Review article

Contributions of mobile applications to pre-hospital care: integrative review

Contribuições dos aplicativos móveis para o atendimento pré-hospitalar: revisão integrativa

Contribuciones de las aplicaciones móviles para la atención prehospitalaria: revisión integradora

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Abstract

Objective: Analyze the scientific contribution of mobile applications developed for pre-hospital care.

Methods: Integrative literature review study; the databases used were the following: Scopus, Web of Science, CINAHL, SciELO, Embase, Lilacs, BDENF, Medline/PubMed, Brazilian Digital Library of Theses and Dissertations, and ProQuest Dissertations & Theses Global; (period 2017-2022), including all article categories (with abstract and full texts available with free access) in Portuguese, English, or Spanish, containing the keywords "Pre-Hospital Assistance", "Pre-Hospital Care", "Pre-Hospital Services", "Pre-Hospital Emergency Care", "Nursing", "Mobile applications", "Portable Software Applications", and "Mobile *Apps*" in titles and/or abstracts. Two researchers applied the eligibility criteria of the studies and collected data using a previously prepared instrument.

Results: From a total of 944 studies, seven were selected for evaluation. Mobile applications developed for the pre-hospital care area are technological tools that have contributed to triage, pediatric first aid, patient safety, preparation of medications during cardiac arrest, quality of cardiopulmonary resuscitation, and communication between the emergency team and the electronic nursing record.

Conclusions: The studies highlighted the potential related to the use of mobile applications in pre-hospital care, contributing especially to improving patient safety and the quality of care provided in pre-hospital urgency and emergencies. The optimization of assistance and early diagnosis times was also shown as a contribution of applications to assistance, in addition to alerting to details that may be unnoticed.

Resumo

Objetivo: Analisar as contribuições científicas dos aplicativos móveis desenvolvidos para o atendimento pré-hospitalar.

Métodos: Estudo de revisão integrativa da literatura; as bases de dados usadas foram Scopus, *Web of Science*, CINAHL, SciELO, Embase, Lilacs, BDENF, Medline/PubMed, Biblioteca Digital Brasileira de Teses e Dissertações e ProQuest *Dissertations & Theses* Global; (período de 2017-2022), incluindo todas as categorias de artigo, (com resumo e textos completos, disponíveis com acesso gratuito) nos idiomas português, inglês ou espanhol, contendo as palavras-chave "Assistência Pré-Hospitalar", "Atendimento Pré-Hospitalar", "Serviços Pré-Hospitalares", "Atendimento de Emergência Pré-Hospitalar", "Enfermagem", "Aplicativos móveis", "Aplicativos de Software Portáteis", "*Apps* Móveis", nos títulos e/ou resumos. Dois pesquisadores aplicaram os critérios de elegibilidade dos estudos e coletaram os dados a partir do instrumento elaborado previamente.

Resultados: De um total de 944 estudos, 07 foram selecionados para avaliação. Os aplicativos móveis desenvolvidos para a área de atendimento pré-hospitalar são ferramentas tecnológicas que contribuíram

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Conflicts of interest: The authors have nothing to declare.

para a triagem, primeiros socorros pediátricos, segurança do paciente, preparação de medicações durante parada cardíaca, qualidade da ressuscitação cardiopulmonar, comunicação entre equipe de emergência e registro eletrônico de enfermagem.

Conclusão: Os estudos apontaram as potencialidades referentes à utilização dos aplicativos móveis no atendimento pré-hospitalar, contribuindo especialmente para melhoria da segurança dos pacientes e a qualidade do cuidado prestado nas situações de urgência e emergência pré-hospitalar. A otimização do tempo de assistência e do diagnóstico precoce foram também mostrados como contribuições dos aplicativos na assistência, além de alertar para os detalhes que podem passar despercebidos.

Resumen

Objetivo: Analizar las contribuciones científicas de las aplicaciones móviles para la atención prehospitalaria.

Métodos: Estudio de revisión integradora de la literatura. Las bases de datos utilizadas fueron Scopus, *Web of Science*, CINAHL, SciELO, Embase, Lilacs, BDENF, Medline/PubMed, Biblioteca Digital Brasileira de Teses e Dissertações y ProQuest *Dissertations & Theses* Global (período de 2017-2022). Se incluyeron todas las categorías de artículos, con resumen y texto completo, disponibles con acceso gratuito, en los idiomas portugués, inglés o español, que contuvieran las palabras clave "Asistencia Prehospitalaria", "Atención Prehospitalaria", "Servicios Prehospitalarios", "Atención de Emergencia Prehospitalaria", "Enfermería", "Aplicaciones Móviles", "Aplicaciones de Software Portátiles", "*Apps* Móviles", en el título o resumen. Dos investigadores aplicaron los criterios de elegibilidad de los estudios y recopilaron los datos a partir de un instrumento elaborado previamente.

Resultados: De un total de 944 estudios, se seleccionaron siete para evaluación. Las aplicaciones móviles desarrolladas para el área de atención prehospitalaria son herramientas tecnológicas que contribuyeron para la clasificación, los primeros auxilios pediátricos, la seguridad del paciente, la preparación de medicaciones durante paro cardíaco, la calidad de la reanimación cardiopulmonar, la comunicación entre los equipos de emergencia y el registro electrónico de enfermería.

Conclusión: Los estudios señalaron el potencial referente a la utilización de las aplicaciones móviles en la atención prehospitalaria, lo que contribuye especialmente a la mejora de la seguridad del paciente y a la calidad del cuidado ofrecido en las situaciones de urgencia y emergencia prehospitalaria. La optimización del tiempo de la atención y el diagnóstico temprano también demostraron ser contribuciones de las aplicaciones de asistencia, además de advertir detalles que pueden pasar desapercibidos.

Introduction

The methods and techniques used in Pre-Hospital Care (PHC) have been improved over decades, as a result of major battles in the nursing history.[1] In the 1960s, two important PHC models emerged and inspired various emergency systems around the world: (1) American "*Load and* Go" model, whose objective is the rapid removal of the victim from the accident site),[2,3] and (2) French *"Stay to Treat"* model, which advocates systematized and rapid care while still on-site, focusing on stabilizing the victim in the first hour so that a safer transport can be carried out.[4]

In Brazil, PHC is characterized by all assistance provided directly or indirectly outside the hospital environment, ranging from medical guidance via telephone to advanced life support. There are several types of mobile emergency units, such as ambulances, aircraft, motorbikes, and boats. They can be Basic Life Support (BLS), Intermediate Life Support (ILS), or Advanced Life Support (ALS), differing in the degree of complexity of resources.[5-7]

In the PHC scenario, the role of nurses is highlighted. In addition to their work in assistance and advanced practices, they are responsible for managing teams and mobile units, developing and reviewing protocols, as well as promoting and implementing measures that ensure patient safety.[7-10] Recently, the Federal Nursing Council (COFEN) recognized the SIV/ILS and standardized the work of the nursing team regarding care guidelines and medication administration.[7]

Considering the challenges and risks that the PHC environment can present, the implementation of safe and responsible practices to mitigate risks and prevent errors is essential, whether through training and permanent education or obtaining technological resources that promote patient safety.[7-9]

Regarding technological resources in the health area, Information and Communication Technologies (ICT) contribute to improving the quality of assistance, promoting evidence-based practice, encouraging research, and bringing practicality and precision to care.[11,12] Among ICTs, Mobile Applications (*apps*) stand out as a promising technology, increasingly inserted in the health area, bringing several versatile and customizable resources to support assistance.[13-16]

In health, *apps* bring benefits for data arrangement, preparation of diagnoses, application of techniques, effective communication, and care coordination.[12-15] Studies indicate that the use of

apps significantly contributes to the development of health care and efficient clinical management, providing good results for managers, health professionals, and users, optimizing care time, and favoring early diagnosis.[14,17-19]

Therefore, this study aimed to analyze the scientific contribution of mobile applications developed for pre-hospital care.

Methods

This was an integrative review study developed in six stages: 1) identification of the theme and guiding question; 2) establishment of criteria for inclusion and exclusion of studies and/or literature searches; 3) data extraction from primary studies; 4) evaluation of studies to be included in the review; 5) interpretation of results, and 6) presentation of review and synthesis of knowledge.[20]

In stage 1, the following was established as a guiding question: "What are the scientific contributions of mobile applications developed for pre-hospital care?".

The inclusion and exclusion criteria for studies were defined in stage 2, starting the selection of research for analysis. The study inclusion criteria were as follows: publications including all article categories (original research, literature and systematic reviews, reflection, updating, and experience report), articles with abstracts and full texts available with free access for analysis, in addition to dissertations and theses, available in Portuguese, English, or Spanish in the period 2017-2022, containing in their titles and/or abstracts the following descriptors and/or keywords: Pre-Hospital Assistance (DECS), Pre-Hospital Care, Pre-Hospital Services, Pre-Hospital Emergency Care, Nursing (DECS), Mobile applications (DECS), Portable Software Applications, Mobile *Apps*, and their respective translations in English and Spanish. In this research, the following exclusion criteria were adopted for publications: editorials, letters, and abstracts in annals of events and studies unavailable in full even after contact with the responsible researcher.

We emphasize that the search strategy protocol was developed together with a librarian to develop an integrative review with methodological rigor, developing a specific Boolean formula for each database. The search for publications was carried out by two authors in May 2022, in the databases Scopus, *Web Of Science*, CINAHL, SciELO, Embase, LILACS/BDENF, and PubMed/MEDLINE, as well as in the Brazilian Digital Library of Theses and Dissertations (BDTD) and *ProQuest Dissertations & Theses* Global (PQDT Global). Chart 1 presents the syntax of the search strategy carried out in the MEDLINE/Pubmed database.

EndNote Web reference manager software was used to organize the results. In the first selection (for an initial floating reading of titles and abstracts by crossing descriptors and keywords), 944 studies were obtained; 69 of them were excluded due to duplication, resulting in 875 studies available in English, Portuguese, and Spanish. After preliminary reading of the studies and application of the inclusion and exclusion criteria (carried out by peers), 13 studies were pre-selected. However, two studies were excluded due to the unavailability of full access even after contacting the authors; the other four studies were excluded because they were not related to PHC. The final sample for analysis was composed of seven studies and is shown using the PRISMA Model[21] (Figure 1).

In stages 3 and 4, data from primary studies were extracted from a previously prepared data collection form. The data extracted were as follows: year of publication and country of origin of the study; titles; authors; objective of the studies; application names and operating system; target audience of the *app*; methods, and main contributions of *apps* to the PHC area. The included studies were carefully analyzed regarding the guiding question and/or objective outlined and/or results, impacts, and/or contributions of mobile *apps.* In stage 5, the results obtained were interpreted with emphasis on the main scientific contributions of mobile *apps* to PHC (especially for nursing). In stage 6, the results obtained were presented descriptively and discussed in light of national and international publications on the researched topic.

Chart 1. Search strategy for searching the MEDLINE/Pubmed database

Database and access points	Search strategy
Scopus Access via the CAPES Periodicals Portal (http://periodicos.capes.gov.br/), using the option "Collection" > "List of bases".	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse")
Web of Science Access via the CAPES Periodicals Portal (http://periodicos.capes.gov.br/), using the option "Collection" > "List of bases".	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse")
CINAHL Access via the CAPES Periodicals Portal (http://periodicos.capes.gov.br/), using the option "Collection" > "List of bases"	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse")
SciELO Access: https://www.scielo.org/	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps" OR "Desenvolvimento tecnológico" OR "Desenvolvimento de tecnologias" OR "Avanço Tecnológico" OR "Avanços Tecnológicos" OR "Aplicativos Móveis" OR "Aplicativos Eletrônicos Portáteis" OR "Aplicativos em Dispositivos Móveis" OR "Aplicativos para Dispositivos Móveis" OR "Aplicativos de Software Portáteis" OR "Apps Móveis" OR "Desarrollo Tecnológico" OR "Adelanto Tecnológico" OR "Adelantos Tecnológicos" OR "Avances Tecnológicos" OR "Desarrollo de Tecnologias" OR "Aplicaciones Móviles") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care" OR "Assistência Pré-Hospitalar" OR "Serviços Pré-Hospitalares" OR "Serviços Médicos de Emergência" OR "Atendimento Pré-Hospitalar" OR "Atendimento de Emergência Pré-Hospitalar" OR "Centros de Emergência" OR "Pronto-Socorro" OR "SAMU" OR "Serviços de Saúde de Emergência" OR "Atención Prehospitalaria" OR "Servicios Prehospitalarios" OR "Asistencia de Urgencias" OR "Atención Prehospitalaria de Urgencias" OR "Atención de Emergencia Prehospitalaria" OR "Atención de Emergencias Prehospitalarias" OR "Atención de Urgencia Prehospitalaria" OR "Atención de Urgencias Prehospitalarias" OR "Atención en Urgencias" OR "Centro de Urgencia" OR "Centro de Urgencias" OR "Centros de Urgencia" OR "Centros de Urgencias" OR "Servicios de Atención de Urgencia" OR "Servicios de Atención de Urgencias" OR "Servicios de Salud de Urgencia") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse" OR "Cuidados de Enfermagem" OR "Enfermagem" OR enfermeir* OR "Atención de Enfermería" OR "enfermeria" OR enfermer*)
EMBASE Access via the CAPES Periodicals Portal (http://periodicos.capes.gov.br/), using the option "Collection" > "List of bases".	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse")
LILACS/BDENF Access: http://bvsalud.org/	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps" OR "Desenvolvimento tecnológico" OR "Desenvolvimento de tecnologias" OR "Avanço Tecnológico" OR "Avanços Tecnológicos" OR "Aplicativos Móveis" OR "Aplicativos Eletrônicos Portáteis" OR "Aplicativos em Dispositivos Móveis" OR "Aplicativos para Dispositivos Móveis" OR "Aplicativos de Software Portáteis" OR "Apps Móveis" OR "Desarrollo Tecnológico" OR "Adelanto Tecnológico" OR "Adelantos Tecnológicos" OR "Avances Tecnológicos" OR "Desarrollo de Tecnologias" OR "Aplicaciones Móviles") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care" OR "Assistência Pré-Hospitalar" OR "Serviços Pré-Hospitalares" OR "Serviços Médicos de Emergência" OR "Atendimento Pré-Hospitalar" OR "Atendimento de Emergência Pré-Hospitalar" OR "Centros de Emergência" OR "Pronto-Socorro" OR "SAMU" OR "Serviços de Saúde de Emergência" OR "Atención Prehospitalaria" OR "Servicios Prehospitalarios" OR "Asistencia de Urgencias" OR "Atención Prehospitalaria de Urgencias" OR "Atención de Emergencia Prehospitalaria" OR "Atención de Emergencias Prehospitalarias" OR "Atención de Urgencia Prehospitalaria" OR "Atención de Urgencias Prehospitalarias" OR "Atención en Urgencias" OR "Centro de Urgencia" OR "Centro de Urgencias" OR "Centros de Urgencia" OR "Centros de Urgencias" OR "Servicios de Atención de Urgencia" OR "Servicios de Atención de Urgencias" OR "Servicios de Salud de Urgencia") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse" OR "Cuidados de Enfermagem" OR "Enfermagem" OR enfermeir* OR "Atención de Enfermería" OR "enfermeria" OR enfermer*)
MEDLINE/Pubmed	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications"[Mesh] OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services"[Mesh] OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care"[Mesh] OR "Nursing Care" OR "Nursing"[Mesh] OR "Nursing" OR "Nursings" OR "Nurses"[Mesh] OR "Nurses" OR "Nurse")

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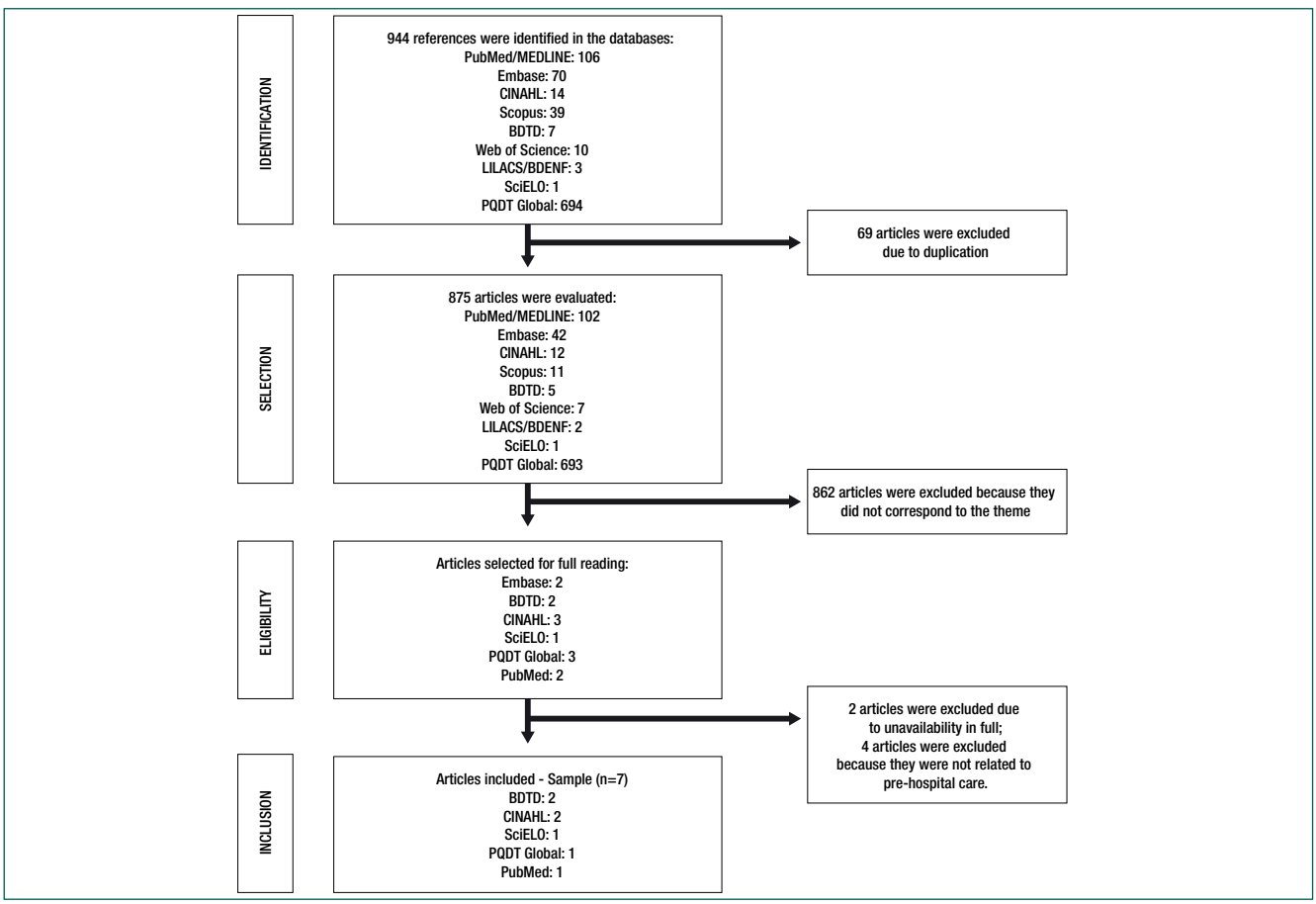
Database and access points	Search strategy
Brazilian Digital Library of Theses and Dissertations (BDTD) Access: http://bdtd.ibict.br/vufind/	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps" OR "Desenvolvimento tecnológico" OR "Desenvolvimento de tecnologias" OR "Avanço Tecnológico" OR "Avanços Tecnológicos" OR "Aplicativos Móveis" OR "Aplicativos Eletrônicos Portáteis" OR "Aplicativos em Dispositivos Móveis" OR "Aplicativos para Dispositivos Móveis" OR "Aplicativos de Software Portáteis" OR "Apps Móveis") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care" OR "Assistência Pré-Hospitalar" OR "Serviços Pré-Hospitalares" OR "Serviços Médicos de Emergência" OR "Atendimento Pré-Hospitalar" OR "Atendimento de Emergência Pré-Hospitalar" OR "Centros de Emergência" OR "Pronto-Socorro" OR "SAMU" OR "Serviços de Saúde de Emergência") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse" OR "Cuidados de Enfermagem" OR "Enfermagem" OR enfermeir*)
ProQuest Dissertations & Theses Global (PQDT Global) Restricted/paid access database. Access via the BU/UFSC Portal: http://bases.bu.ufsc.br/proquest/	("Technological Development" OR "Advances in Technology" OR "Development of Technologies" OR "Technological Advancement" OR "Technological Advancements" OR "Mobile Applications" OR "Mobile App" OR "Mobile Application" OR "Mobile Apps" OR "Portable Electronic App" OR "Portable Electronic Application" OR "Portable Electronic Applications" OR "Portable Electronic Apps" OR "Portable Software App" OR "Portable Software Application" OR "Portable Software Applications" OR "Portable Software Apps") AND ("Prehospital Care" OR "Pre-Hospital Care" OR "Prehospital Services" OR "Pre-Hospital Services" OR "Emergency Medical Services" OR "Emergency Care" OR "Emergency Health Service" OR "Emergency Health Services" OR "Emergency Medical Service" OR "Emergicenter" OR "Emergicenters" OR "Medical Emergency Service" OR "Medical Emergency Services" OR "Prehospital Emergency Care") AND ("Nursing Care" OR "Nursing" OR "Nursings" OR "Nurses" OR "Nurse")



Source: PRISMA SRs (PAGE et al.,2021).[21]

Figure 1. Selection process and final sample of publications on *app* contributions to PHC based on the PRISMA Model

Results

Of the seven studies analyzed, two were published in 2017, one in 2018, one in 2019, one in 2020, and two in 2021. As for the countries of origin of the studies analyzed, three were performed in Brazil and one in Turkey, the USA, Thailand, and Switzerland, four in English, three in Portuguese, and none in Spanish. Regarding the design and method of the studies, five studies were on applied technological de-

Chart 2. Summary of the contribution of mobile *apps* to PHC

Authors, years, and countries	Names of apps and operating systems	Objectives	Focus and/or Thematic Areas	Main scientific contributions
Eksert S *et al*;[22] 2017; Türkiye	WhatsApp® Android® e iOS®	To investigate the effectiveness of the WhatsApp® smartphone application as a communication tool for the emergency team of a level-I trauma center.	Patient safety: effective communication	It reduces emergency team response time to patients who have suffered combat injuries, assists in coordinating the emergency team, reduces the team leader's workload, and encourages the professionals involved. It is also a useful and effective communication tool for transmitting medical information between healthcare professionals due to its ease of use and fast and efficient features.
Martins W;[23] 2017; Brazil	SAMUV Android®	To develop a mobile application about accidents with multiple victims to assist in the ongoing education of professionals who work in SAMU	Educational	It helps in teaching and improving content related to PHC, contributes to the learning process about multiple-victim accidents (AMUV), and supports AMUV care. It is also a tool to help as a complementary device in the continuous training and/or permanent education of SAMU professionals.
Weissheimer AS;[24] 2018; Brazil	SOS KIDS Android®	To analyze scientific production on unintentional pediatric injuries in the home environment and describe the development and validation processes of an application for mobile devices on first aid for unintentional pediatric injuries.	Educational	It helps healthcare professionals search for updated pediatric first aid content; contributes to reducing mortality indicators and makes a technological tool of health education available to the general population; helps SAMU professionals, indicating step-by-step procedures for better understanding in addition to verbal guidance to the rescuer; makes it easier to activate the SAMU 192 with an easy-to-access button that directs to any connection screen; and reduces pediatric death rates and/or prolonged hospitalization.
LU, TC;[25] 2019; USA	(Unnamed) Android Wear®	To develop a new *app* with a smartwatch worn on the wrist of first responders to facilitate high-quality cardiopulmonary resuscitation (CPR) in emergencies.	Technical skill	It significantly improves the quality of CPR related to the depth and pace of chest compressions (using the smartwatch *app* with real-time instructions and feedback).
Sutham K, Khuwuthyakorn P, Thinnukool O;[26] 2020; Thailand	Triagist Android® e iOS®	To develop a mobile application to optimize the pre-hospital patient triage process based on the CBD (Criteria Based Dispatch) triage protocol to improve emergency service requests.	Educational	It supports the pre-hospital process by classifying patients' conditions before admission to the emergency department. It also supports the correctness of the screening protocol, screening reliability, usability, and satisfaction to users, bringing benefits such as speed and effectiveness for emergencies. It is especially suitable for non-emergency medical personnel in new emergency team training and patients who want to identify their symptoms before requesting medical services, as well as a tool to avoid overcrowding in emergency care units (in Thailand hospitals).
Pizzolato AC, Sarquis LMM, Danski, MTR;[27] 2021; Brazil	Nursing APHMóvel iOS®	To develop an application for a mobile device for registration in the Nursing Process by nurses from the Mobile Emergency Care Service.	Nursing Process	It supports the nurses' work by allowing the stages of the nursing process to be recorded; provides indicators for service management; and contributes to the communication and continuity of care initiated in mobile PHC.
Siebert JN *et al*;[28] 2021; Switzerland	PedAMINES Android® e iOS®	To evaluate the effectiveness of an evidence-based mobile application to reduce the occurrence of medication errors compared to conventional methods of preparation during simulated pre-hospital pediatric cardiac arrest scenarios.	Technical skill Patient safety: harm associated with medication	Decrease in the number of medication errors (in absolute terms) of the mean times of medication preparation and emergency drug administration in a pre-hospital environment. The *app* contributes to the objectives of the 3rd Global Patient Safety Challenge of the World Health Organization (WHO), mainly to reduce the harm associated with medicines by 50% in all countries in the next 5 years.

velopment and production research, one pilot study, and a simulation-based multicenter and randomized clinical trial. Regarding operating systems, three studies developed *apps* for Android® and IOS®, three studies only for Android®, and one for IOS®. Only five studies presented the names of the applications developed (mobile NURSING PHC; SAMUV, SOS KIDS, TRIAGIST, and PedAMINES). As for the target audience, the studies included PHC nurses, primary emergency doctors, the lay public in general, SAMU health professionals, hospital emergency teams, first responders, and advanced paramedics. That is, the results obtained show that all health professionals involved in PHC were considered in the *apps* developed. Chart 2 summarizes the results obtained (authorship, year, and country; *app* name and operating system; objective of the study; focus and/or area of the theme, and main scientific contributions).

Discussion

The studies analyzed indicate that the *apps* involve specific PHC themes such as patient safety (effective communication and reduction in harm associated with medication), education, screening, pediatric first aid, quality of cardiopulmonary resuscitation, technical skill, and nursing process. We also highlight that the target audience of the *app* included the multidisciplinary team and the lay population in general, *i.e.*, the *apps* presented a potential scientific contribution both to PHC areas and to the people (professionals and users) involved in this scenario.

The development of new technologies is increasingly present in contemporary and globalized society, specifically in mobile devices and *apps.* Mobile devices differ from other ICTs because

they are portable, the user can access them at any time and place, and they are portable, ensuring access to information and knowledge, including healthcare, etc.[29]

In the scenario of mobile devices, the development of mobile *apps* is highlighted. Studies indicate that *apps* are technological tools that are part of New Information and Communication Technologies (NICT) as they have specific functions that allow access and sharing of various information.[13,14]

The "*m-Health*" (mobile health) concept emerged from the increase in the use of mobile devices in healthcare. It is defined by the Global Observatory for *e-Health* as medical and public health practices that use the technological support of mobile devices (such as cell phones, sensors, and other equipment) directly connected to the user, enabling reliable information to be obtained about clinical health data at any time and place.[30]

With the advent of *m-Health*, it has been observed that healthcare professionals are increasingly using *apps* in their daily clinical practice. They allow searching and researching information, acquiring and deepening knowledge, making it possible to improve assistance, management, and education.[15,17,31,32]

Several studies describe the benefits and positive impacts of *m-Health* through smartphones and mobile *apps*.[17-19,31,33,34] Among the *apps*' potential, the following stand out: possibility of collaborating in the construction of a new modality of care and education in health, placing communication, internet connectivity, and sophisticated configurations in the hands of professionals and patients in real and/or remote time;[17-19,33] provision of free and/or low-cost content, becoming an alternative for accessing information and a technological tool for health promotion and/or prevention for the population;[34] and improvement in patient care, decision making, reduction of errors in healthcare, and communication between members of the healthcare team.[31]

Mobile Applications developed for healthcare have been used to improve recording and access to information for communication, treatment, and monitoring of patients, decision-making, education, and healthcare training.[32] The results obtained in the present study confirm this information.

In this study, the *apps* developed for the PHC context address topics that encompass the area. We consider that the diversity of content in PHC *apps* can be incorporated into the context of the various studies that develop, evaluate, and/or use *apps* with various purposes for different specificities in the health area. We highlight that the *apps* analyzed contribute to patient safety, nursing care, and electronic patient records.

Patient safety can be ensured by preventing possible harm during patient care. In this study, *apps* were presented as an available technology to reduce the possibility of adverse events, encourage the professional education process, improve communication, reduce errors in the preparation and administration of medications, and improve technical skills, directly contributing to patient safety in the context of PHC. This study revealed that *apps* can also be used to improve recording and access to information for health education and training, including patient communication, treatment, and monitoring.[14]

Most *apps* described in the analyzed sample have a care and educational focus, suggesting that they can be used as technological support during the work of various health professionals and nurses. The work of nurses in mobile PHC is based on clinical reasoning, a fundamental element for making decisions related to priority nursing care for patients. In this context, mobile *apps* can facilitate the systematization and care of nursing in the different environments to which professionals are exposed.[21,35]

In the PHC scenario, health care focuses on assisting and promoting clinical and hemodynamic stabilization, seeking not to worsen the vulnerable health status of patients until they arrive at the definitive treatment site.[7-9] Thus, the use of *apps* can result in optimizing care time, increasing patient safety, completing electronic records, legally supporting professionals, and ensuring continuity in patient care.[27,35]

We highlight that *apps* also contribute to improving the vocabulary of nursing informatics, encouraging Electronic Health Records (EHRs), usable technologies, *big data*, analytical data, and greater involvement of patients in their care.[27]

Conclusion

The potential of mobile applications is highlighted in nursing care in the contexts of Pre-Hospital Care and health and all areas of knowledge. Mobile Applications contribute to supporting care, mainly in patient safety, communication between team members, reducing errors during medication, recording patient information, and continuing education for the team working in Pre-Hospital Care. Optimizing assistance time and early diagnosis are also contributions of Mobile Applications in assistance, also alerting to details that may go unnoticed. The increase in the accuracy and precision of assistance and procedures obtained with Mobile Applications can increase the chances of survival and reduce sequelae in patients. To implement and use mobile applications in care, rigorous studies are still needed in real scenarios to better determine their benefits.

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