge and specialized professionals in diverse and complementary areas. Innovation is a complex, non-linear and uncertain process that requires interaction between employees, organizations and leaders[25].

The process of implementing a new technology in health directly implies the functioning of organizations, as there is a need to adapt their work processes, investments to obtain equipment, as well as the training of these professionals, requiring skills to handle these technologies. Thus, the impact of new technologies brings a new context to the way health services will be performed[26].

Article 10 highlights problems in updating mobile technology systems, which makes it difficult to maintain information, such as vaccination card records, compromising the validity of the information. In addition, there is a lack of trained professionals in health IT, that is, health informatics. It is evident that we are following a path of automating many services, and this requires more skilled labor for the technology segment[20].

Article 12 highlights that the use of ICTs can be seen as something challenging and innovative in the nursing scenario. However, there is some resistance from some professionals regarding the adequacy and, subsequently, the use of technologies as tools for integration in the various dimensions of care[27].

The lack of knowledge of technology, as a work tool, can be considered an essential factor for the unleashing of resistance, given that the computerization of health institutions is something recent; and that professionals are not yet able to work with this type of technology. Consequently, this leads to a delay in the inclusion of advanced informatics in health, causing professionals to adopt negative behaviors in relation to the use of these new technologies. Therefore, it is of paramount importance to have some kind of support for the use of an Information System in daily work[28].

Article 04 emphasizes the challenges for the implementation of the electronic medical record, a tool that is essential for the development of activities, but which generates high costs for managers and public coffers[29]. Since reducing costs and increasing efficiency is a constant pursuit of any company. This is one of the biggest challenges, implementing these technologies, since they are work instruments of high economic cost. Thus, it is necessary to strategically position health organizations for the treatment of informational resources, as well as to choose an Information Technology tool capable of bringing the expected benefits to these organizations[30].

Thus, another factor to be analyzed is data security, an item that a priori is essential, as there is the right to information, but, on the other hand, there is also the right to privacy in the right to data security in the digital environment[31].

However, despite the difficulties faced by the health IT segment, this is an area that has a high potential for improvement in relation to patient care, with the prospect of leading to more investments and prominence for this sector.

CONCLUSION

This study described the mobile technologies developed by nursing, with several objectives, but mainly aimed at improving the quality of health care directly or indirectly. In addition, the versatility of these tools was highlighted, such as their presence in various themes, guidance for patients, forms of organization in the service, data collection, assistance for diagnosis and care, among others.

Mobile applications are propagated in different areas of health and present benefits for the different agents that write these scenarios, such as patients, their families and health professionals, who can be providers of direct care or health management.

Since nursing is the protagonist in the creation of mobile technologies, whose purpose is the development of promotion, prevention, recovery and rehabilitation, in pathological and therapeutic processes, procedures and orientations, it is notorious to observe that the purpose of apps is to assist in the execution of health care.

It is possible to observe the influences that nursing practice suffers through advances in technologies and their use, which allows decision-making through clinical reasoning, taking into account the various aspects and situations that involve the patient.

It is essential that nurses are prepared to keep up with advances in the health area, always seeking to train and improve their skills. It is essential to remember that technology should be used as an ally on the path to more efficient and safer care. Thus, professionals must be in a constant learning process for the sake of patient care.

Some limitations were found in the elaboration of this study, among them, the scarcity of national studies, the repetition of publications, and the disagreement with the design of the study criteria.

In short, it is relevant to mention the need for further studies on mobile technologies in the field of nursing, which may fill gaps. It is hoped that they will be triggers for other research, seeking to contribute to technology in Nursing.

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