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Healthcare-associated infections: an ongoing challenge for patient safety and quality of care.

Healthcare-associated infections: an ongoing challenge for patient safety and quality of care

Infections associated with health care: a constant challenge for patient safety and the quality of care

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SUMMARY

Introduction: Healthcare-associated infections (HAIs) remain a central patient safety concern. They are associated with increased morbidity and mortality, prolonged hospital stays, resource consumption, and contribute to antimicrobial resistance.

Objective: To analyze recent scientific evidence on healthcare-associated infections (HAIs), focusing on the European context — particularly on the areas of antimicrobial resistance, hospital epidemiological surveillance, and institutional prevention and control strategies.

Method: Integrative literature review. The search was conducted in PubMed, SciELO, and Google Scholar, encompassing publications between 2021 and 2025, in Portuguese, English, and Spanish, in full text.
Documents from the European Centre for Disease Prevention and Control (ECDC) and the Directorate-General of Health (DGS) were also considered.

Results: Eighteen scientific studies and two institutional documents were included. The evidence confirms the persistence of healthcare-associated infections (HAIs) as a public health problem, with particular emphasis on infections associated with invasive devices, ventilator-associated pneumonia, Clostridioides difficile infection, urinary tract infection associated with urinary catheters, and the spread of multidrug-resistant microorganisms. The most consistent strategies include active epidemiological surveillance, microbiological screening, intervention bundles, hand hygiene, antimicrobial stewardship, and team training.

Conclusion: Controlling healthcare-associated infections (HAIs) requires an integrated institutional approach—continuous surveillance, clear protocols, rational use of antimicrobials, and involvement of various professions. Nursing plays a central role, both through adherence to preventive practices and by consolidating the safety of care.

Keywords: *Healthcare-associated infections; Antimicrobial resistance; Hospital epidemiological surveillance; Patient safety.*

ABSTRACT

Introduction: Healthcare-associated infections (HAIs) remain a core patient safety problem. They are associated with higher morbidity and mortality, longer hospital stays, increased resource use and growing antimicrobial resistance.

Objective: To analyze recent scientific evidence on HAIs, with a focus on the European context — antimicrobial resistance, hospital epidemiological surveillance and institutional prevention and control strategies.

Method: An integrative literature review was carried out in PubMed, SciELO and Google Scholar, covering publications from 2021 to 2025, in Portuguese, English and Spanish, available in full text.
Relevant documents from the European Center for Disease Prevention and Control (ECDC) and the Portuguese Directorate-General of Health (DGS) were also considered.

Results: Eighteen scientific studies and two institutional documents were included. The evidence confirms HAIs as an ongoing public health concern, particularly infections associated with invasive

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devices, ventilator-associated pneumonia, Clostridioides difficile infection, catheter-associated urinary tract infection and the spread of multidrug-resistant organisms. The strategies with the strongest evidence base include active epidemiological surveillance, microbiological screening, care bundles, hand hygiene, antimicrobial stewardship and staff training.

Conclusion: Controlling HAIs requires an integrated institutional approach — continuous surveillance, clear protocols, rational antimicrobial use and multiprofessional involvement. Nurses play a central role through adherence to preventive practices and the strengthening of patient safety.

Keywords: *Healthcare-associated infections; Antimicrobial resistance; Hospital epidemiological surveillance; Patient safety.*

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1. INTRODUCTION

Healthcare-associated infections (HAIs) remain one of the most persistent patient safety problems. They cause increased morbidity and mortality, prolong hospital stays, increase costs, and put pressure on the human and material resources of institutions. In the European area, the European Centre for Disease Prevention and Control (ECDC) estimates that around 4.3 million patients acquire at least one HAI per year in acute care hospitals in the European Union and the European Economic Area [1].

In Portugal, the Infection Prevention and Control and Antimicrobial Resistance Program (PPCIRA), of the Directorate-General of Health, defines as priorities the prevention of healthcare-associated infections (HAIs), epidemiological surveillance, the appropriate use of antimicrobials, and the reduction of antimicrobial resistance [2]. This guidance has become even more relevant: care is increasingly complex, and patients are older, have more comorbidities, and are more exposed to invasive procedures.

Among the most clinically significant healthcare-associated infections (HAIs) are urinary tract infections associated with urinary catheters, ventilator-associated pneumonia, bloodstream infections, surgical site infections, and Clostridioides difficile infection. The risk largely depends on the presence of invasive devices, the length of hospital stay, immunosuppression, prior antibiotic exposure, and colonization by multidrug-resistant microorganisms—factors that also complicate treatment once infection develops.

Antimicrobial resistance exacerbates this situation. The circulation of multidrug-resistant microorganisms reduces therapeutic options, increases the complexity of the clinical approach, and demands more robust surveillance systems. Prevention cannot be based on isolated measures: it depends on institutional protocols, continuous training, auditing, active surveillance, and antimicrobial stewardship, supported by a responsibility that must be shared among clinicians, infection prevention and control teams, and hospital management.

The role of nursing is particularly relevant because it is the professional who is, in fact, at the patient's side. They insert and maintain devices, monitor, promote hand hygiene, educate patients and families, and apply intervention bundles in daily practice. Understanding recent evidence on healthcare-associated infections (HAIs) is therefore essential to support clinical, organizational, and management decisions.

This study aims to analyze recent scientific evidence on healthcare-associated infections (HAIs), focusing primarily on the European context, and in particular on the areas of antimicrobial resistance, hospital epidemiological surveillance, and institutional prevention and control strategies.

2. LITERATURE REVIEW

Preventing healthcare-associated infections (HAIs) is simultaneously technical, behavioral, and organizational. Hand hygiene remains one of the most impactful practices, but the literature shows that isolated educational interventions produce limited results when not accompanied by adequate institutional conditions, availability of materials, visual reinforcement, auditing, and a safety culture [3,4]. Adherence to basic precautions is, therefore, an individual and institutional responsibility.

Antimicrobial resistance is the central focus of the problem. Figueiredo et al. demonstrated, in a study of patients with liver cirrhosis, that the emergence of multidrug-resistant organisms is associated with clinical and care factors that affect the treatment of infections [5]. Meira Gonçalves and Gomes do Carmo highlighted the direct impact of HAIs on health management — increased costs, prolonged hospital stays, readmissions and pressure on the safety of care [6].
Matos and Graça reinforced this dimension in the specific context of ventilator-associated pneumonia in the intensive care unit (ICU) [7].

Intervention bundles, also known as *bundles,* are small sets of evidence-based measures applied together consistently. Inácio et al. concluded that the bundles

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Measures aimed at the insertion and maintenance of urinary catheters contribute to reducing catheter-associated urinary tract infections [8]. The logic is consistent with the standards applied to other devices, such as invasive ventilation and vascular catheters.

Elderly, institutionalized patients with functional dependence and multiple comorbidities form a particularly vulnerable group [9]. In ICUs, prolonged use of a urinary catheter and invasive ventilation are factors frequently associated with an increased risk of infection [7,10]. These situations require daily assessment of the need for the device and removal as early as clinically possible.

Antimicrobial stewardship is another essential component. Ruiz-Ramos et al. observed that antibiotic therapy optimization programs for urinary tract infections caused by multidrug-resistant strains improve therapeutic adequacy and can reduce new admissions to emergency departments [11]. The findings reinforce the need to coordinate antibiotic prescribing, microbiology, pharmacy, clinical teams, and infection prevention and control structures.

Active microbiological surveillance allows for the early identification of colonization or infection by multidrug-resistant microorganisms. Fernández et al. described colonization by these microorganisms in patients admitted to ICUs during the COVID-19 pandemic [12]. Soria-Segarra et al. showed that colonization by carbapenem-resistant Gram-negative bacteria can anticipate infection, which reinforces the value of screening in defined contexts [13].

Some specific preventive measures, such as chlorhexidine bathing in ICUs, have shown benefit in certain contexts — especially in reducing bloodstream infections and infections caused by Gram-positive bacteria [14]. However, their use should be considered on a case-by-case basis, depending on the risk, local epidemiology and institutional protocols.

Clostridioides difficile infection remains clinically and epidemiologically relevant. Arriba-Fernández et al. monitored the evolution of the incidence of multidrug-resistant microorganisms and *C. difficile* in the Canary Islands between 2012 and 2019 [15]. Aràjol et al. published recommendations from the Catalan Society of Gastroenterology for the diagnosis and management of this infection [16]. Sante Fernández et al. evaluated the amplification threshold value of the toxin B gene as a prognostic marker, without the results supporting its systematic use as a predictor of severity [17]. Muñoz et al. identified factors associated with the infection, highlighting recent hospitalization, hypoalbuminemia, and prior antibiotic use [18].

The COVID-19 pandemic has altered the dynamics of healthcare-associated infections (HAIs) in several contexts. Bravo et al. analyzed bacterial infections in critically ill patients with COVID-19 and drew attention to the importance of secondary infections and the use of antibacterials in the intensive care setting [19]. In the post-pandemic period, Tomás-Vecina et al., in a consensus study, advocated for the need for integrated, innovative, and operationally viable strategies to reduce healthcare-associated infections [20].

3. METHODS

3.1 Type of study

This is an integrative literature review. This approach is justified by the possibility of bringing together studies with different methodological designs—observational studies, systematic reviews, narrative reviews, consensus documents, and institutional reports—as long as they are related to the defined objective. The review was organized in a structured and transparent manner, with a sequential description of the selection process, without adopting the designation of a systematic review.

3.2 Information sources and research strategy

The research was conducted using the PubMed, SciELO, and Google Scholar databases. Institutional documents from the ECDC and DGS/PPCIRA were also considered due to their epidemiological importance.

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normative framework in European and Portuguese contexts. Publications between 2021 and 2025, in Portuguese, English and Spanish, in full text, were included.

In PubMed, combinations of the following terms were used: *Healthcare-Associated Infections, Nosocomial Infections, Hospital Infection, Antimicrobial Resistance, Multidrug-Resistant Organisms, Hospital Epidemiological Surveillance, Infection Control, Patient Safety ,* and *Intensive Care Units.* In SciELO and Google Scholar, equivalent combinations were used in Portuguese, English, and Spanish, with the central terms "IACS," "antimicrobial resistance," "hospital epidemiological surveillance," "multidrug-resistant organisms," and "hospital infection control."

3.3 Inclusion and exclusion criteria

Studies published between 2021 and 2025, in full text, in Portuguese, English or Spanish, related to healthcare-associated infections (HAIs), antimicrobial resistance, hospital epidemiological surveillance, multidrug-resistant microorganisms, infection prevention and control, and patient safety were included. European studies were prioritized. Studies from other contexts were accepted when they addressed topics directly relevant to the discussion, such as COVID-19, *C. difficile* infection , or the role of nursing.

Duplicates, academic dissertations, works without full text access, publications outside the defined period, studies focused solely on occupational biosafety without a direct link to healthcare-associated infections (HAIs), and publications unrelated to the objectives were excluded. Brief reports and letters to the editor were excluded from the main sample.

3.4 Study selection and data extraction

1187 potentially relevant records were identified (359 in PubMed, 9 in SciELO, and 819 in Google Scholar). After removing duplicates and excluding those due to thematic inadequacy, geographical incompatibility, lack of open access, unavailability of full text, or lack of relevance to the objectives, 51 studies remained eligible for full-text reading. After this reading, 33 were excluded for not meeting the defined criteria. The final sample included 18 scientific studies and 2 institutional documents.

Data extraction considered title, authors, year, country, objective, methodological design, and main conclusions. The synthesis was done in a narrative form, grouping the results by themes: impact of healthcare-associated infections (HAIs), antimicrobial resistance, invasive devices, epidemiological surveillance, intervention bundles, antimicrobial management, *C. difficile infection,* COVID-19, and the role of nursing.

3.5 Methodological limitations

This review has limitations. The use of Google Scholar reduces the reproducibility of the research, given the variability of the results and the sorting algorithms. The inclusion of studies with different designs limits the direct comparison of findings. No meta-analysis or formal assessment of the risk of bias was performed. The results should therefore be read as an integrative synthesis of the available evidence, and not as a quantitative estimate of the effect of the interventions. Furthermore, the sample has a predominantly Spanish representation within the European set, and two extra-European studies (Brazil and Chile) were accepted only for thematic relevance, which may limit the generalizability of the conclusions.

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4. RESULTS AND DISCUSSION

4.1 Characterization of the included studies

The sample comprised 18 scientific studies, published between 2021 and 2025, mostly from Europe, supplemented by 2 institutional documents. Table 1 presents a summary of the included studies, ordered alphabetically by first author.

Table 1. *Summary of studies included in the review.*

Author No./Year/Country	Design	Theme	Summary of findings
1 Aràjol et al. 2026/Spain	Position paper/ consensus document	Diagnosis and management of *C. difficile* infection	Evidence-based and consensus-based recommendations to reduce recurrence and improve clinical management.
2 De Arriba-Fernández et al. 2021/Spain	prospective study	Incidence of multidrug-resistant microorganisms and *C. difficile*	Reduction of MRSA, increase in resistant Enterobacterales, and continued relevance of surveillance.
3 Braga et al. 2025/Portugal	Scoping review of IACS in elderly people in long-term care.		The risk of healthcare-associated infections (HAIs) in institutionalized elderly individuals is high; the 48-hour post-admission criterion may misclassify pre-existing infections as HAIs.
4 Bravo et al. 2022/Chile	Observational study	Bacterial infections in critically ill patients with COVID-19	Secondary infections and the use of antibacterial agents require attention to antimicrobial resistance.
5 Esarte and Mujika 2022/Spain	Systematic review	Bath with chlorhexidine in UCI	Possible reduction of bloodstream and Gram-positive infections in defined contexts.
6 Fernández et al. 2021/Spain	Observational study	Colonization by multidrug-resistant microorganisms in ICUs	Microbiological surveillance supports early detection and epidemiological control.
7 Figueiredo et al. 2022/Portugal	Observational study	Multidrug-resistant organisms in cirrhosis liver	Multidrug-resistant microorganisms affect treatment and... prognosis.
8 Inácio et al. 2021/Portugal	Systematic review	Intervention bundles in Urinary tract infection (UTI) associated with a urinary catheter.	Interventional bundles reduce infections associated with urinary catheters.
9 Matos and Graça 2024/Portugal	Observational study	Ventilator-associated pneumonia	Invasive ventilation and the ICU setting maintain a significant risk of healthcare-associated infections (HAIs).
10 Meira Gonçalves and Gomes do Carmo 2022/Portugal	Narrative review: Impact of IACS on health management		Healthcare-associated infections (HAIs) increase costs, morbidity and mortality, and compromise patient safety.
11 Muñoz et al. 2023/Spain	Case-control	Factors associated with *C. difficile* infection	Recent hospitalization, antibiotic use, and hypoalbuminemia are associated with risk and prognosis.
12 Nunes et al. 2021/Portugal	Narrative review: Nursing interventions in hand hygiene		Education and institutional conditions encourage adherence to preventive practices.
13 Pauseiro et al. 2025/Portugal	Systematic review	Infections associated with urinary catheters in the ICU	The prolonged use of the catheter increases the risk and reinforces the need for protocols.
14 Rêgo et al. 2023/Brazil	Literature review	Nursing and multidrug-resistant bacteria	Nursing contributes to prevention, education, and adherence to control measures.

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Author No./Year/Country	Design	Theme	Summary of findings
15 Ruiz-Ramos et al. 2023/Spain	Observational study	Antimicrobial management in ITU multi-resistant	Antibiotic optimization improves therapeutic appropriateness and can reduce readmissions.
16 Sante Fernández et al. 2022/Spain	Observational study	Ct value in *C. difficile* infection	The Ct value did not demonstrate sufficient consistency as a systematic predictor of severity.
17 Soria-Segarra et al. 2021/Spain	Observational study	Colonization by carbapenem-resistant Gram-negative bacteria	Colonization can anticipate infection and justify active surveillance.
18 Tomás-Vecina et al. 2023/Spain	Expert consensus	Challenges in preventing IACS	Integrated, technological, and human-centered strategies are recommended.

Source: author's own elaboration, based on the studies included in the review.

4.2 Synthesis and discussion of results

The evidence analyzed confirms that healthcare-associated infections (HAIs) continue to be a persistent problem—both in terms of public health and patient safety. The ECDC and DGS/PPCIRA documents carry specific weight, as they result from national and European surveillance systems and frame the epidemiological and institutional dimension of the problem [1,2]. They support the need for continued policies of monitoring, prevention, antimicrobial stewardship, and improvement of the quality of care.

The observational studies included help to understand the dynamics of HAIs in specific contexts. Arriba-Fernández et al. showed that prolonged surveillance allows capturing distinct trends among pathogenic agents [15]. Ruiz-Ramos et al. demonstrated the usefulness of antibiotic therapy optimization programs in multidrug-resistant urinary tract infections [11]. Muñoz et al. and Soria-Segarra et al. reinforced the importance of identifying risk factors and colonization by resistant microorganisms [13,18].

The included systematic reviews naturally have greater weight in guiding preventive practice, despite the heterogeneity of the studies analyzed. Inácio et al. and Pauseiro et al. confirm the value of intervention bundles in the prevention of urinary catheter-associated infections [8,10]. Esarte and Mujika point to the benefit of chlorhexidine bathing in certain intensive care settings, with the caveat that its application should be adapted to local epidemiology and institutional protocols [14].

Narrative and bibliographic reviews have less weight of evidence, but are useful for contextualizing the role of management, nursing and organizational culture. Nunes et al. and Rêgo et al. value nursing intervention in education, monitoring and promoting adherence to preventive measures [3,4]. Meira Gonçalves and Gomes do Carmo recall the impact of HAIs on the sustainability of services and the quality of care [6].

Clostridioides difficile infection emerges as a relevant problem due to morbidity, mortality, relapse, and its link to prior antibiotic use. Aràjol et al. offer evidence-based and consensus-based clinical recommendations [16]. Sante Fernández et al. contribute by showing that not all evaluated laboratory markers have sufficient practical utility—this was the case with the Ct value as a systematic predictor of severity [17]. This distinction is important: it avoids excessive conclusions and helps to calibrate expectations around new markers.

The COVID-19 pandemic exposed weaknesses in infection prevention and control systems. Studies by Fernández et al. and Bravo et al. point to increased concern regarding colonization by multidrug-resistant microorganisms, secondary infections, and the use of antibacterial agents in overburdened ICUs [12,19]. In the post-pandemic period, Tomás-Vecina et al. advocate integrated strategies—combining surveillance, technology, training, humanization, and operational feasibility [20].

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No single measure is sufficient to control healthcare-associated infections (HAIs) — this is perhaps the most consistent conclusion in all the reviewed literature. Prevention depends on a continuous, coordinated, and monitored strategy. Intervention bundles, hand hygiene, early removal of invasive devices, microbiological surveillance, antimicrobial stewardship, and team training must be integrated into consistent institutional programs, not applied as isolated actions.

5. FINAL CONSIDERATIONS

This integrative review shows that healthcare-associated infections (HAIs) continue to pose a significant challenge to hospital systems, particularly due to their link to antimicrobial resistance, the use of invasive devices, prolonged hospital stays, and the increasing complexity of patient care. The evidence analyzed documents clinical, epidemiological, economic, and organizational impacts, with direct repercussions on patient safety and quality of care.

The most practically applicable strategies include active epidemiological surveillance, targeted microbiological screening, intervention bundles, hand hygiene, antimicrobial stewardship, ongoing staff training, and indicator monitoring. These measures should be implemented together, not as isolated actions.

The role of nursing is central because it is the professional who is, in fact, at the patient's side: providing care, monitoring devices, promoting hand hygiene, and educating patients and families. Even so, the effectiveness of preventive practices also depends on institutional conditions, leadership, available resources, and a culture of safety.

Despite the heterogeneity of the included studies, there is convergence regarding the need to strengthen institutional infection prevention and control programs. For future research, it is recommended to conduct studies with more robust methodology, evaluate results in real-world contexts, compare interventions, and analyze the economic impact of preventive strategies.

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