Digital tools for care-related infection prevention in intensive care units: An integrative review

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ABSTRACT

The study aimed to map digital tools with collective interventions and potential guidelines and limitations in the prevention of care-related infections in intensive care units. This is an integrative literature review, to survey the articles in the literature, a search was carried out in the following databases: Latin American and Caribbean Literature in Health Sciences and Medical Literature Analysis and Retrieval System Online, National Library of Medicine and National Institutes of Health and Nursing Database from April to May 2022. Inclusion criteria: articles published in Portuguese and English, in the years 2011 to 2021, available free of charge and in full. Articles that did not have a well-defined research design were excluded. A total of 1,666 articles were found, and after defining the inclusion and exclusion criteria, 305 articles remained, of which ten articles were included in the search. The use of applications is very common among health services and helps

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in the organization of data, enabling access to information in real time and/or remotely. It is worth noting that the methods of developing these technologies are complex, involving a mix of instructional, systematized, contextualized, and user-centered design. The present study, in view of the literature found, and the evidence presented, shows the importance of technologies in the critical environment in terms of infection prevention, as well as the relevance of constantly updating and building technologies that promote the prevention and optimization of diseases in the work process.

Keywords: Sepsis, Intensive Care Unit, Infection prevention.

INTRODUCTION

Healthcare-Associated Infections (HAIs) are infections acquired during patient care due to an imbalance between body defenses and microbiota, and are considered one of the most common complications of care; they represent a high risk to patient health/safety and are seen as a public health problem (Pereira *et al.,* 2016).

In relation to the hospital environment, it is noteworthy that the factors related to the occurrence of HAI can be related to three areas: iatrogenic (undesirable harm to the patient caused by the action of the health agent voluntarily or involuntarily organizational and related to the patient (Torres, *et al*., 2021).

In view of the demand for complex activities in a critical environment, risks of infection inherent to all procedures, it is necessary to constantly update professionals, having technological tools as an apparatus for this, since professionals have little time and the practicality offered. Health technology is "medicines, materials, equipment and procedures, organizational, educational, information and support systems, and care programs and protocols", where, through them, the health, well-being, and safety of the patient are promoted, and the prevention of errors and damages is inserted in this context (Brasil 2010).

Sepsis is considered the leading cause of death in ICUs of all ages. There are approximately 47 million cases each year, and the mortality rate of its severe form, especially in the areas of preference, is more than 50%. Due to late diagnosis and lack of intensive care beds (Viana, et al., 2020).

At this juncture, the important thing is that technological tools are capable of qualifying permanent education practices, through a vision of co-participation among the team mediated by interactivity and creativity (Salvador, *et al.,* 2015)

In view of the aforementioned context and with a nurse with more than ten years of experience in the care of critically ill patients and identifying a high incidence of HAIs, with severe and fatal outcomes, the need arose to develop a study that would allow the analysis of digital tools in line with information about the prevention of infections in ICUs, focusing on collective interventions that can be carried out with the team. its potential for orientation and limitations in relation to the proposed purpose.

Based on these reflections, the study has as its guiding question: which literatures, collective interventions and existing contents in the technological tool have the potential to guide and limitations in the prevention of infection related to care in intensive care units?

The study is relevant because it points out the quality of virtual guides on HAI prevention in ICUs, their strengths and limitations, as well as because it strengthens the discussion of the

importance of in-service education and aims to map digital tools with collective interventions and potential guidance and limitations in the prevention of care-related infection in intensive care units.

METHODOLOGY

This is an integrative literature review (IR) According to Mendes et al. (2019), synthesizing knowledge is a scientific methodology that summarizes evidence from several studies on a specific issue, identifying research gaps and suggesting new studies in order to support decision-making in health. They add that IR is a method that allows this synthesis of knowledge through a systematized and rigorous process

In the first stage of the study, to identify the theme and select hypotheses, we used the anagram PICo to guide the problem question, with P for population; I for intervention; Co: context (Anima educação, 2014). Thus, the following question was asked: "What are the collective interventions and existing contents of the virtual guide technological tool with guidance potentials and limitations in the prevention of care-related infection in intensive care units?" Where P: nurses, nurses, nursing, nurse; I: digital technology, e-health, management;infection control; Co: Intensive Care Units, Intensive Care Units.

To survey the articles in the literature, we searched the following databases: Latin American and Caribbean Health Sciences Literature (LILACS) and Medical Literature Analysis and Retrieval System Online (MEDLINE), National Library of Medicine and National Institutes of Health (PUBMED) and Nursing Database (BDENF) from April to May 2022.

The selection of these databases is justified due to the wide availability of national and international articles with a broad impact in the area of health. The following controlled descriptors will be used to search for articles, indexed in the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH), and their combinations in English, Portuguese, and Spanish. The descriptors were cross-referenced and combined with Boolean operators 'AND' and 'OR' in order to refine the studies according to the topic in question. The following keywords appear:

"Nurses, nurses, OR Nursing, AND AND "Digital Technologies" OR Applications(application) OR "inovation and health" AND e-health OR "infection control" OR "infection prevention" OR infection control AND "Intensive Care Units" OR "Intensive Care Center".

In the second stage, we adopted as inclusion criteria: articles published in Portuguese and English, in the years 2011 to 2021 available free of charge and in full that portray the theme studied, articles published and indexed in the aforementioned databases. Articles that did not present a well-defined research design, that did not make the full text available, or that addressed other aspects related to the prevention of infection in the ICU, such as: self-care, letter to the reader, opinion articles, home care were excluded

In the third stage of the study, the information to be extracted from the studies was defined, in this way, the analysis of the information will be possible from the full reading of the articles in an exploratory way, later they will be stored in a table containing the title of the study, journal published, place of research, year of publication, methodological characteristics (type of study), subjects/objects of the research, and results obtained (Galvão, 2006).

For the categorization of the level of evidence (NE), we opted for the categorization of the level of evidence (NE), proposed by Melnyk & Fineout-Overholt (2005): level 1 – evidence from a systematic review or meta-analysis of relevant randomized controlled clinical trials or from clinical guidelines based on systematic reviews of randomized controlled clinical trials; level 2 – evidence obtained from at least one well-designed randomized controlled trial; level 3 – evidence obtained from well-designed clinical trials without randomization; level 4 – evidence from well-designed cohort and case-control studies; level 5 – evidence from a systematic review of descriptive and qualitative studies; level 6 – evidence from a single descriptive or qualitative study; Level 7 – Evidence from the opinion of authorities and/or the report of expert committees

In the fifth stage, the presentation of the results and discussion of the data obtained was done in a descriptive and analytical way, based on the exploration of the material, developed from the rereading of the texts, which culminated in the construction of thematic categories of analysis. Subsequently, in the stage of interpretation of the results, the existing statements were observed from the perspective of different authors (Jorge et al., 2022).

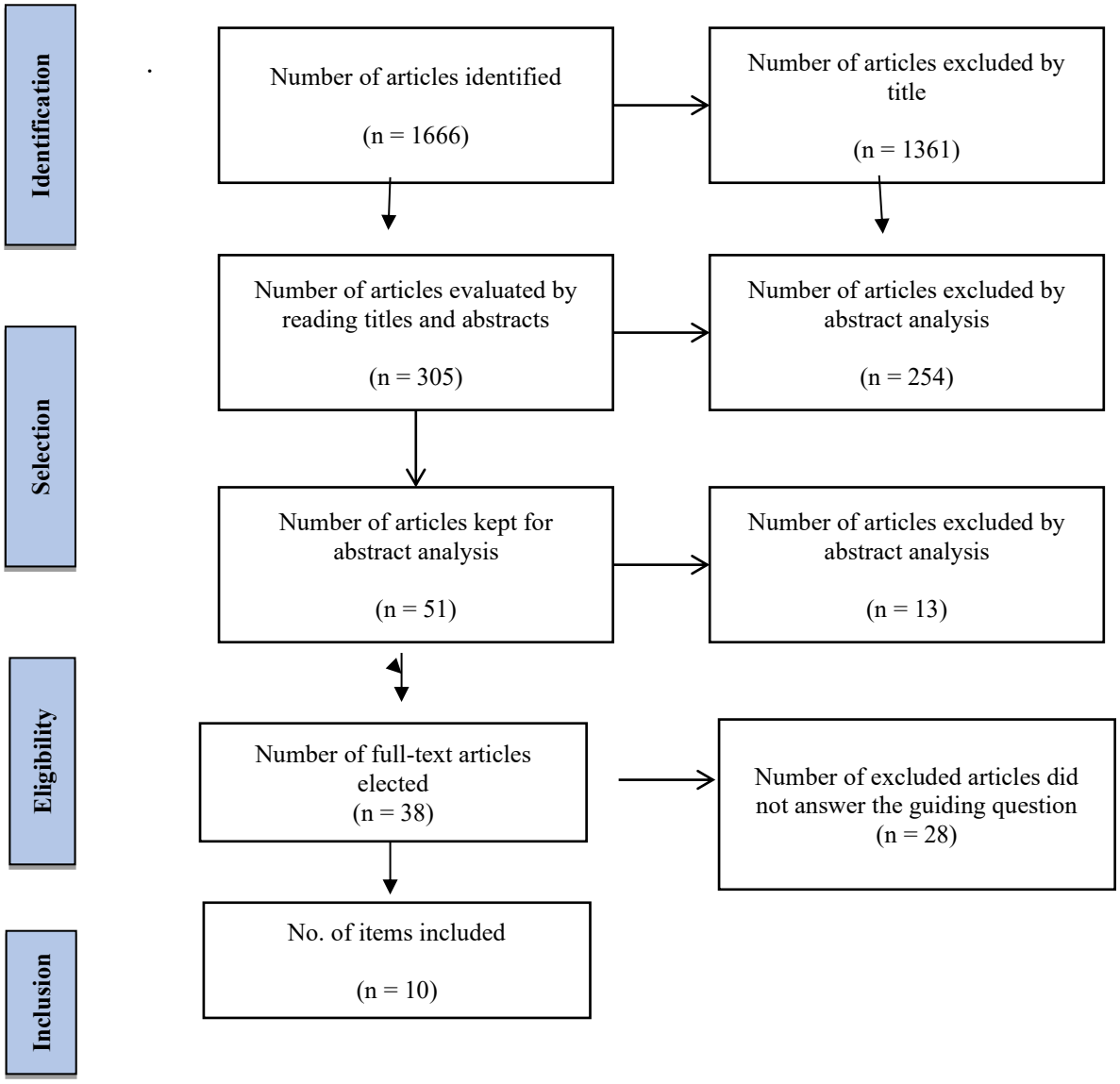
The last phase consisted of the elaboration of this study, which sought to describe in a clear and systematic way all the steps taken by the authors for the elaboration of the research and to present the main results evidenced from the analysis of the included articles.

RESULTS AND DISCUSSION

A total of 1666 articles were found: after the delimitation of the inclusion and exclusion criteria, 1361 articles were eliminated, leaving 305 articles, of which 254 were excluded by the analysis of the abstract. Of the remaining 51 articles, ten articles were included in the study according to the inclusion and exclusion criteria (FIGURE 1).

Of the selected articles, four were identified in the Pubmed database and eight in the LILACS database, two in the Medline database and five in the BDENEF. However, it is difficult to identify articles in other databases

Figure 1 - Flowchart of articles from the Integrative Review



Source: prepared by the authors

Chart 1 below presents the results of the filtering performed and, which constitute the "corpus" of the research, the inclusion and exclusion criteria were applied, resulting in a final sample of 10 articles distributed in the databases

Author Study title	Magazine published	Year of publication	Kind of study	Study subjects	Purpose of the study	Level of evidence
CHAOFAN WANG ET AL; SISTEMAS DE MONITORAMENTO ELETRÔNICO PARA HIGIENE DAS MÃOS: REVISÃO SISTEMÁTICA DA TECNOLOGIA	**J Med Internet Res**	2021	SYSTEMATIC REVIEW	SYSTEMATIC STUDIES IN PUBMED, ACM DIGITAL LIBRARY AND IEEE XPLORE DIGITAL LIBRARY FOLLOWING PRISMA GUIDELINES	SUMMARIZE THE LATEST TECHNOLOGIES ADOPTED IN ELECTRONIC HAND HYGIENE MONITORING SYSTEMS AND DISCUSS THE CAPABILITIES AND LIMITATIONS OF THESE SYSTEMS.	1
ELIEZER FARIAS DE MELO ET AL; DESENVOLVIMENTO DE WEBSITE PARA ENFERMAGEM EM CUIDADOS CRÍTICOS SOBRE INFECÇÃO RELACIONADA À ASSISTÊNCIA À SAÚDE	**Revista Brasileira de Enfermagem**	2021	DESCRIPTIVE METHODOLOGY	INTENSIVE CARE UNIT NURSING	DESCRIBE THE DEVELOPMENT OF A WEBSITE ABOUT THE MAIN HAIS AND RESPECTIVE BUNDLES THAT CAN BE USED TO PREVENT THESE DISEASES, AIMED AT NURSING WORK IN ICUS	6
THIAGO QUINELLATO LOURO ET AL.; A TERAPIA INTENSIVA E AS TECNOLOGIAS COMO MARCA REGISTRADA	**Rev. Pesqui. (Univ. Fed. Estado Rio J., Online)**	2012	DESCRIPTIVE, EXPLORATORY, WITH A QUANTITATIVE-QUALITATIVE APPROACH	NURSES AND NURSING TECHNICIANS WHO CARRIED OUT CARE ACTIVITIES IN INTENSIVE CARE CENTERS	DESCRIBE THE USE OF HARD TECHNOLOGIES IN INTENSIVE CARE UNITS FROM THE PERSPECTIVE OF THE NURSING TEAM; AND ANALYZE THE IMPLICATIONS OF THIS USE IN ASSISTING CRITICALLY ILL CLIENTS IN INTENSIVE CARE.	6
ISABELA SHUMAHER FRUTUOSO ET AL.; CRIAÇÃO DE UM AMBIENTE VIRTUAL DE APRENDIZAGEM EM TERAPIA INTENSIVA	Rev. enferm. UFPE on line	2019		PROFESSIONALS WHO MAKE UP THE ICU NURSING TEAM	CREATE A VIRTUAL LEARNING ENVIRONMENT (VLE) FOR CONTINUING EDUCATION IN INTENSIVE CARE UNITS	6
PATRÍCIA KUERTEN ROCHA ET AL; CUIDADO E TECNOLOGIA EM TERAPIA INTENSIVA	**Index Enferm**	2013		TECHNOLOGIES IN INTENSIVE CARE ENVIRONMENT	DESCRIBE TECHNOLOGIES IN AN INTENSIVE CARE ENVIRONMENT	6
GEISA REGINA DOMINGOS MELLO ET AL Sepsiscare: avaliação de aplicativo móvel no cuidado de enfermagem ao paciente com sepse	Cogitare Enferm	2018	DESCRIPTIVE, TRANSVERSAL	SIX NURSES FROM THE INTENSIVE CARE UNIT OF A PUBLIC HOSPITAL IN SANTA CATARINA PARTICIPATED IN THE STUDY.	EVALUATE A MOBILE APPLICATION FOR THE PREVENTION, IDENTIFICATION AND NURSING CARE OF SEPTIC PATIENTS	6
ANDRÉ LUIZ ALVIM, BRAULIO COUTO **hands clean – taxa automática para higienização das mãos: desenvolvimento de aplicativo para controladores de infecção**	Enfermagem em foco	2019	QUALITATIVE APPROACH AND DESCRIPTIVE NATURE.	CONTROLLERS	DEVELOP AN APPLICATION TO EVALUATE HAND HYGIENE PRACTICES IN HEALTHCARE SERVICES	6
GERALDO MAGELA SALOMÉ;GISLAINE CRISTINA MARTINS ROSA;JONAS ISAC DA ROSA	Rev. Enferm. Contemp	2021	DESCRIPTIVE STUDY	OF INFECTION, WHO WORK IN PUBLIC INSTITUTIONS	BUILD AND VALIDATE A MULTIMEDIA APPLICATION ON A MOBILE	6

Validação do aplicativo móvel Asptraqueal para aspiração					PLATFORM TO GUIDE THE PROCEDURE STEP BY STEP	
ANTONIO HENRIQUE SILVA DOS SANTOS ET AL UTI Escore - protótipo de aplicativo para gestão da assistência de enfermagem	J. Health Inform.	2020	METHODOLOGICAL	NURSES AND PHYSIOTHERAPISTS	SUCTION OF THE ENDOTRACHEAL CANNULA AND AIRWAYS	6
VITTORIA DE ARAÚJO BARRETO, ISABEL CRISTINA FONSECA DA CRUZ Qual a melhor tecnologia digital para intervenção de enfermagem no cuidado da ferida cirúrgica na UTI? -	Cuidados de enfermagem especializados	2021	DESCRIPTIVE	PATIENTS TREATED IN THE ADULT NEUROLOGY INTERNSHIP AT THE UNIFOR HEALTH SCHOOL CLINIC	TO ANALYZE THE PREVALENCE, AS WELL AS THE MAIN EPIDEMIOLOGICAL VARIABLES RELATED TO STROKE, THROUGH THE EVALUATION FORMS OF PATIENTS TREATED IN THE ADULT NEUROLOGY INTERNSHIP AT THE UNIFOR HEALTH SCHOOL CLINIC	1

Source: The author.

DISCUSSION

From the perspective of technology, the vision of care reflects on the inherent capacity of human beings to seek innovations that transform daily life, To understand the current context of care and the art of care in the technological world of Intensive Care Units (ICU), it is necessary to review and reflect on the different historical moments, on the understanding of the cultural and technological evolution that new concepts about care and technology within the ICU. Technology as a process implies knowledge and skills, and should be distinguished from technology as a product, which is represented by technological equipment or devices, which configure an expression of technology that results from the knowledge that makes a team possible (Rocha et al. 2013).

The technology is used in the search for a safe practice to implement a standard of service of excellence. In order to carry out a safe practice with options that indicate referral care, nurses increasingly use knowledge mainly from the use of hard soft technology, such as the use of *guidelines,* consensus, algorithms, among others, which are proposed by different societies or foundations (Rocha et al. 2013).

The use of technological tools was introduced in the nursing field more than 40 years ago and continues to expand, as this type of aid has been used to facilitate decision-making and bring agility to the work. With the use of these technologies, better professional performance and optimization of care are observed, thus helping in the prompt identification, diagnosis and treatment of diseases. This true revolution generates demand for a new nursing professional, not only capable of using these new tools, but also able to create and model new care instruments (Mello et al, 2018).

It is important to emphasize that the significant use of health technologies aims to ensure quality and safety, providing improvement in communication and care management. These applications have been used in the most diverse contexts, from the training of some technique such as cardiopulmonary resuscitation to the aid in the self-management of some disease such as asthma (Mello et al, 2018)

The construction of applications should be strongly based on the literature and clinical evidence in order to provide technological, technical, clinical, administrative and financial support, always aiming at improving patient care and the best results for the institution (Salomé; Rose; Rosa, 2021).

Applications in the health area are technologies that guide decision-making in the face of clinical care issues, add scientific rationality and serve as guides for clinical diagnosis, self-care, prevention and treatment of chronic and acute diseases. They provide information about the best prophylactic-therapeutic conduct to be adopted in each clinical evaluation and procedures performed by health professionals, which confirms their proficiency and accuracy as a guiding instrument for care. The elaboration and structuring of the application should be composed of the evaluation of the application by a professional with knowledge in the area, care actions and therapeutic proposal (Salomé; Rose; Rosa, 2021).

The practicality of digital tools, such as mobile devices, corroborate in professional practice, optimizing their work process, acting in the promotion of healthy habits, preventing health problems, and even in the management of material and human resources of nursing. Bringing nursing closer and closer to mobile technology, accessible to professionals, enabling quality care that allows the development of all its functions (Santos, et al. 2020)

Due to the complexity of the critical environment, technological mediation in educational activities has strengthened the process of dissemination of information inherent to processes, such as the prevention of HAIs. There are also expectations that scientific advances can improve the quality of care provided, increasingly minimizing adverse events resulting from hospital infections. In this scenario, studies on technological innovation are essential to meet the demands that emerge from changes in society (Melo et al. 2021).

The technological apparatus used in the ICU seems to give meaning to the care process in this environment and is a reference framework, in such a way that it has become impossible to think of these units without their presence and without the constant need for improvement and improvement. As a result, nursing was increasingly searching for new technical knowledge, associated with the theoretical foundation of scientific basis, which is extremely necessary for the development of its care activities. (Louro et al., 2012).

In this context, the virtual learning environment is an important tool for the realization of continuing education and the construction of knowledge can be increased by the union of teaching strategies that allow autonomy of the professional, the dialogic relationship and the deepening of the contents. It was proven that the development and implementation of a tool for continuing education stimulates the discussion of specific topics and debates in forums, as a means of promoting the evolution of scientific knowledge by the team involved. (Frutuoso et al, 2019).

The use of digital technologies and tools enables the optimization of infection prevention processes such as hand hygiene, one of the most effective ways to prevent healthcare-associated infections and reduce their transmission. Due to recent advances in sensing technologies, electronic hand hygiene monitoring systems have been integrated into the daily routines of healthcare professionals to measure the compliance and quality of hand hygiene, verifying, among other points, its effectiveness (WANG, et al., 2021).

This implies mentioning that technological tools are also responsible for optimizing accessibility during on-site observations, promoting faster feedback on compliance rates (Alvim & Couto, 2019).

The use of applications is very common among health services and supports the organization of data, enabling access to information in real time and/or remotely. It is worth mentioning that the methods for developing these technologies are complex, involving a mix of instructional, systematized, contextualized and user-centered design. In other words, the development of an App does not only involve the creation and availability for download on digital platforms. In this case, other complex methodological steps are needed to validate the use of technology (Alvim & Couto, 2019).

Although such methods/techniques still face problems of accuracy, data integration, privacy and confidentiality, usability, associated costs and infrastructure improvements, these produce a positive impact for the adapted nursing work environment. Technology in care aims at the intervention of procedures and the precision of use, which, in addition to optimizing time and reducing, resize the space for the nursing effort to become more efficient in actions. The main technological advances in the field of nursing are protected in patient care and are recommended for qualifying and protecting safe care. Providing advances related to productivity and quality of health service provision for the cure of diseases, cost reduction, and rapid improvement (Barreto & Cruz, 2021).

Thus, the importance of constant improvement in the work process in the critical environment is emphasized, as listed in the studies, bringing the need for greater awareness in this environment about the importance of using and building technological tools that optimize, among other things, the prevention of infection.

CONCLUSION

The present study, in view of the literature found and evidence presented, shows the importance of technologies in the critical environment regarding infection prevention, as well as the relevance of constant updating and construction of technologies that promote disease prevention and optimization in the work process.

At the end of this work, it is possible to understand the relevance of the role of nursing in the prevention of infection in the critical environment, as well as the operationalization and replication of the use of tools that bring greater awareness to the team about the implications of infection in critically ill patients, as well as the appropriate use of digital tools that allow it to prevent/minimize it.

The study presented as a limitation the small amount of construction of technological tools for infection prevention in a critical environment, bringing the need for greater discussion and awareness of the problem, as well as the search for solutions and innovations in the area by the academic-professional community.

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