

Epidemiological characteristics of hospital-acquired pneumonia in pediatric patients at an Ecuadorian general hospital (2018–2022)

Características epidemiológicas de la neumonía nosocomial en pacientes pediátricos de un hospital general ecuatoriano (2018-2022)

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Reception: 02-11-2025

Acceptance: 06-01-2026

Publication: 31-01-2026

ABSTRACT

Nosocomial pneumonia is one of the most frequent infections in the hospital setting and represents an important cause of morbidity and mortality in children under five years of age, particularly in those with associated risk factors. The objective of this study was to describe the epidemiological characteristics of nosocomial pneumonia in pediatric patients at Hospital General Portoviejo during the period 2018–2022. A quantitative, observational, descriptive, cross-sectional study was conducted through the analysis of 70 randomly selected medical records. The results showed a higher frequency among children aged 5 to 9 years, males, and those from urban areas. Comorbidities predominated as intrinsic risk factors, while extrinsic factors included the use of nasogastric tubes, hospital stays of 7 to 12 days, prior antibiotic use, and the administration of antacids. The most frequent underlying conditions among children diagnosed with nosocomial pneumonia were allergies and asthma.

Keywords: hospital-acquired pneumonia, pediatric, risk factor diagnosis.

RESUMEN

La neumonía intrahospitalaria es una de las infecciones más frecuentes en el ámbito hospitalario y constituye una causa importante de morbilidad y mortalidad en niños menores de cinco años, especialmente en aquellos con factores de riesgo. Este estudio tuvo como objetivo describir las características epidemiológicas de la neumonía intrahospitalaria en pacientes pediátricos del Hospital General Portoviejo durante el período 2018–2022. Se realizó un estudio cuantitativo, observacional, descriptivo y transversal, a partir del análisis de 70 historias clínicas seleccionadas aleatoriamente. Los resultados evidenciaron una mayor frecuencia en niños de 5 a 9 años, de sexo masculino y procedencia urbana. Predominaron las comorbilidades como factores de riesgo intrínsecos, y entre los factores extrínsecos destacaron el uso de sonda nasogástrica, la hospitalización de 7 a 12 días, la administración previa de antibióticos y el uso de antiácidos. Las patologías de base más frecuentes fueron las alergias y el asma.

Palabras clave: neumonía intrahospitalaria, pediatría, diagnóstico factores de riesgo.

Cite as: España, J. F., Guzmán, K., & Toledo, N. (2026). Epidemiological characteristics of hospital-acquired pneumonia in pediatric patients at an Ecuadorian general hospital (2018–2022). *Revista Gregoriana de Ciencias de la Salud*, 3(1), 79-92. <https://doi.org/10.36097/rgcs.v3i1.3219>

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INTRODUCTION

Pneumonia is an acute infectious disease of the respiratory system characterized by inflammation of the lung parenchyma and is one of the leading causes of childhood morbidity and mortality worldwide. According to reports from the United Nations Children's Fund (UNICEF), approximately 700,000 children under six years of age die annually from this disease, including roughly 150,000 newborns, which equates to one child death every 45 seconds attributable to pneumonia (UNICEF, 2025). These figures reflect the magnitude of the problem and its persistent impact on global public health.

From an epidemiological perspective, pneumonia is classified as community-acquired and hospital-acquired or nosocomial pneumonia (NIH). Hospital-acquired pneumonia (HAP) is defined as an infection of the lung parenchyma that was absent at the time of hospital admission and develops at least 48 hours after hospitalization, although in the pediatric population, it can manifest even before this period, primarily associated with pathogens such as gram-negative bacilli and *Staphylococcus aureus* (Sethi & Albert, 2024). HAP represents one of the most frequent and serious nosocomial infections, with an estimated incidence of 4 to 8 cases per 1,000 hospital discharges, high morbidity and mortality, and a worse clinical prognosis, especially in patients with comorbidities (Allgood, 2022; Torres et al., 2020).

In the pediatric setting, HAP is especially relevant due to the immunological vulnerability of children, particularly those hospitalized in Pediatric Intensive Care Units (PICUs). Studies conducted in South America have reported that hospital-acquired pneumonia accounts for up to 31% of nosocomial infections, occurring most frequently in critical care units (Álvarez et al., 2021). Associated complications include respiratory failure, renal failure, and disseminated intravascular coagulation, which increase the length of hospital stay and healthcare costs (Cano et al., 2022).

In Ecuador, pneumonia remains a leading cause of death in children under five years of age. Data from the Ministry of Public Health indicate a high number of cases and deaths, predominantly in the 1- to 4-year-old age group and with a higher incidence in males (MSP, 2022). However, despite the clinical and epidemiological relevance of hospital-acquired pneumonia, there

is limited availability of up-to-date information on its prevalence in the pediatric population at the national level, attributed to underreporting and a lack of systematic local studies.

Several risk factors have been associated with the development of hospital-acquired pneumonia (HAP), which are grouped into intrinsic and extrinsic categories. Extrinsic factors include mechanical ventilation, prior use of broad-spectrum antibiotics, H2 antagonist antacids, immunosuppressants, and invasive procedures such as nasogastric tube insertion or bronchoscopy. Intrinsic factors include the presence of serious underlying diseases, malnutrition, immunosuppression, low birth weight, and prolonged hospitalization in the PICU or NICU (Figuerola et al., 2003; Martínez-Santander et al., 2022). The increase in antimicrobial resistance in the hospital setting also presents an additional challenge for the control and treatment of this infection (WHO, 2022; PAHO, 2024).

Despite advances in public health policies and hospital infrastructure, hospital-acquired pneumonia remains a significant problem in secondary care hospitals, such as the Portoviejo General Hospital, where a considerable number of pediatric cases are observed, associated with multiple risk factors. Identifying and characterizing these factors is essential to strengthening prevention strategies, optimizing clinical management, and reducing childhood morbidity and mortality associated with this preventable condition.

In this context, the objective of this research was to describe the epidemiological characteristics of hospital-acquired pneumonia in pediatric patients treated at the Portoviejo General Hospital between January 2018 and December 2022.

METHODOLOGY

The research was conducted as an observational, descriptive, cross-sectional study with a quantitative approach, aimed at the epidemiological characterization of hospital-acquired pneumonia in the pediatric population. The population consisted of 84 anonymized medical records of pediatric patients hospitalized in the inpatient wards and the Pediatric Intensive Care Unit of the Portoviejo General Hospital, diagnosed with hospital-acquired pneumonia, during the period between January 2018 and December 2022. The sample size was determined using simple random probability sampling, considering a 95% confidence level and a 5% margin of error, which allowed for the selection of 70 medical records that met the inclusion criteria. Patients aged one

month to 14 years with a confirmed diagnosis of hospital-acquired pneumonia and complete clinical information were included, while cases with incomplete data and those referred to other healthcare institutions were excluded. Data collection was carried out with prior institutional authorization, using a database provided by the hospital's Statistics Department and a structured form designed according to the operationalization of the variables. The data source was secondary and consisted of anonymized clinical records. Empirical and theoretical methods, as well as descriptive statistics, were applied for the analysis, establishing absolute and relative frequencies and 95% confidence intervals.

The data were processed in Microsoft Excel 2019, employing tabulation and filtering tools for organization. The study was approved by the Ethics Committee for Research in Human Beings of the Technical University of Manabí (code CEISH-UTM-INT_23-10-17_EMMG), and the confidentiality of the information was guaranteed through the exclusive use of anonymized data. The authors declared no conflicts of interest.

RESULTS AND DISCUSSION

Table 1 presents the distribution of sociodemographic factors of pediatric patients diagnosed with hospital-acquired pneumonia. Regarding age, the results showed that 37% of patients were in the 5- to 9-year-old age group, followed by the 1- to 4-year-old group with 30%, while the lowest frequency was observed in infants aged 1 to 11 months. These findings differ from those reported by Sánchez and González, who, in a study conducted in the Pediatric Intensive Care Unit of the José Carrasco Arteaga Hospital in Ecuador, identified a higher incidence of hospital-acquired pneumonia in children under 3 years of age, associated with various risk factors (Sánchez et al., 2020). However, the results of this study are somewhat similar to those reported by Romero (2024), who observed a higher frequency of hospital-acquired pneumonia in children aged 1 to 5 years, coinciding with the present study's high proportion of cases in the preschool age group.

Table 1. Sociodemographic factors of pediatric patients with hospital-acquired pneumonia treated at Portoviejo General Hospital

Sociodemographic factor	Category	Percentage	Observations relevant
Age	1–11 months	Minor frequency	Age group less affected
	1–4 years	30	Second group further frequent
	5–9 years	37	Group with higher prevalence
Area of residence	Urban	77	Associated with the geographical location of the hospital
	Rural	23	No conclusive association was found
Sex	Male	60	Greater impact, consistent with regional reviews
	Female	40	Minor proportion

Regarding the area of residence, it was found that 77% of the patients came from urban areas. This finding could be related to the hospital's geographic location, which primarily serves an urban population. While several studies indicate that rural origin can be a risk factor for respiratory diseases due to limited access to health services and poor road conditions (Romero, 2024), the available evidence does not conclusively establish place of residence as a determining epidemiological characteristic in hospital-acquired pneumonia. In this sense, the results of this study are consistent with those reported by Sánchez and González in Cuenca, Ecuador, who observed that 58.9% of affected pediatric patients came from urban areas (Sánchez et al., 2020).

Regarding sex, a predominance of males was observed, with 60% of cases, compared to 40% for females. These results are consistent with those described in the systematic review by Martínez et al., who noted a higher prevalence of pediatric hospital-acquired pneumonia in Latin America among males (Martínez-Santander et al., 2022), as well as with the prospective cohort study by Cano et al. (2022), in which 43.5% of cases were male. However, they differ from the findings of Sánchez and González, who reported a higher frequency of the disease in females (53.3%) in their study population (Sánchez et al., 2020).

Table 2 shows the intrinsic and extrinsic risk factors associated with hospital-acquired pneumonia in pediatric patients treated at the Portoviejo General Hospital between 2018 and 2022. It was observed that 43 of the 70 pediatric patients (61.4%) had pre-existing conditions as relevant clinical history. Respiratory diseases predominated, with allergies present in 20% of cases (n = 14) and bronchial asthma in 17% (n = 12). Other conditions, such as neurological and congenital

disorders, gastroesophageal reflux disease (GERD), and metabolic disorders, were observed less frequently.

Table 2. Intrinsic and extrinsic risk factors associated with hospital-acquired pneumonia in pediatric patients at Portoviejo General Hospital

Factor type	Risk factor	Percentage	Relevant evidence
Intrinsic	Presence of comorbidities	45	It coincides with Vizmanos and Martín (2017) and Romero (2024).
	birth weight	33	Predisposing factor frequent
	Malnutrition	22	Associated with greater vulnerability
	Presence of ≥ 1 intrinsic factor	64	Concurrence of multiple factors
Extrinsic	Procedures invasive (global)	31	NIH determining factor
	Probe nasogastric	45	Procedure invasive further frequent
	Enteral nutrition	24	Associated with microaspiration
	Ventilation mechanics	18	Lower frequency in this study
	Catheter central venous	14	Risk of infectious additional
	Hospital stay (7–12 days)	65	Extended stay significant
	Stay >12 days	23	Increased exposure to pathogens
	Use prior broad-spectrum antibiotics spectrum	74	Risk of germs multi-resistant
	Use of antacids	79	A high gastric pH as a risk factor
	Use of immunosuppressants	36	Greater susceptibility infectious
	Edema pulmonary	83	Main complication extrinsic
	Sepsis	6	Similar to comparative studies comparatives
Embolism pulmonary	6	Minor frequency	
Atelectasis	5	Coinciding with the literature	

It is important to note that several patients had multiple underlying conditions. These findings are consistent with those reported by Delgado, who identified the presence of serious underlying diseases as a significant risk factor for the development of hospital-acquired pneumonia, particularly in *Aspergillus* infections, while *Candida* pneumonia was associated with

prior antibiotic use, parenteral nutrition, invasive procedures, greater clinical severity, mechanical ventilation, and prolonged stay in pediatric intensive care units (Delgado-Pimienta et al., 2021). Furthermore, it has been recognized that underlying disease, such as congenital heart disease, along with factors such as extreme age, inadequate initial antibiotic treatment, and the type of causative microorganism, significantly influence mortality from nosocomial pneumonia (Yancha & Granillo, 2021). However, the limited availability of recent literature prevented direct comparisons with current studies specifically analyzing bronchial asthma or allergies as predisposing factors in children with hospital-acquired pneumonia. Nevertheless, the presence of asthma is recognized as a significant clinical concern, since chronic airway inflammation and frequent corticosteroid use can increase susceptibility to respiratory infections and worsen the clinical course of hospital-acquired pneumonia in the pediatric population (Cabanés et al., 2019).

Figure 1 shows the distribution of associated pathologies in the pediatric patients studied ($n = 70$). Of the total pediatric patients included in the study, 45 (64%) presented intrinsic risk factors. Among these, 45% showed the presence of a comorbidity, 33% had low birth weight, and 22% had some degree of malnutrition. It is worth noting that several patients presented with multiple intrinsic and extrinsic risk factors. These findings are consistent with those reported by Vizmanos and Martín (2017), who identified comorbidities and malnutrition as relevant intrinsic factors associated with the development of hospital-acquired pneumonia in the pediatric population (Figuerola et al., 2003; Llerena et al., 2022). Similarly, Romero (2024) reported a statistically significant association between hospital-acquired pneumonia and the presence of concomitant respiratory disease (OR = 20.812; 95% CI: 8.097–53.493), as well as with comorbidity (OR = 3.148; 95% CI: 1.574–6.297), results that are consistent with those observed in the present study (Romero, 2024).

Regarding extrinsic risk factors, it was found that 31% of patients underwent invasive procedures. Nasogastric tube insertion was the most frequent procedure (45%), followed by enteral nutrition (24%), while central venous catheter placement and mechanical ventilation accounted for 14% and 18%, respectively. Although multiple studies identify mechanical ventilation as one of the main factors associated with hospital-acquired pneumonia, with reported prevalences of up to 95%, especially in pediatric intensive care units in the United States and Spain (Manzanares et al., 2023), this was not the predominant factor in the analyzed population.

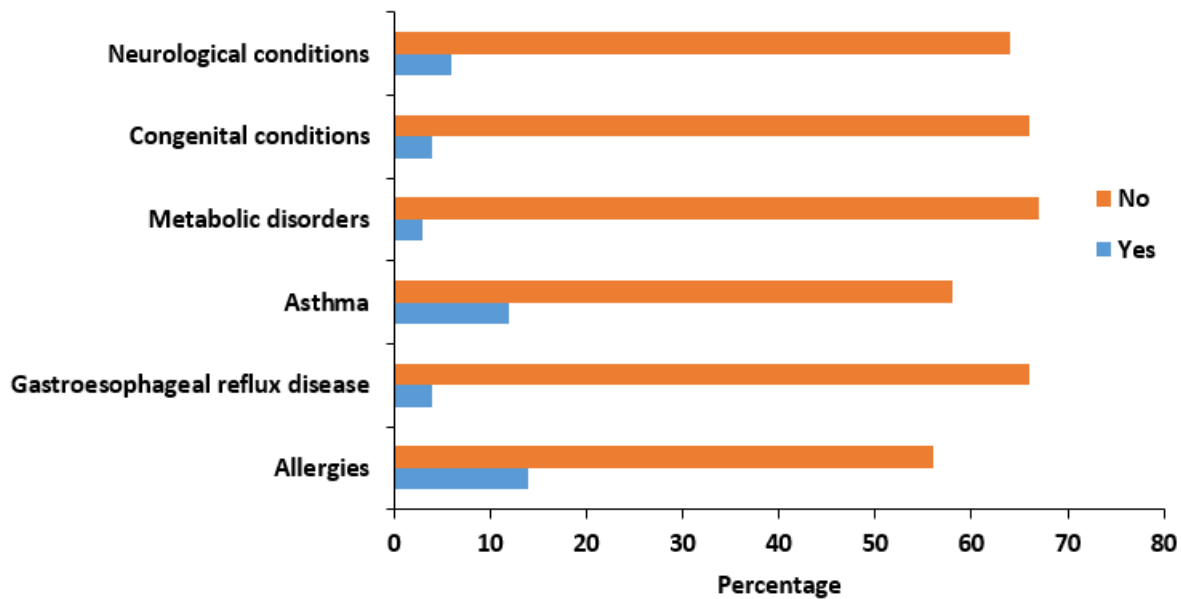


Figure 1. Pathologies associated with hospital-acquired pneumonia in pediatric patients. Portoviejo General Hospital (2018-2022).

Similar results were reported by Duarte in Mexico, who identified nasogastric tube insertion as the procedure most frequently associated with nosocomial infections, despite a high rate of mechanical ventilation (Duarte-Raya & Baeza-Zarcoa, 2016). Similarly, Peralta reported nasogastric tube placement as an invasive factor in 26% of pediatric patients with ventilator-associated pneumonia in a Latin American pediatric hospital (Paz & Peralta, 2019).

Regarding hospital stay, 65% of patients remained hospitalized for 7 to 12 days, 23% for more than 12 days, and only 12% for 1 to 6 days. Prolonged hospitalization is a determining factor in the development and severity of hospital-acquired pneumonia due to increased exposure to potentially pathogenic microorganisms in the hospital environment. These results are comparable to those reported by Sánchez et al. (2020), who described an average stay of 8 ± 24 days in children hospitalized with pneumonia. Similarly, the study conducted at the Huacho Regional Hospital corroborated prolonged hospital stay as a statistically significant risk factor (OR= 10.084; 95% CI: 4.457–22.817) for the development of hospital-acquired pneumonia (Romero, 2024). It is recognized that this condition develops at least 48 hours after hospital admission in patients not undergoing mechanical ventilation, with microaspiration of colonizing bacteria from the

oropharynx and upper airways being a frequent cause, which increases the risk with prolonged hospitalization (Yancha & Granillo, 2021).

Analysis of prior broad-spectrum antibiotic use revealed that 74% of patients had received this type of treatment before their diagnosis of hospital-acquired pneumonia. This result aligns with the findings of Sánchez et al. (2020), who reported a predominant use of beta-lactams (82.6%), followed by macrolides (7.8%), as treatment for previous infections, which was associated with a higher risk of nosocomial pneumonia (Sánchez et al., 2020; Yancha & Granillo, 2021). Similarly, Choez identified prolonged hospital stay and prior antibiotic use as factors associated with multidrug-resistant infections and the development of hospital-acquired pneumonia (Choez, 2023). Infection with resistant microorganisms is associated with a significant increase in morbidity and mortality, reinforcing the role of prior antibiotic use as a relevant risk factor (Cabanés et al., 2019).

Antacid use was recorded in 79% of cases, generally as prophylaxis associated with the use of broad-spectrum antibiotics, while 21% did not receive this treatment. The increase in gastric pH induced by H2 blockers or proton pump inhibitors has been recognized as a risk factor for hospital-acquired pneumonia. In agreement with Lovera et al. (2020), gastric acid suppressants were used in 89.1% of children with ventilator-associated pneumonia in Paraguay.

Regarding the use of immunosuppressants, 36% of patients received this type of medication, while 64% did not have this indication. Although pediatric evidence is limited, Vizmanos and Martín (2017) highlight the use of immunosuppressants as a relevant extrinsic factor associated with hospital-acquired pneumonia. Studies such as that by Oliveira et al. have indicated that immunosuppression favors infection by multidrug-resistant bacteria, increasing the risk of healthcare-associated pneumonia (Silva et al., 2022).

Other extrinsic risk factors were identified in 26% of patients, considered in many cases as complications. Of these, 83% presented with pulmonary edema, while pulmonary embolism and sepsis were recorded in 6% of cases each, and atelectasis in 5%. These results are partially consistent with those reported by Ruiz et al. (2017), who identified pleural effusion (7.04%) and sepsis (6.34%) as associated factors. Previous studies have described the presence of atelectasis, pulmonary embolism, aspiration, cardiogenic pulmonary edema, and pleural effusion as conditions

associated with pediatric hospital-acquired pneumonia (Chacha et al., 2019; Sethi & Albert, 2024).

In the present study, 61.4% of pediatric patients had pre-existing conditions as relevant clinical history. Respiratory diseases predominated, with allergies occurring in 20% of cases (n = 14) and bronchial asthma in 17% (n = 12). Other conditions, such as neurological and congenital disorders, gastroesophageal reflux disease (GERD), and metabolic disorders, were observed less frequently. It is important to note that several patients had multiple underlying conditions. These findings are related to what was reported by Delgado, who identified the presence of serious underlying diseases as a significant risk factor for the development of hospital-acquired pneumonia, particularly in *Aspergillus* infections, while *Candida* pneumonia was associated with prior antibiotic use, parenteral nutrition, the application of invasive techniques, greater clinical severity, mechanical ventilation, and prolonged stay in pediatric intensive care units (Delgado-Pimienta et al., 2021).

Furthermore, it has been recognized that underlying conditions, such as congenital heart disease, along with factors like extreme age, inadequate initial antibiotic treatment, and the type of causative microorganism, significantly influence mortality from nosocomial pneumonia (Yancha & Granillo, 2021). However, the limited availability of recent literature prevented direct comparisons with current studies specifically analyzing bronchial asthma or allergies as predisposing factors in children with hospital-acquired pneumonia. Nevertheless, the presence of asthma is recognized as a relevant clinical concern, since chronic airway inflammation and frequent corticosteroid use can increase susceptibility to respiratory infections and worsen the clinical course of hospital-acquired pneumonia in the pediatric population (Cabanés et al., 2019).

CONCLUSIONS

Hospital-acquired pneumonia in the studied pediatric population primarily affected boys aged 5 to 9 years from urban areas. Comorbidities were identified as the main intrinsic risk factor, while extrinsic factors included nasogastric tube use, a hospital stay of 7 to 12 days, prior administration of broad-spectrum antibiotics, and antacid use, demonstrating the influence of clinical interventions and length of hospital stay on the development of this infection. Furthermore, the most frequent underlying conditions in patients with nosocomial pneumonia were chronic respiratory diseases, especially allergies and asthma, highlighting the need for more rigorous

monitoring and preventive management in this vulnerable group.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: Jhoan F. España and Katerine Guzmán. **Data curation:** Jhoan F. España and Katerine Guzmán. **Formal analysis:** Jhoan F. España, Katerine Guzmán, and Nancy Toledo. **Investigation:** Jhoan F. España, Katerine Guzmán, and Nancy Toledo. **Methodology:** Nancy Toledo. **Supervision:** Nancy Toledo. **Validation:** Nancy Toledo. **Writing – original draft:** Jhoan F. España, Katerine Guzmán, and Nancy Toledo. **Writing – review & editing:** Jhoan F. España, Katerine Guzmán, and Nancy Toledo.

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