

# Hospital air infection control in the intensive care unit: An integrative review

**RESUMO** | Objetivo: Analisar as evidências científicas disponíveis na literatura acerca do controle de infecção hospitalar na unidade de terapia intensiva. Método: Trata-se de uma revisão integrativa. Realizou-se a busca por artigos; atemporal; nos idiomas português, inglês e espanhol; disponíveis na íntegra. Nas seguintes plataformas de dados: BDNF, DOAJ, LILACS, MEDLINE, SciELO, SCOPUS e Web of Science. Resultados: Os dados foram organizados e apresentados em figuras e tabelas. Dos 18.991 estudos encontrados, 95 estava disponível na BDNF, 385 na DOAJ, 394 na LILACS, 8018 na MEDLINE, 0 na SciELO, 9899 na SCOPUS e 200 na Web of Science. Contudo, após a leitura permaneceram apenas os que atendiam aos critérios para inclusão e exclusão descritos na metodologia, 7 estudos. Conclusão: Este estudo mostrou que os serviços de saúde requerem PCIH, principalmente aqueles que prestam cuidados de alta complexidade, como a UTI, ambiente onde os pacientes permanecem por longos períodos de tempo.

**Descritores:** Programa de Controle de Infecção Hospitalar; Unidades de Terapia Intensiva; Infecção Hospitalar.

**ABSTRACT** | Objective: To analyze the scientific evidence available in the literature about nosocomial infection control in the intensive care unit. Method: This is an integrative review. The search for articles was carried out; timeless; in Portuguese, English and Spanish; available in full. On the following data platforms: BDNF, DOAJ, LILACS, MEDLINE, SciELO, SCOPUS and Web of Science. Results: Data were organized and presented in figures and tables. Of the 18,991 studies found, 95 were available from BDNF, 385 from DOAJ, 394 from LILACS, 8018 from MEDLINE, 0 from SciELO, 9899 from SCOPUS and 200 from the Web of Science. However, after reading, only those that met the inclusion and exclusion criteria described in the methodology remained, 7 studies. Final Considerations: This study showed that health services require PCIH, especially those that provide high-complexity care, such as the ICU, an environment where patients remain for long periods of time.

**Keywords:** Hospital Infection Control Program; Intensive Care Units; Cross Infection.

**RESUMEN** | Objetivo: Analizar la evidencia científica disponible en la literatura sobre el control de infecciones nosocomiales en la unidad de cuidados intensivos. Método: Esta es una revisión integradora. Se realizó la búsqueda de artículos; eterno; en portugués, inglés y español; disponible en su totalidad. En las siguientes plataformas de datos: BDNF, DOAJ, LILACS, MEDLINE, SciELO, SCOPUS y Web of Science. Resultados: Los datos fueron organizados y presentados en figuras y tablas. De los 18.991 estudios encontrados, 95 estaban disponibles en BDNF, 385 en DOAJ, 394 en LILACS, 8018 en MEDLINE, 0 en SciELO, 9899 en SCOPUS y 200 en Web of Science. Sin embargo, después de la lectura, solo quedaron aquellos que cumplían con los criterios de inclusión y exclusión descritos en la metodología, 7 estudios. Consideraciones Finales: Este estudio mostró que los servicios de salud requieren PCIH, especialmente aquellos que brindan atención de alta complejidad, como la UCI, un ambiente donde los pacientes permanecen por largos períodos de tiempo.

**Palabras claves:** Programa de Control de Infecciones Hospitalarias; Unidades de Cuidados Intensivos; Infección Hospitalaria.

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## INTRODUCTION

Hospital infections (HI) are one of humanity's greatest challenges when it comes to providing health care and patient safety. HI has been characterized as any infection acquired after the patient is hospitalized and that

can manifest during hospitalization or post-discharge, when associated with hospitalization or procedures performed in the hospital. <sup>(1)</sup>

However, this concept is currently considered insufficient because infections can occur not only in hospitals but also in other settings. It is currently defined as a Healthcare-Related Infection (HAI), a local or systemic condition resulting from an adverse reaction to the presence of an infectious agent or its toxin, which can manifest within 48 hours after admission. <sup>(2)</sup>

Hospitalized patients are exposed to a variety of pathogenic microorganisms, mainly in the Intensive Care Unit (ICU),

a hospital environment with an organized system that offers highly complex life support with multiple advanced care modalities. Where the use of potent and broad-spectrum antimicrobial antibiotics combined with the power of invasive procedures significantly contributes to the increase in the rate of HI. They represent a favorable environment for the presence of pathogens, about 30% of nosocomial infections occur in these environments. <sup>(3)</sup>

These infections are considered a worldwide problem. In Europe, about 6.8% of hospitalized patients acquire at least one HAI. It is estimated that more than two million cases of HI occur in the United States annually. <sup>(4)</sup> In Brazil, about 15% of hospitalized patients are affected, which is a public health problem that affects morbidity and mortality, length of stay, and treatment costs. <sup>(5)</sup>

In this scenario, considering the complexity of HI control, especially in the ICU, as a starting point for the development of HI prevention and control measures, it is essential to identify the predominant infections in this sector. On average, ICUs present a risk of infection 5 to 10 times higher than other sectors, and despite the number of beds representing about 5 to 10% of hospital beds, it is estimated that this sector represents about 25 to 30% of hospital infections. <sup>(5)</sup>

Therefore, this study aims to analyze the scientific evidence available in the literature about nosocomial infection control in the intensive care unit.

## METHOD

This is a descriptive, integrative, literature review study with a qualitative approach that provides opportunities to analyze the scientific literature and fully understand research topics, thus contributing to evidence-informed patient care practice. <sup>(6)</sup>

The fulfillment of the following steps was determined: (1) elaboration of the guiding question and objective of the study; (2) definition of inclusion and exclu-

sion criteria for scientific productions; (3) search for scientific studies in databases and virtual libraries; (4) analysis and categorization of the productions found; (5) results and discussion of findings. <sup>(7)</sup>

To ask the guiding question, the PICo strategy was used, a methodology that helps in the construction of a research question and search for evidence for non-clinical research, where P = Population/Patient; I = Interest; and Co = Context (P: Intensive care unit; I: Hospital infection control; Co: Quality). In this way, the following guiding question of the research was defined: "How does hospital infection control in the intensive care unit occur?".

For the selection of articles, the following inclusion criteria were used: original article, complete, with delimitation in the last 5 years (2017-2021), in Portuguese, English or Spanish, relevant to the objective of the study. Gray literature was excluded, as well as repeated publications of studies in more than one database and articles that did not answer the guiding question of the study and were

accessible via the Virtual Private Network (VPN) of the University of Pernambuco (UPE). Justifying the distinction to find current articles.

Data collection was carried out in September 2022 in the following databases: Nursing Database (BDENF); Directory of Open Access Journals (DOAJ); Latin American and Caribbean Literature in Health Sciences (LILACS); Medical Literature Analysis and Retrieval System Online (MEDLINE); SCOPUS and on the Web of Science. And in the Scientific Electronic Library Online (SciELO) virtual library.

Articles indexed from the Health Sciences Descriptors (DeCS) were searched: "Programa de Controle de Infecção Hospitalar", "Unidades de Terapia Intensiva", "Infecção Hospitalar". The respective terms from the Medical Subject Headings (MeSH) were used: "Hospital Infection Control Program", "Intensive Care Units", "Cross Infection". The operationalization and search strategy was based on the combination of the Boolean operators AND and OR, where the search was performed together and individually in order

Chart 1 - Database search strategy. Recife, Pernambuco (PE), Brazil, 2022.

Databases	Search terms	Results	Selected
BDENF	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	95	2
DOAJ	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	385	0
LILACS	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	394	3
MEDLINE	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	8018	2
SciELO	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	0	0
SCOPUS	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	9899	0
Web of Science	("Hospital Infection Control Program" OR "Cross Infection") AND ("Intensive Care Units")	200	0
Total		18.991	7

Source: Survey data, 2022.

to correct possible differences (Chart 1).

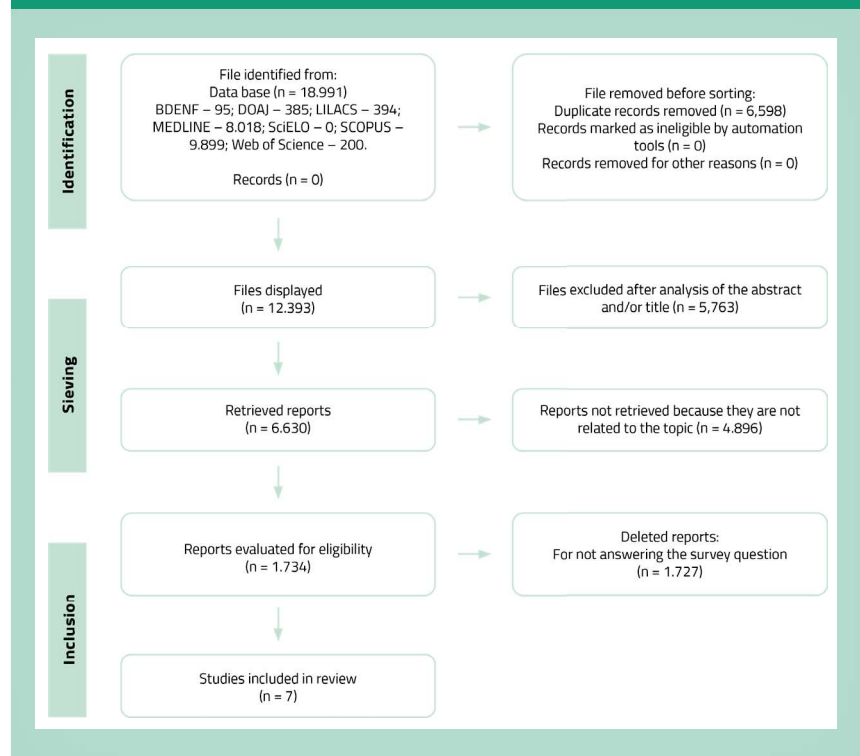
The selection of studies was based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) with the aim of assisting in the development of articles. (8) Initially, duplicate studies were removed by reading titles and abstracts. A complete reading of these lists was performed to screen those who met the guiding question and the inclusion/exclusion criteria. Then, the final sample was created with studies relevant to the previously defined criteria (Figure 1).

After reading the selected articles, the studies were categorized, dividing the knowledge acquired into levels of evidence (9): Level I, evidence refers to systematic reviews or meta-analyses of randomized controlled trials or clinical guidelines based on systematic reviews of randomized controlled trials; at level II, evidence from at least one well-designed randomized controlled trial; at level III, evidence from well-designed clinical trials without randomization; at level IV evidence from the cohort and well-designed case-control studies; at Level V, evidence from a systematic review of descriptive and egalitarian studies; at Level VI, evidence from a single descriptive or qualitative study; and at Level VII, evidence resulting from the opinion of authorities and/or the report of expert committees.

Also the quality of evidence according to the GRADE system: High: We are very confident that the actual effect is close to the estimate; Moderate: There is moderate confidence in the estimated effect; Low: Trust in effect is limited; and very low: Confidence in the effect estimate is very limited. The results show a significant degree of uncertainty. (10)

To assess the risk of bias, the Cochrane Collaboration Tool was used, based on seven domains (1. Random sequence generation; 2. Allocation concealment; 3. Blinding of participants and professionals; 4. Blinding of outcome assessors; 5. Incomplete outcomes; 6. Selective outcome report; and 7. Other

Figure 1: Flowchart of the selection process for primary studies adapted from PRISMA. Recife, Pernambuco (PE), Brazil, 2022.



Source: Survey data, 2022.

sources of bias), which assess different types of bias that may be present in randomized clinical trials, such as selection bias, performance bias, detection bias, attrition bias, reporting bias, and other biases. The judgment of each domain is performed in three categories (high risk of bias, low risk of bias and uncertain risk of bias). (11)

The corpus information was summarized with a tool: identification of the original article; authorship of the article; year of publication, country; methodical peculiarities of the study; and study sample. An analytical reading of the studies was carried out, identifying the key positions for the hierarchy and synthesis of ideas.

RESULTS

The reviewed studies are organized

by title, author, year of publication, level/quality of evidence, objective, results, and sample characterization. After reading the selected articles, the studies were categorized, classifying the knowledge acquired on the topic into levels of evidence, mostly Level VI - evidence derived from a single descriptive or qualitative study; on quality of evidence, moderate: There is moderate confidence in the estimated effect. The main results presented in the objectives and conclusions are directly related to the control of HI in the ICU (Table 1).

Regarding the risk of bias, it was observed that, regarding the generation of the random sequence, 71.4% (n = 5) of the studies had a low risk of bias; regarding allocation concealment, 85.7% (n = 6) had a low risk of bias; regarding the blinding of participants and professionals, all of them had an uncertain risk of

**Table 1: Synthesis of the main findings on difficulties in gynecological care for trans men. Recife, Pernambuco (PE), 2022.**

N	Title/Base	Authors (Year)	Country	Level/Quality of Evidence	Objective	Results	Sample
1	Surgical site infections: incidence and profile of antimicrobial resistance in an intensive care unit (Infecções de sítio cirúrgico: incidência e perfil de resistência antimicrobiana em unidade de terapia intensiva) / BDEF	Boaventura et al., (2020) <sup>(12)</sup>	Brazil	VI / Moderated	Analyze the incidence of surgical site infections and their microbial resistance profile in an Intensive Care Unit.	Serious risks, especially related to the management of antibiotics, impact on health use.	N = 52; Age Group +18 Form Salvador 2011-2013
2	Epidemiological profile of nosocomial infections in the intensive care unit of a tertiary hospital (Perfil epidemiológico das infecções hospitalares na unidade de terapia intensiva de um hospital terciário) / BDEF	Michelin; Fonseca (2018) (13)	Brazil	VI / Moderated	To know the profile of nosocomial infections in the Intensive Care Unit of a hospital, in the countryside of São Paulo.	The respiratory tract was the most affected site and Acinetobacterspp and Staphylococcus aureus were the most frequently found pathogens.	N = 42 Age Group +18 Secondary data São Paulo 2010-2011
3	Healthcare-associated infections in patients admitted to a cardiac intensive care unit. (Infecções relacionadas à assistência à saúde em pacientes internados em unidade de terapia intensiva cardiológica.) / LILACS	Farias; Gama (2020) <sup>(14)</sup>	Brazil	VI / Moderated	To know the characteristics of HAI in patients hospitalized in a Cardiac Intensive Care Unit in a referral hospital in Santa Catarina, from January to December 2017.	Continuing education actions, development of prevention and control protocols (bundles), and correct hand hygiene techniques have been shown to be effective in reducing infections.	N = 86 Age Group +18 Secondary data Santa Catarina 2017
4	Epidemiological profile of healthcare-associated infections in an adult intensive care unit in a maternal-infant referral hospital in Pará. (Perfil epidemiológico das infecções relacionadas à assistência à saúde em unidade de terapia intensiva adulto em hospital referência materno-infantil do Pará.) / LILACS	Ferreira et al., (2019) <sup>(15)</sup>	Brazil	VI / Moderated	To know the epidemiological profile of infections related to health care in an adult intensive care unit in a public hospital in Belém-PA, in 2016.	Assist in the reflection on the adoption of prevention and control measures to ensure patient safety.	N = 40 Age Group +20 Secondary data Pará 2016
5	Profile of healthcare-associated infections in an intensive care unit in Minas Gerais. (Perfil das infecções relacionadas à assistência à saúde em um centro de terapia intensiva de Minas Gerais.) / LILACS	Silva et al., (2019) <sup>(16)</sup>	Brazil	VI / Moderated	Describe HAIs that occurred in the ICU of a general hospital in the interior of Minas Gerais from 2014 to 2016.	Data on infections related to health care in the ICU showed a low occurrence	N = 181 Age Group +21 Dados secundários Minas Gerais 2014-2016
6	Infection control measures in neonatal units: implementation of change in the Gaza-Strip. / MEDLINE	Alrumi et al., (2020) <sup>(17)</sup>	Brazil	VI / Low	Examine healthcare personnel adherence to infection control measures prior to NICU entry and in minor and major procedure packages	Including regular infection control training combined with feedback in the curriculum for healthcare providers can improve the sustainability of infection control programs.	Doesn't apply
7	Successful implementation of infection control measure in a neonatal intensive care unit to combat the spread of pathogenic multidrug resistant Staphylococcus capitis. / MEDLINE	Ory et al., (2019) <sup>(18)</sup>	France	VI / Moderated	To assess the impact of infection control (IC) interventions to reduce the spread of Staphylococcus capitis NRCS-A in a NICU.	Use of the steam cleaning system in addition to ongoing infection control interventions was associated with a significant reduction in S. capitis NRCS-A in NICUs.	N = 37 Age Group +18 Secondary data França 2012-2017

Fonte: Dados da pesquisa, 2022.





**Table 2: Risk of bias analysis. Recife, Pernambuco (PE), 2022.**

	Boaventura et al., (2020)	Michelin; Fonseca (2018)	Farias; Gama (2020)	Ferreira et al., (2019)	Silva et al., (2019)	Alrumi et al., (2020)	Ory et al., (2019)
Random sequence generation	?	-	-	-	-	?	-
Allocation concealment	-	-	-	-	-	?	-
Blinding of participants and professionals	?	?	?	?	?	?	?
Incomplete outcomes	-	-	-	-	-	-	-

(+) high risk of bias, (-) low risk of bias, and (?) uncertain risk of bias  
Source: Survey data, 2022.

bias; and finally, regarding incomplete outcomes, all studies had a low risk of bias (Table 2).

After reading the selected articles, the studies were categorized into knowledge acquired on the topic, risks of bias, mainly low risk.

**DISCUSSION**

**Hospital infection control program**

The introduction of indicators for the evaluation of Hospital Infection Control Programs (PCIH - Programas de Controle de Infecção Hospitalar) in hospitals has become an important tool, which has shown that the Hospital Infection Control Centers (CCIH - Centros de Controle de Infecção Hospitalar) have been widely implemented in accordance with current legislation, although the PCIH in relation to operational policies and activities related to the prevention and control of HI, still need to be adapted. (12-18)

Corroborating this, studies suggest that the new coronavirus has surprisingly managed to “raise awareness” of professionals to commit to the goals desired by the CCIH. Currently, professionals are attentive and concerned with the minimum standard of precautionary measures in patient care. Several examples of this emphasized concern were observed: the techniques of dressing and undressing, the questions about the time of wearing masks, change of

gowns and gloves during procedures, consumption of sanitizers and surface disinfectants, reprocessing of medical devices and reprocessing of disposable products. (19-20)

In addition, studies confirm that these care are essential measures to prevent the transmission of infections during the care of all patients and in all health facilities and to protect professionals from environmental risks. In addition to hand hygiene, it also includes the correct use and disposal of personal protective equipment (PPE) (gloves, apron, mask, glasses and/or face protection). It is considered in the international goals on patient safety, formalized in care protocols as an essential and effective barrier to protect the patient and health professionals. (17-18,21)

**Hospital infection control in the ICU**

In the ICU, intensive cleaning aims to remove dirt and decontaminate surfaces, maintaining a comfortable working environment. The germicidal products to be used, as well as the frequency and routine of cleaning, will be determined by the CCIH. Its failure is associated with an increased risk of patient contamination. (12-18)

Corroborating, some studies show the importance of well-defined standards, protection, respiratory and contact protocols. It is necessary to raise awareness and train the entire team to respect the hand hygiene protocol to

be carried out when entering the ICU, in case of visible dirt, before and after meals and when going to the bathroom, as well as after removing gloves. (3-5,22)

Using the search strategies, we found a small sample and little availability of academic articles to compare the results. Despite the number of articles presented based on the descriptors, few met the objective of the study. In addition, the included studies have limitations such as a single center, different comparison systems, small sample size, and lack of randomization.

However, it has been possible to observe scientific evidence related to infection control in the ICU. However, there is a need to carry out more studies with a larger sample to allow a more comprehensive discussion on the topic.

This study can help to spread the importance of nosocomial infection control in healthcare environments, especially in the ICU. Expand the knowledge of the profession and help form the multiprofessional health team.

**CONCLUSION**

This study showed that health services require PCIH, especially those that provide high-complexity care, such as the ICU, an environment where patients stay for long periods of time. Indicating the need for continuing education to promote patient safety and the health



professionals who work with them. Although there are studies that give real importance to this subject, which

is fundamental for education, work and continuing education, scientific studies that address this issue are still neces-

sary. Therefore, this study provides evidence for the essential role of PCIH in intensive care units. 🐦

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