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REVIEW

Mobile technologies in the Nursing area

Tecnologias móveis na área de Enfermagem

Tecnologías móviles en el área de Enfermería

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ABSTRACT

Objective: To identify in the literature studies on mobile technologies in Nursing. **Method:** Integrative literature review in which was used the Population, Interest and Context (PICo) strategy, the tool of the National Library of Medicine for formulation of the research question, and search without a determined period of time in the following bibliographic databases: Medical Literature and Retrieval System onLine/PubMed®), Cumulative Index to Nursing & Allied Health Literature (CINAHL), SCOPUS (Elsevier), Latin American and Caribbean Literature in Health Sciences (LILACS) and Nursing Database (BDENF). Data collection period was from January to March 2017. **Results:** Fifteen articles were selected, in which were addressed mobile technologies in Nursing for nurses, undergraduate students and patients. **Conclusion:** Mobile technologies in Nursing are a recent theme and enable care data sharing, experience acquisition by undergraduate students and patient empowerment.

Descriptors: Mobile Applications; Smartphone; Nursing Informatics; Application of Medical Informatics; Mobile Phones.

RESUMO

Objetivo: Identificar na literatura estudos sobre tecnologias móveis na área de enfermagem. **Método:** Revisão integrativa da literatura, utilizando a estratégia População, Interesse e Contexto (PICo), ferramenta da National Library of Medicine para formulação da questão de pesquisa e busca sem recorte temporal nas bases de dados bibliográficas: Medical Literature and Retrieval System onLine (MEDLINE/PubMed®), Cumulative Index to Nursing & Allied Health Literature (CINAHL), SCOPUS (Elsevier), Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) e Base de Dados em Enfermagem (BDENF). A coleta de dados ocorreu no período de janeiro a março de 2017. **Resultados:** Foram selecionados 15 artigos, que abordaram tecnologias móveis na área da enfermagem para enfermeiros, graduandos e pacientes. **Conclusão:** As tecnologias móveis na área da enfermagem são tema recente e possibilitam compartilhamento de dados na assistência, aquisição de experiência por graduandos e empoderamento do paciente.

Descritores: Aplicativos Móveis; *Smartphone*; Informática em Enfermagem; Aplicação de Informática Médica; Telefones Celulares.

RESUMEN

Objetivo: Identificar en la literatura estudios sobre tecnologías móviles en el área de Enfermería. **Método:** Revisión de la literatura en que se utilizó la estrategia Población, Interés y Contexto (PICo), herramienta de la National Library of Medicine para la formulación de la cuestión de la investigación y la búsqueda sin recorte temporal en las siguientes bases de datos bibliográficos: Medical Literature and Retrieval System onLine (MEDLINE/PubMed®), Cumulative Index to Nursing & Allied Health Literature (CINAHL), SCOPUS (Elsevier), Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS) y Base de Datos en Enfermería (BDENF). El período de la recolección de datos fue de enero a marzo de 2017. **Resultados:** Se seleccionaron 15 artículos, que abordaron tecnologías móviles en el área de Enfermería para enfermeros, estudiantes y pacientes. **Conclusión:** Las tecnologías móviles en el área de Enfermería son tema reciente y posibilitan compartir datos en la asistencia, adquisición de experiencia por estudiantes y empoderamiento del paciente.

Descriptores: Aplicaciones Móviles; Smartphone; Informática en Enfermería; Aplicación de Informática Médica; Teléfonos Móviles.

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INTRODUCTION

The term 'technology' has been misconceived as product, computerization, cybernetics and robotics. However, depending on the context, it can mean technical or scientific knowledge, tools, processes and materials created from such knowledge, which are related, base the Nursing care and generate solutions to practical problems[1].

Information and Communication Technologies (ICTs) are all communication technologies that facilitate transmission of information through digital means, and include computers, wireless networks, among other devices. They have been used globally in personal, educational, business and health contexts[2]. In these contexts, from ICTs, it was also possible to process and transform data, images and voice, act on mechanisms that operate changes of state, sensors and actuators; to store, persist, maintain and recover data, images, voice and communication, and carry from one point to another what was processed and stored[3].

Among ICTs, smartphones stand out because they enable communication, have several functionalities and offer many options for users given their efficient operating system and easy internet access[4]. In Brazil, according to the Global Mobile Consumer Survey, in 2016, 80% of people used smartphones daily, a very close percentage to the global average, which at that time was 81%[5].

Studies have been conducted in the health field for identifying the use of mobile technologies in the national and international literature. A systematic review of smartphone-based health technologies according to their functionality has shown that many smartphone applications are developed and used in health professionals' education, self-management of diseases and remote patient monitoring[6]. In Brazil, in another integrative review study, was identified that research involving mobile technologies applied to health has been more used for professional support[7].

The present study was proposed given the lack of an integrative review of the literature on mobile technologies in the Nursing area. Furthermore, it is part of a macro project with the aim to develop a smartphone application on intestinal elimination ostomy. Its result will allow the identification of the state of the art on mobile technologies in Nursing, of other gaps in the literature, and the expansion of the body of knowledge.

OBJECTIVE

To identify in the literature studies on mobile technologies in the Nursing area.

METHOD

An integrative literature review. It implies the analysis of relevant research that supports decision making and improvement of clinical practice, enables the synthesis of the knowledge state of a given subject, and points out knowledge gaps that need to be filled with new studies[8].

The steps of this integrative review were the following: elaboration of the research question; sampling and data collection strategy; extraction of relevant data from primary studies; evaluation of studies; analysis and synthesis of the results of the review and presentation of the integrative review[9].

The research question to be answered was 'What is the scientific production on mobile technologies in the Nursing area?'. It was developed by using the PICo strategy (Population/Problem, Interest and Context), which is a tool of the National Library of Medicine. This strategy is based on segmentation of the research question, and allows researchers to select words that bring the appropriate definition of the initial questioning by identifying the best scientific information about the topic. Chart 1 describes the strategy used in the development of this review[10].

Chart 1 - Research question according to Population/Problem, Interest and Context (PICo) strategy, Brazil, 2016

Description	PICo	Components	Descriptor	Type	UND
Population/ Problem	P p	Original studies	-	-	-
Interest	I	Mobile phone applications	"Computers, handheld"	DeCS MeSH Emtree	iPhoneAndroid blackberry blackberry Windows MobileWindows Phone deviceapplication
			"Smartphone"		
			"Mobile applications"		
Context	CCo	Nursing	Nursing	DeCS MeSH	nurs$ nurs*

Note: UND = Uncontrolled descriptor

The following bibliographic databases were used for the selection of articles: Medical Literature and Retrieval System onLine (MEDLINE/PubMed®) via National Library of Medicine, Cumulative Index to Nursing&Allied Health Literature (CINAHL); SCOPUS (Elsevier); Latin American and Caribbean Literature in Health Sciences (LILACS) and Nursing Database (BDENF). The controlled descriptors used in the search strategy were selected in MESH (Medical Subject Headings), DeCs (Health Sciences Descriptors) and Emtree (CINAHL Terminology), as well as uncontrolled descriptors (described in Chart 1). A search strategy was used for each bibliographic database (Chart 2).

Original articles in full and available online in selected bibliographic databases, published in Portuguese, English and Spanish (with no determined period of time) until the search was completed in December 2016 were included. Articles of theses, dissertations, review articles, non-material scientific papers, articles in which it was not possible to identify a relationship with the subject by reading title and abstract, and duplicate articles in the bibliographic databases were excluded.

The search and selection of articles were performed by two reviewers independently in order to give more rigor to this procedure. Initially, the selection of studies was performed by reading the titles

Chart 2 – Search strategies according to bibliographic databases, Brazil, 2016

Databases	Search strategy
MEDLINE/PubMed®	("Mobile Applications"[Mesh] OR "Mobile Applications"[AllFields]) OR ("Mobile Application$"[AllFields]) OR ("computers, handheld"[MeSHTerms] OR ("computer$"[AllFields] AND "handheld"[AllFields]) OR "handheld computer$"[AllFields]) OR ("smartphone$"[AllFields] OR "smart-phone$"[AllFields] OR "smartphone$"[AllFields] OR "iPhone"[AllFields] OR "Android"[AllFields] OR "blackberry"[AllFields] OR "blackberry"[AllFields] OR "Windows Mobile"[AllFields] OR "Windows Phone"[AllFields]) AND ((("nursing"[MeSHTerms] OR "breastfeeding"[MeSHTerms]) OR "nursing"[AllFields]) OR nurs$[AllFields])
CINAHL	((MH "Mobile Applications") OR "mobile application") OR (((MH "Computers, Hand-Held") OR (MH "Computers, Portable") OR "computers, handheld" OR (MH "Smartphone") OR "smartphone" OR "iphone" OR "android" OR "windowsphone" OR "windows mobile" OR "blackberry" OR "blackberrry") AND ((nursing) OR (nurs*))) Limitadores –Revistas Acadêmicas Restringir por Language: - portuguese Restringir por Language: - spanish Restringir por Language: - english Modos de pesquisa - Booleano/Frase
SCOPUS	((ALL("mobile application") OR ALL("deviceapplication"))) OR (((ALL(smartphone) OR ALL(smartphone$) OR ALL(smart-phone$) OR ALL("smartphone$") OR ALL("computers,handheld$") OR ALL("computers, handheld") OR ALL(iphone) OR ALL("windowsphone") OR ALL(android) OR ALL(blackberry) OR ALL("blackberry"))) AND ((ALL(nurs*) OR ALL(nursing)))) AND (LIMIT-TO(SUBJAREA,"NURS")) AND (LIMIT-TO(LANGUAGE,"English") OR LIMIT-TO(LANGUAGE,"Portuguese") OR LIMIT-TO(LANGUAGE,"Spanish")) AND (LIMIT-TO(DOCTYPE,"ar"))
LILACS and BDENF	(tw:("nursing")) OR (tw:(nurs*)) AND (tw:((tw:("Mobile Applications")) OR (mh:("Mobile Applications")) OR (tw:(mobile application*)) OR (tw:("computers, handheld")) OR (tw:(handheld computer*)) OR (tw:(smartphone)) OR (tw:(smartphone*)) OR (tw:(smart-phone*)) OR (tw:(smartphone*)) OR (tw:(iphone)) OR (tw:(android)) OR (tw:(blackberry)) OR (tw:("blackberry")) OR (tw:("Windows Mobile")) OR (tw:(windowsphone)))) AND (instance:"regional") AND (db:("LILACS" OR "BDENF"))

and abstracts based on inclusion criteria. From this selection, the remaining articles were read in full in order to include only relevant publications and consistent with the problem of the study.

After applying the inclusion and exclusion criteria, reading titles and abstracts, and full texts, the sample consisted of 15 articles. For the collection of information of articles, was used an instrument adapted from the literature[11] that included the following information: identification (authors, title, publication year and journal, database and mobile technologies in the Nursing area) and methodological characteristics (type of study/level of evidence).

Figure 1 shows a flowchart of the search and selection process of articles by bibliographic database.

In this review, the classification of the type of study/level of evidence was the following: level I: systematic review or meta-analysis of all relevant randomized controlled trials, or from clinical guidelines based on systematic reviews of randomized controlled trials; level II: at least one well-delineated randomized controlled clinical trial; level III: well-delineated clinical trials without randomization; level IV: well-delineated cohort and case-control studies; level V: systematic review of descriptive and qualitative studies; level VI: a single descriptive or qualitative study; level VII: opinion of authorities and/or report of expert committees[12].

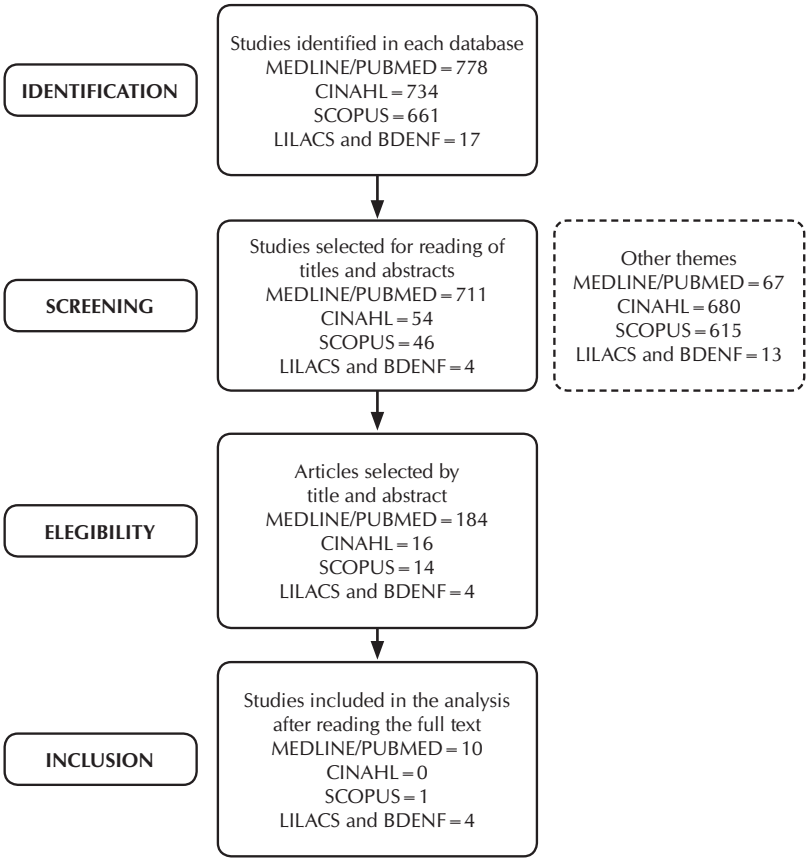

Figure 1 – Flowchart of the process of identification, screening, eligibility and inclusion of articles in the integrative literature review, Brazil, 2017

The articles were analyzed descriptively and summarized in Charts with categorization of mobile technologies in Nursing according to the target audience: nurses, nursing undergraduate students and patients.

The research project of this review was not sent to the Research Ethics Committee (REC) because there is no direct involvement of human beings. In all stages of this review were respected the ethical principles and authors' copyright by citing each one of them.

RESULTS

Of the 218 articles selected by title and abstract, 203 mentioned the impact and usability of mobile technologies in the lives of patients and health professionals, but since there was no reference to the development process, these were not included in this study.

Of the 15 articles included, four were published in Brazil and 11 abroad. Regarding the target audience, six articles described mobile technologies in Nursing for nurses (Chart 3), two for undergraduate students and seven for patients (Chart 4).

Chart 3 and 4 show articles describing mobile technologies in Nursing for nurses, undergraduate students and patients according to authors, titles, year/journal, type of study/level of evidence and name of the application (when it was named and quoted by the author).

Almost all articles (93%)[13-26] are from the last five years. Seven (46%)[13,16-17,20,22,24-25] are from the two last years. In the majority (87%)[13-22,24-25], was used some qualitative method for evaluation of the mobile technology during its development, or the process and development stages were only described and classified as level VI[12]. In studies in which was used randomization (13%)[13,24], the aim was to compare participants' perceptions before and after the development and use of mobile technology.

Chart 3 – Articles selected for the study according to mobile technologies in Nursing for nurses, Brazil, 2017

Database	Authors	Title	Year/Journal	Type of study/ Level of evidence	Mobile technologies in Nursing according to target public
Study A (LILACS and BDENF)	Velasco HF, Cabral CZ, Pinheiro PP, Azambuja RCS, Vitola LS, Costa MR, et al.	Use of digital media for the education of health professionals in the treatment of childhood asthma	2015/ Jornal de Pediatria	Randomized controlled trial/ Level II	Not mentioned
Study B (LILACS and BDENF)	Grossi, L.M.; Pisa, I.T.; Marin, H.F.	Oncoaudit: development and evaluation of an application for nurse auditors	2014/Acta Paulista de Enfermagem	Qualitative and quantitative study/ Level VI	Oncoaudit
Study C (LILACS and BDENF)	Catalan VM, Silveira DT, Neutzling AL, Martinato LHM, Borges GCM.	The NAS system: Nursing Activities Score in mobile technology	2011/Revista da escola de Enfermagem da USP	Descriptive study/ Level VI	Nursing Activities Score
Study D (Pubmed)	Kim H, Chung H,Wang S,Jiang X,Choi J.	SAPPIRE: a Prototype Mobile Tool for Pressure Ulcer Risk Assessment	2014/Studies in Health Technology and Informatics	Descriptive study/ Level VI	SAPPIRE(Skin Assessment for Pressure Ulcer Prevention, an Integrated Recording Environment)
Study E (Pubmed)	Wang J,Yao N,Wang Y,Zhou F, Liu Y,Geng Z,et al.	Developing ''Care Assistant'': A *smartphone* application to support caregivers of children with acutely lymphoblastic leukemia	2015/ Journal of Telemedicine and Telecare	Descriptive study/ Level VI	Care Assistant
Study F (Pubmed)	Warpenius E, Alasaarela E,Sorvoja H,Kinnunen M.	A mobile user-interface for elderly care from the perspective of relatives	2015/ Informatics for Health and Social Care	Descriptive study/ Level VI	Not mentioned

Chart 4 – Articles selected for the study according to mobile technologies in Nursing for Nursing undergraduate students and patients, Brazil, 2017

Database	Authors	Title	Year/Journals	Type of study/ Level of evidence	Mobile technologies in Nursing according to target public
Study A (LILACS and BDENF)	Galvão, ECF, Püschel, VAA.	Multimedia application in mobile platform for teaching the measurement of central venous pressure	2012/ Revista da escola de Enfermagem da USP	Qualitative study/ Level VI	Not mentioned

To be continued

Chart 4 (concluded)

Database	Authors	Title	Year/Journals	Type of study/ Level of evidence	Mobile technologies in Nursing according to target public
Study B (Pubmed)	Juric,S.; Zalik, B	An innovative approach tonear-infrared spectroscopy using a standard mobile device and its clinical application in the real-time visualization of peripheral veins	2014/ BMC medical informatics and decision making	Qualitative study/ Level VI	mVeinVision
Study C (Pubmed)	Chang CW, Ma TY, Choi MS, Hsu YY, Tsai YJ, Hou TW	Electronic personal maternity records: Both web and smartphone services	2015/ Computer methods and programs in biomedicine	Qualitative study/ Level VI	Pregfone Care
Study D (Pubmed)	Jeon, E., Park, HA.	Development of a smartphone Application for Clinical-Guideline Based Obesity Management	2014/ Healthcare Informatics Research	Qualitative study/ Level VI	Not mentioned
Study E (Pubmed)	Kang H, Park HA.	Development of Hypertension Management Mobile Application based on Clinical Practice Guidelines	2015/Studies in Health Technology and Informatics	Descriptive study/ Level VI	Not mentioned
Study F	Nes AAG, Van Dulmen S,Eide E,Finset A,Kristjánsdóttir OB,Steen IS,et al.	The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2	2012/ Diabetes research and clinical practice	Descriptive study/ Level VI	Not mentioned
Study G	Morrison CF, Szulczewski L,Strahlendorf LF,Lane JB,Mullins LL,Pai AL	Designing Technology to Address Parent Uncertainty in Childhood Cancer	2016/ Advances in Nursing Science	Randomized controlled trial/ Level II	Not mentioned
Study H	Jaensson M, Dahlberg K, Eriksson M, Grönlund Å, Nilsson U.	The Development of the Recovery Assessments by Phone Points (RAPP): A Mobile Phone App for Postoperative Recovery Monitoring and Assessment	2015/ JMIR mHealth and uHealth	Descriptive study/ Level VI	Recovery Assessments by Phone Points (RAPP)
Study I	Cho MJ, Sim JL, Hwang SY.	Development of Smartphone Educational Application for Patients with Coronary Artery Disease	2014/Healthcare Informatic Research	Descriptive study/ Level VI	Strong Heart

DISCUSSION

The use of ICTs in Nursing has changed the way of dealing with massive amounts of information on care and resources used in a fast and organized way. Mobile technologies are a way of storing and sharing information, they improve the Nursing team performance and promote customer care[27].

Smartphone mobile technologies enable a range of computing activities and telephony activities such as data access, internet browsing, e-mail sending and receiving, instant messaging applications, wireless communication technology (Wi-Fi®), among others. In the health and nursing context, several functions can be used by patients or professionals. Emerging mobile technologies allow that professionals share information in real time, obtain data through a wireless system, and stimulate the self-care of patients of certain clinical conditions[28].

These technologies fit into the context of mHealth, which means "health and medical practice supported by mobile devices such as mobile phones, patient monitoring devices, Personal Digital Assistants (PDAs) and other wireless devices"[29]. This modality of patient care has been growing in line with the innovation of mobile devices, their popularization and new demands on patient health care[30].

Mobile technologies in Nursing for nurses

Mobile technologies have proven innovative in Nursing practice and changed the way nurses perform their interventions and communicate with patients and other health professionals. This allows for preventive and diagnostic actions, and for disease treatment[31].

In general, nurses are open to the acquisition of mobile technologies at work for reducing the time in insertion and sharing of patient data. Mobile technologies should not be an extra form of record, but rather facilitators of systematization and access to patient information and the care process[32].

Mobile technologies are tools for expanding the knowledge and systematization of work, and offer nurses the opportunity to

strengthen ties with patients and family members, and provide guidance regarding self-care. Patient engagement in health care places nurses in the role of consultants and advisors and improves outcomes, especially in the management of chronic diseases. To this end, Nursing professionals need to be able to handle mobile technologies, know their potentialities and limitations[33].

In this study, the mobile technologies in Nursing for nurses mentioned in Chart 3 presented several purposes, namely: educational tool for acquiring practical knowledge in the treatment of asthma[13], management tool in auditing hospital bills[14], access and sharing of data in a hospital system through a smartphone[34], coding system for pressure ulcer risk assessment items[15], support system for caregivers of children with acute lymphoblastic leukemia[16] and elderly care[17].

Despite the different purposes mentioned in studies in Chart 3, all publications converge to the need for usability and user satisfaction. Seeking to improve functionality and attractiveness, software development professionals and health researchers use evaluative tools. In study B (described in Chart 3)[14], professionals specialized in the creation of the mobile technology in question used the heuristic evaluation of Nielsen. This evaluation is performed through principles (heuristics) observed by more than one evaluator, who has the role of finding problems and suggesting usability improvements[35]. The evaluation performed by health researchers is usually done through satisfaction questionnaires or interviews with participants in a subjective way.

Mobile technologies in Nursing for undergraduate students

Considering the change caused by ICTs in Nursing practice, the training process of future professionals must follow this evolution and present new strategies for knowledge acquisition. The availability of technological means throughout undergraduate studies prepares students for the field, since nowadays, work places are incorporating mobile technologies, shortening time, work and optimizing assistance[36].

The use of mobile technologies as field simulation tools is done in an experience report on the use of an iPad application during patient care simulation. The application provided several pertinent auscultation sounds to the clinical case in question. This allowed that students had a practice experience similar to reality, and the opportunity to improve their skills, thereby generating less exposure and risk to the patient because of students' inexperience[37]. In the same perspective, in study B (described in Chart 4), was demonstrated how the mVeinVision application helped Nursing students to improve their venipuncture technique by causing less harm to the patient[19].

In the present study, only two articles addressed mobile technologies in Nursing for undergraduate students. This demonstrates that even though this resource expedites problem solving and develops communication and management skills, and information access, the use of technologies by educational institutions and teachers has limitations. There are several negative points, such as unavailability of technological resources to all students, failure during the use of device, lack of teachers' knowledge regarding use of device, and focus on individual work rather than teamwork[38-39].

Mobile technologies in Nursing for patients

Population aging and increasing rates of chronic or disabling diseases require resources that reduce morbidity and mortality and allow self-management of the disease by patients and family members. In this context, mobile technologies are a useful alternative and of easy access to patients, since these tools are part of the daily lives of a large part of the world population. In the Nursing setting, they are allies in the control of disease symptomatology, drug adherence and nurse-patient communication[40].

In the findings of this review related to mobile technologies in Nursing for patients, there were studies with target audiences with different diseases/health conditions, such as pregnant women, obese, hypertensive, diabetic, children with cancer, people in the postoperative period and patients with heart disease. In general, the aim of mobile technologies in these studies was the digital reproduction of information, guidelines and monitoring of health conditions routinely performed personally in consultations.

Limitations on the use of these mobile technologies included the following: lack of ability to use the mobile phone tool, small font size due to cell phone or tablet screen, difficult internet access and fear of dehumanization in care. Recommendations for improvement include: improving interactivity between the patient and mobile technology, providing simple information, detailing functions, reproducing information from clinical practice protocols, and creating decision support systems based on user response.

The aim of mobile technologies in Nursing is not the replacement of nurse-patient personal contact, but rather to act complementarily to consultations by providing patients' empowerment about their health condition and enabling their awareness on their role in their quality of life. In addition, daily care enabled by mHealth reduces the occurrence of crisis in chronic patients because information on changes in their health status can be evaluated in real time, which avoids unnecessary displacement and time spent in health units[41].

Limitations of the study

In this review, publications with higher levels of evidence were scarce, which is explained by the descriptive design of most studies. The strategies used in the development and evaluation of mobile technologies were varied, highlighting the subjectivity of evaluation by research nurses, and scarce use of standardized scales of evaluation. The convenience sample was the most used by researchers, which generated results that cannot be applied to any type of population.

Contributions for Nursing

Knowing the reality about mobile technologies in Nursing made it possible to synthesize what is in the literature, identify unmet needs, and foster new research with fewer gaps in design and performance. Consequently, evidence can be better through studies with elaborated methods.

CONCLUSION

The articles selected in this review were on mobile technologies in Nursing for nurses, undergraduate students and patients. The profile of selected articles indicates the theme

is recent and developed in countries where there are more technological resources.

For professionals, the possibilities of creating mobile technology range from the record of patient data, mean of information about diseases, managerial and administrative activities, among others. The increasing complexity of patients' cases and of nurses' job demands encourages the development of mobile technologies that make the work agile and optimize professionals' time during care and management activities.

Despite these limitations, mobile technologies can be great allies for building students' knowledge and their acquisition of experience before entering fields of practice.

For the technology business, patients represent a growing consumer market of mobile technology, which is no different when it comes to health. In this study, the aim of mobile technologies in Nursing for patients is empowering their health, self-care and frequent monitoring of changes in their health conditions by complementing nursing consultations.

In summary, results indicate the need for new studies on mobile technologies in Nursing, especially with undergraduate students. New studies may fill the current gaps and contribute to the practice of flexible, systematized and safe Nursing.

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