

## REVIEW ARTICLE

**Epidemiology of hospital-acquired infections in Ecuador (2018-2023): analysis of indicators and risk factors**

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**ABSTRACT**

**Introduction:** healthcare-associated infections constitute a critical indicator of hospital quality and an increasing challenge for public health.

**Objective:** to analyze the epidemiology of hospital-acquired infections in Ecuador between 2018 and 2023, evaluating their indicators and risk factors.

**Methods:** a literature review was conducted using a search algorithm, complemented by a manual "snowball" strategy. Inclusion criteria focused on studies on healthcare-associated infections in Ecuador during the specified period, followed by critical analysis of the identified sources.

**Development:** results show progressive epidemiological surveillance through the Integrated Epidemiological Surveillance System, with an increase in reporting hospitals between 2018 and 2022. The incidence of healthcare-associated infections showed variations, with a significant increase in 2021 attributed to the COVID-19 pandemic. The most frequent infections were ventilator-associated pneumonia and central venous catheter-related bloodstream infections, followed by urinary tract and surgical site infections. Risk factors include advanced age, immunodeficiency, invasive procedures, and antimicrobial use, promoting bacterial resistance. Comparisons with Chile and Peru reveal higher rates in Ecuador, especially in pediatric and neonatal services.

**Conclusions:** surveillance of healthcare-associated infections in Ecuador has advanced, but high incidence rates and microbial resistance persist, making it necessary to define annual reduction targets and optimize preventive strategies.

**Keywords:** INFECTION CONTROL; EPIDEMIOLOGY; CROSS INFECTION.

## INTRODUCTION

Healthcare-associated infections (HAIs), formerly known as nosocomial infections or diseases, are defined as infections that manifest in hospitalized patients or individuals who have received care in a healthcare facility and were not in the incubation period at the time of admission. These infections typically present with symptoms equal to or after 48 hours of hospital admission or even after discharge, constituting a relevant adverse event in the context of healthcare delivery.<sup>(1)</sup> This definition highlights the direct relationship between the care process and the onset of such infections, distinguishing them from community-acquired infections.

The World Health Organization (WHO) expands this concept to include not only infections acquired during hospitalization but also those that manifest after discharge and occupational infections affecting healthcare personnel. Furthermore, the WHO recognizes HAIs as the most frequent adverse event in healthcare and emphasizes that no country or institution has completely eradicated them, estimating that hundreds of millions of patients are affected annually worldwide.<sup>(2)</sup> Consistently, the Pan American Health Organization (PAHO) states that these infections affect approximately 15 % of hospitalized patients and up to 34 % of patients admitted to intensive care units in developing countries, demonstrating their disproportionate impact in contexts of greater health vulnerability.<sup>(1)</sup>

HAIs constitute a global problem affecting both developed and developing countries. It is estimated that around 1.4 million patients acquire an HAI, with the highest morbidity and mortality rates concentrated in Intensive Care Units (ICUs). Healthcare-associated pneumonias and bloodstream infections represent the leading causes of death linked to these infections, with particularly high incidence in ICUs, followed by high-risk and conventional neonatology units. Multicenter studies endorsed by the WHO have reported an average prevalence of 8.7 % for nosocomial infections among hospitalized patients, confirming their relevance as a public health problem.<sup>(1,3)</sup>

Currently, nosocomial infections or HAIs are considered one of the main indicators of hospital care quality and institutional efficiency. Hospital performance evaluation is no longer limited solely to classical indicators such as mortality or bed utilization but increasingly incorporates the rate of healthcare-associated infections.<sup>(4)</sup> The emergence of outbreaks caused by emerging and re-emerging pathogens highlights the critical role of hospital environments in the transmission of infectious diseases, especially when adequate conditions to interrupt the chain of transmission are lacking.<sup>(5)</sup> Various studies have demonstrated that HAIs increase the duration of hospitalization, the use of diagnostic and therapeutic resources, the risk of mortality, and healthcare costs, in addition to promoting the dissemination of multidrug-resistant microorganisms.<sup>(6)</sup>

In Latin America, the prevalence of HAIs reaches 23.2 %, with an average of 1.4 episodes per patient treated in public health institutions, and they are associated with more than 140,000 deaths annually worldwide, according to WHO estimates.<sup>(7)</sup> In Ecuador, these infections represent a significant economic and health burden, which is why epidemiological surveillance strategies were implemented, establishing the Integrated Epidemiological Surveillance System (SIVE) in 2001.<sup>(1,4)</sup> Through the SIVE-Hospital subsystem, the Ministry of Public Health collects and analyzes information on the occurrence and risk factors of HAIs to guide decision-making and strengthen infection prevention and control programs.

However, limited national scientific output and heterogeneity in surveillance systems hinder the precise estimation of their true incidence, justifying the objective of this review: to analyze the behavior of HAIs as an intrahospital indicator in Ecuador during the period 2018–2023. Accordingly, this review aimed to analyze the epidemiology of hospital-acquired infections in Ecuador between 2018 and 2023, evaluating their indicators and risk factors.

## METHODS

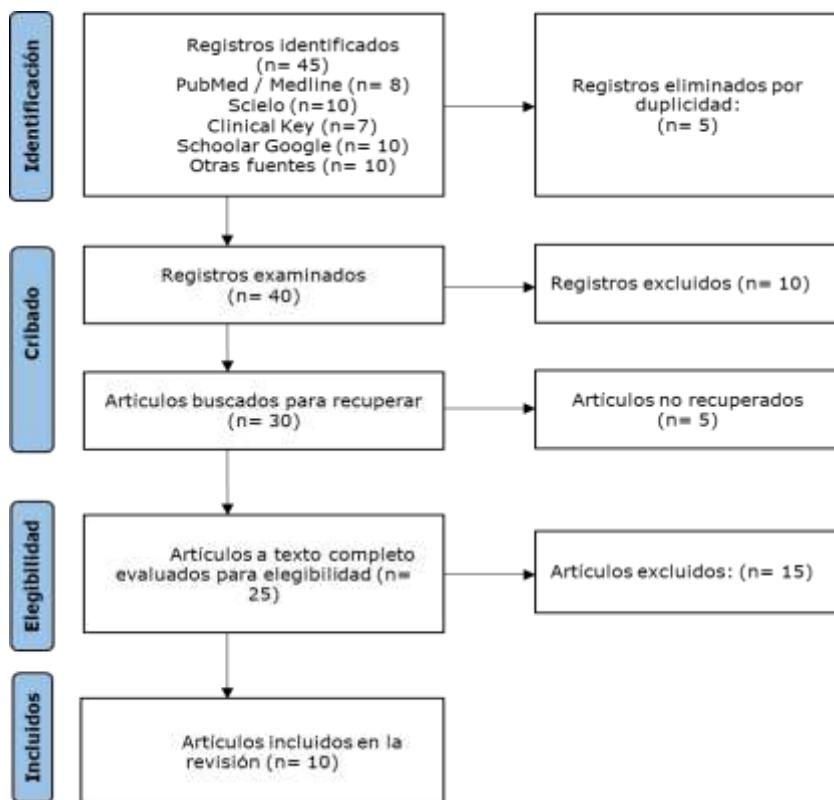
This study was conducted as a systematic literature review, developed in accordance with the guidelines established by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement, with the aim of ensuring transparency, reproducibility, and methodological rigor in the process of identifying, selecting, and analyzing scientific evidence. The bibliographic search covered the period from January 2010 to December 2024, considering relevant publications directly related to the study topic. The methodological design was structured in advance, defining the stages of search, screening, eligibility, and inclusion of studies.

Information sources included electronic databases of recognized prestige in the biomedical and scientific fields, including PubMed/MEDLINE, SciELO, ScienceDirect, Google Scholar, LILACS, and the Virtual Health Library (VHL). Additionally, a manual search of secondary references from selected articles was carried out using the “snowball” technique to identify potentially relevant studies not retrieved in the initial search. Grey literature, such as technical reports and institutional documents, was also considered when providing relevant and verifiable information.

The search strategy was designed by combining controlled descriptors and free terms, adapted to each database. Keywords related to the central topic were used, linked by Boolean operators AND, OR, and NOT to optimize the sensitivity and specificity of the search. Terms were used in Spanish, English, and Portuguese to broaden the coverage of available literature. The complete strategy was iteratively reviewed and adjusted to ensure the retrieval of relevant studies.

Inclusion criteria included original articles, systematic reviews, and observational studies published within the defined timeframe, with full-text access and direct relevance to the topic of interest. Duplicates, studies outside the established period, publications without full-text access, irrelevant works for the review's objective, and those with insufficient or methodologically deficient information were excluded. The selection process was carried out in three phases: title reading, abstract review, and full-text evaluation, independently and systematically.

The search in the Medline, PubMed, SciELO, Google Scholar, and Scopus databases provided a total of 45 citations. After adjusting for duplicates and applying inclusion and exclusion criteria, 30 remained. Of these, 20 studies were discarded because, after reviewing the abstracts, these articles clearly did not meet the criteria, leaving a total of 10 studies, as shown in Figure 1. The analysis was performed through a qualitative synthesis of the evidence, without conducting a meta-analysis due to the methodological heterogeneity of the included studies.



**Fig. 1** Flowchart of the review process developed.

## DEVELOPMENT

The results of this review show that epidemiological surveillance of HAIs in Ecuador has demonstrated progressive strengthening during the period 2018–2023, particularly regarding the expansion of the number of reporting hospitals and the consolidation of the SIVE-Hospital subsystem. This progress aligns with what is described in national normative documents and epidemiological bulletins, which highlight surveillance as a strategic axis for early event detection, outbreak identification, and guidance of preventive measures.<sup>(1,2)</sup> However, the increase in case capture also raises the need to carefully interpret trends, differentiating between a real increase in incidence and an improvement in notification capacity, an aspect previously noted in surveillance studies in similar contexts.<sup>(5)</sup>

Surveillance of HAIs in Ecuador has shown sustained expansion of its notification network, reflecting the progressive strengthening of the epidemiological surveillance subsystem initiated in 2016 with the incorporation of 13 sentinel units nationwide. In 2018, 35 reporting hospitals were recorded, a figure that increased to 52 in 2019 and reached 59 facilities in 2021, mostly belonging to the Ministry of Public Health, along with IESS hospitals, private sector facilities, and ISFFA and ISSPOL subsystems. This growth continued in 2022, when the National Health System network expanded to 77 reporting hospitals at primary, secondary, and tertiary levels of care, more broadly integrating the Comprehensive Public Health Network and the Public and Complementary Network. In terms of geographic distribution, reporting hospitals were mainly concentrated in the provinces of Pichincha and Guayas during 2021 and 2022, followed by

Manabí, Los Ríos, and Santo Domingo de los Tsáchilas, evidencing greater surveillance coverage in areas with higher population density and hospital capacity in the country.<sup>(1,2,8)</sup>

Regarding HAI incidence, marked interannual variability was observed, with a significant increase in 2021 coinciding with the impact of the COVID-19 pandemic. This finding is consistent with national and international reports describing an increase in device-associated infections during the pandemic, attributable to service overload, prolonged stays in intensive care units, and intensive use of mechanical ventilation and vascular catheters.<sup>(1,6)</sup> The subsequent decrease recorded in 2022 suggests partial recovery of infection control programs; however, rates remain high compared to pre-pandemic years, indicating that the indirect effects of the health crisis could persist in the medium term.<sup>(8)</sup>

In analyzing HAI incidence behavior in the country, relevant variations were detected during the analyzed period. In 2018, compared to 2017, 46 % of events showed a slight decrease in incidence density, 8 % remained unchanged, and the remaining 46 % showed a slight increase; simultaneously, a 30 % increase in total case capture was recorded (508 additional events), although with an overall reduction in incidence density of 8,7 %, equivalent to 0,59 fewer cases per thousand exposed patients.<sup>(2)</sup>

In 2019, a national decrease in incidence was observed, attributable to greater HAI control during that period, a trend that could not be sustained from 2020 onward. In 2021, 5,420 cases were reported, representing a 49,6 % increase compared to 2020 and a 98,3 % increase compared to 2019, an increase primarily associated with the impact of the COVID-19 pandemic on hospital services.<sup>(1)</sup> That year, the most frequent events were ventilator-associated pneumonia, accounting for 51,5 % of cases, followed by central venous catheter-related bloodstream infections at 30 %; to a lesser extent, catheter-associated urinary tract infections, enterocolitis, post Cesarean surgical site infections, endometritis, conjunctivitis, omphalitis, and meningitis were recorded, forming a profile dominated by infections linked to the use of invasive devices.<sup>(1,4)</sup>

The distribution of HAI types shows a consistent pattern throughout the analyzed period, with predominance of ventilator-associated pneumonia and central venous catheter-related bloodstream infections, followed by urinary tract and surgical site infections. This profile coincides with reports from other national and regional studies, where device-associated infections represent the greatest burden of HAIs, especially in adult, pediatric, and neonatology services.<sup>(1,4,9)</sup> The persistence of this pattern suggests structural and operational difficulties in the sustained application of prevention bundles, particularly in contexts of high healthcare demand.

When analyzing hospital services, results show that adult services concentrate the highest percentage of notifications, followed by neonatology and pediatrics. This finding is consistent with the literature, which identifies intensive care units and neonatal services as high-risk areas due to patient vulnerability and frequent use of invasive procedures.<sup>(3)</sup> However, the high burden observed in neonatology, especially in bloodstream infections, is concerning and coincides with increases reported in recent years, which could reflect deficiencies in catheter insertion and maintenance, as well as limitations in specialized human resources.<sup>(1,8)</sup>

International comparisons with Chile and Peru reveal relevant discrepancies. In most of the services and events analyzed, Ecuador presents higher incidence density rates, particularly in ventilator-associated pneumonias and bloodstream infections in adults, pediatrics, and neonatology.<sup>(1,8)</sup> These differences could be related to variations in protocol adherence, availability of supplies, staffing levels, and maturity of surveillance systems. However, in some gynecological-obstetric events, such as surgical site infections and post-cesarean endometritis, national rates were lower than those of the compared countries, suggesting specific strengths in this care component or possible methodological differences in notification.<sup>(10)</sup>

The risk factors identified in the review—advanced age, immunodeficiency, underlying diseases, invasive procedures, and antimicrobial use—broadly agree with international evidence and reinforce the multifactorial nature of HAIs.<sup>(9)</sup> In this context, antimicrobial resistance emerges as a cross-cutting problem, favored by intensive and, at times, inappropriate antibiotic use, especially during the pandemic. Although national bulletins describe the presence of multidrug-resistant pathogens in hospital outbreaks, the available information is limited and heterogeneous, making it difficult to conduct a deeper analysis of temporal trends and resistance patterns.<sup>(8)</sup>

From a methodological standpoint, the review reveals important knowledge gaps. The absence of official reports and published studies for the years 2023 and 2024 limits the evaluation of recent trends and updated regional comparisons. Likewise, the heterogeneity in the designs of the included studies and the predominance of institutional secondary sources restrict the possibility of performing more robust quantitative analyses. These limitations coincide with what other authors have pointed out regarding the scarce national scientific output in the field of HAIs and the need to strengthen applied research in this area.<sup>(4,7)</sup>

Finally, the findings of this review highlight the clinical and epidemiological relevance of HAIs as an indicator of hospital care quality in Ecuador. The high rates observed, especially in device-associated events, underscore the urgency of consolidating comprehensive infection prevention and control programs, with emphasis on continuous staff training, active surveillance, and rational antimicrobial use.<sup>(3,5)</sup> In the future, multicenter studies with standardized methodologies and analyses of the impact of specific interventions are required to generate solid evidence to guide public policies and improve patient safety in the Ecuadorian health system.

## CONCLUSIONS

Healthcare facilities conducting HAI surveillance should perform systematic local analyses of their rates, comparing them with historical records from previous years to identify priorities aligned with their epidemiological reality; this approach allows the implementation of continuous improvement plans based on effective prevention and control measures, as well as the establishment of realistic annual percentage reduction targets. Complementarily, it is essential to strengthen infection control teams and committees, ensuring coordinated and interdisciplinary work that provides ongoing technical support and permanent advisory services to staff upon the occurrence of these events. Likewise, it is fundamental to continuously reinforce and evaluate the technical competencies of healthcare personnel, recognizing them as key actors in the prevention of HAIs and in the timely notification of cases, which constitutes an essential strategy for early detection and outbreak prevention.

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