Research Article ISSN 3065-7636

Journal of Nursing Care & Reports

Pathologies Associated with Lethality in Patients with Healthcare-Associated Infections Due to The Use of Mechanical Ventilation in Adult Intensive Care Units in Health Institutions of the Municipality of Neiva During the Year 2023

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Submitted:12 Dec 2025; **Accepted:**20-Dec-2025; **Published:** 2 Jan 2026

Citation: Reyes, E. M. et al., (2026). Pathologies Associated with Lethality in Patients with Healthcare-Associated Infections Due to The Use of Mechanical Ventilation in Adult Intensive Care Units in Health Institutions of the Municipality of Neiva During the Year 2023. *J Nurs Care Repo; 7*(1):1-6. DOI : https://doi.org/10.47485/3065-7636.1044

Abstract

In modern healthcare, the use of mechanical ventilation in Intensive Care Units (ICUs) is an essential intervention for patients with severe respiratory failure; however, its use carries significant risks, such as ventilator-associated pneumonia (VAP), one of the most frequent and deadly nosocomial infections. The complexity of its management, antimicrobial resistance, and multifactorial pathogenesis underscore the need for further research.

Objective: *To identify the pathologies associated with lethality in patients with healthcare-associated infections due to the use of mechanical ventilation in adult Intensive Care Units in Health Institutions of the Municipality of Neiva during the year 2023.*

Methods: *This was a quantitative, observational, descriptive, and retrospective study based on the analysis of records from the Public Health Surveillance System (SIVIGILA) corresponding to the event Device-Associated Infections (DAI), code 357, reported in 2023 by the Intensive Care Units (ICUs) of institutions in the municipality of Neiva. All records that met the inclusion criteria were used, and a descriptive statistical analysis was performed using Excel, evaluating epidemiological variables. For the causative pathologies, a bivariate analysis was performed to calculate the Relative Risk and the Odds Ratio (OR).*

Results: *The main findings of this study showed that the case fatality rate in adult patients with ventilator-associated infections in the ICU of Neiva during 2023 was 66.7%, with prior infection being the main risk factor for mortality, above comorbidities such as cancer, malnutrition, and immunosuppression. The majority of cases occurred in men over 60 years of age.*

Introduction

In modern healthcare, the use of mechanical ventilators in Intensive Care Units (ICUs) has become a critical and often life-saving intervention for patients with severe respiratory distress. These devices are essential for maintaining adequate oxygen levels in patients who cannot breathe on their own due to serious illness or injury. Modern ventilators are sophisticated machines that can be precisely controlled to meet the specific needs of each patient, offering ventilation modes based on pressure, flow, and volume (Trivitron Health Care, 2024; American Association for the Surgery of Trauma, 2011).

The most common situations requiring mechanical ventilation include severe respiratory illnesses such as acute respiratory distress syndrome (ARDS), chronic obstructive pulmonary disease (COPD), and severe pneumonia. In these critical scenarios, ventilators are essential for patient survival, providing the necessary support to overcome respiratory failure until they can regain the ability to breathe independently (González & Cabrera 2014).

However, the use of mechanical ventilators is not without risks, with healthcare-associated infections (HAIs), such as ventilator-associated pneumonia, being one of the most serious and frequent problems. These infections not only significantly increase morbidity and mortality in critically ill patients, but

also generate a considerable increase in healthcare costs and the length of hospital stays (Morales, 2022; González, 2022) (Rego Avila et al., 2020).

Ventilator-associated pneumonia (VAP) is one of the most common hospital-acquired infections in intensive care units (ICUs) and is associated with high morbidity and mortality rates. Research indicates that VAP can double mortality in ICUs and significantly extend the duration of mechanical ventilation and hospital stay. Furthermore, the additional cost per episode of ventilator-associated pneumonia can be considerable, increasing healthcare expenditures by thousands of euros per patient (Pileggi et al., 2011) (Rodríguez et al., 2025) (Sadigov et al., 2019).

Several studies have shown that ventilator-associated pneumonia (VAP) increases mortality in intensive care units (ICUs) by up to 45%, in addition to prolonging the duration of mechanical ventilation and hospital stay by an average of 6 to 12 additional days. These increases not only affect patient recovery but also represent a significant additional cost to the healthcare system. For example, it is estimated that each episode of VAP can increase healthcare costs by approximately US$40,000 per patient (Cabrera-Tejada et al., 2024).

Despite the prevention and control strategies implemented, the prevalence of VAP in ICUs remains high, varying between 10% and 20% in different studies, which underlines the urgent need for further research to develop more effective and efficient methods of prevention and management (Pileggi et al., 2011) (Sadigov et al., 2019).

The prevalence of ventilator-associated pneumonia (VAP) varies widely, reflecting its complexity and the challenge it presents in terms of clinical management and prevention. Recently, it has been found that between 10% and 20% of patients receiving mechanical ventilation develop VAP, which underscores the urgency of adopting effective measures for its prevention and treatment (Ministerio de Salud Pública de Ecuador, 2020).

Therefore, the aim is to identify the pathologies associated with mortality in patients with healthcare-associated infections due to the use of mechanical ventilation in adult Intensive Care Units in the Health Institutions of the Municipality of Neiva during the year 2023

Methodology

An observational, descriptive study was conducted to identify the pathologies associated with mortality in patients with healthcare-associated infections (HAIs) due to the use of mechanical ventilators in adult Intensive Care Units (ICUs) in healthcare institutions in the municipality of Neiva during 2023. To this end, the researchers relied on reports generated by the epidemiological surveillance system (SIVIGILA) in the department of Huila, corresponding to the year under investigation. The information used was collected through XLS files notifying cases of the epidemiological event of Device-Associated Infections (DAI) Code 357, reported to SIVIGILA by the Primary Data Generating Units (UPGD) that had authorized adult intensive care unit (ICU) services in the department of Huila, after prior approval for their use by this entity.

For the development of this research, 100% of the notification records from the database of the event Device-Associated Infections (DAI) Code 357, reported to SIVIGILA in 2023, in the city of Neiva, Huila department, were used.

Inclusion Criteria

- Patients who were reported to SIVIGILA for Device-Associated Infections (DAIs) Code 357, in the period 2023, whose permanent residence is the city of Neiva, Huila department, and who have a correctly completed event form.

Exclusion Criteria

- Duplicate data records.
- Data records that were discarded due to data entry errors.

For the development of this research, the notification form for the Device-Associated Infections (DAI) event, Code 357 of the INS, was used as an instrument. This form is mandatory for all UPGDs in the country that have adult intensive care unit (ICU) services, and the information obtained from this instrument was recognized as official.

This information was handled through Excel databases (XLS files) with the reported events, respecting the principles of confidentiality and information protection, in accordance with current regulations in the country.

Control de errores y sesgos: Al ser el SIVIGILA una fuente secundaria, el riesgo de alteraciones en la recolección de los datos fue inherente a la investigación debido al poco control sobre el correcto diligenciamiento de la ficha de notificación. Este sesgo fue evitado mediante la selección minuciosa de los casos, verificando la ausencia de ediciones en el diligenciamiento de los datos y la coherencia de los mismos.

Results and Discussion

The results presented below correspond to the analysis of data collected from official records of the event "Device-Associated Infections" (DAI), code 357, reported to the Public Health Surveillance System (SIVIGILA) during 2023 by the Intensive Care Units (ICUs) of health institutions in the municipality of Neiva. A total of 60 records were included that met the inclusion criteria established in the methodology, representing all reported cases of ventilator-associated infections in the adult population during the study period.

Epidemiological variables of patients who developed healthcare-associated infections due to mechanical ventilation.

The epidemiological analysis showed that the majority of reported cases of ventilator-associated infections (HAIs)

occurred in patients over 60 years of age (50%), followed by adults between 27 and 59 years of age (30%), and to a lesser extent, young adults between 18 and 26 years of age (20%). The mean age was 53.3 years, with a wide range (18 to 85 years). Regarding sex, there was a clear predominance of males (80%), compared to 20% females.

Table 1: Age and sex of the reported patients.

AGE		
Fashion	18 años	
Average	53.3 años	
Median	59 años	
Minimum age	18 años	
Maximum age	85 años	
Standar deviation	21.7888947 años	
Age ranges	**(N)**	**(%)**
Youth (18-26 years)	12	20%
Adulthood (27-59 years)	18	30%
Senior Citizen (60 years or older)	30	50%
TOTAL	**60**	**100%**
SEX		
Female	12	20%
Male	48	20%
TOTAL	**60**	**100%**

Source: Researchers database

Epidemiological variables of patients who developed healthcare-associated infections due to the use of mechanical ventilation.

Epidemiological analysis revealed that the majority of reported ventilator-associated infections (VASIs) occurred in patients over 60 years of age (50%), followed by adults between 27 and 59 years of age (30%), and to a lesser extent, young adults between 18 and 26 years of age (20%). The mean age was 53.3 years, with a wide range (18 to 85 years). Regarding sex, there was a clear predominance of males (80%) compared to females (20%).

Mortality in patients with healthcare-associated infections due to the use of mechanical ventilation.

Analysis of the final status of patients affected by ventilator-associated infections in Neiva's ICUs during 2023 reveals a critical situation. Of the 60 cases analyzed, only 20 patients (33.3%) survived, while 40 patients (66.7%) died, resulting in a case fatality rate of 66.7%.

The high mortality rate highlights the urgent need to strengthen prevention strategies, early diagnosis, and timely management of device-associated infections in critically ill patients, as well as the need to optimize comprehensive care for this particularly vulnerable group.

Table 2: Final status of the patients.

Final State	No. of Patients	%
Alive	20	33,3
Dead	40	66,7
Total	**60**	**100,0**
Lethality	0,67	66,7

Source: Researchers database

Underlying pathologies, by sex of patients who developed healthcare-associated infections due to the use of mechanical ventilation.

The association between different comorbidities and fatal outcomes in patients with ventilator-associated infections was assessed using 2x2 tables and odds ratio analysis, with the presence or absence of prior infection as the reference. The results show that certain underlying conditions significantly increased the risk of mortality.

The results showed that, when comparing mortality attributable to various comorbidities with that observed in patients with prior infection (reference group), prior infection stood out as the factor with the highest risk of lethality in the studied cohort. Factors such as cancer, malnutrition, immunosuppression, and obesity, although traditionally recognized as high-risk comorbidities, presented a significantly lower risk of death when compared to prior infection. This was reflected in odds ratios (OR) greater than 11 and relative risks (RR) of 9, with 95% confidence intervals that did not include the value of 1 and with statistically significant p-values ($p < 0.05$). This indicates that, for the analyzed population, the probability of death was considerably higher in patients with a history of prior ventilator-associated infection, above other relevant clinical conditions.

For their part, conditions such as chronic kidney disease, COPD, and trauma were also analyzed in comparison to prior infection, but did not reach statistical significance, suggesting that in this sample a clear difference in mortality risk could not be demonstrated between these factors and prior infection. In the case of patients with HIV/AIDS, there were no deaths, which led to very high OR and RR values, although with wide confidence intervals, reflecting the low frequency of outcomes in this subgroup.

In summary, the findings of this study highlight that the presence of a prior ventilator-associated infection is the leading risk factor for mortality in critically ill ICU patients in Neiva during 2023, even surpassing comorbidities commonly associated with a poor prognosis. These results underscore the need to strengthen strategies for the prevention, early diagnosis, and timely management of nosocomial infections in patients undergoing mechanical ventilation, as well as the importance of optimizing infection surveillance and control protocols in local ICUs to reduce mortality and improve clinical outcomes in this vulnerable group.

Table 3: Bivariate analysis of pathologies associated with mortality due to previous ventilator-associated infection.

Factor	Dead	Alive	Odds	IC	RR	IC	p	p (Fisher)
CÁNCER	1	39	11.32	1.36 – 94,25	9	1.20 – 67,27	0.0068	0.0143
MALNUTRITION	1	39	11.32	1.36 – 94,25	9	1.20 – 67,27	0.0068	0.0143
DIABETES	1	39	11.32	1.36 – 94,25	9	1.20 – 67,27	0.0068	0.0143
KIDNEY DISEASE	4	36	2.61	0.73 – 9,32	2.25	0.75 – 6,71	0.1297	0.2247
EPOC	3	37	3.58	0.89 – 14,39	3	0.88 – 1027	0.0603	0.1149
IMMUNOSUPPRESSED	1	39	11.32	1.36 – 94,25	9	1.20 – 67,77	0.0068	0.0143
VIH SIDA	0	40	23.23	1.30 – 416,29	18.23	1.09 – 303,94	0.0015	0.0024
TRAUMA	15	25	0.48	0.18 – 1,29	0.6	0.30 – 1,21	0.1432	0.2222
OBESITY	1	39	11.32	1.36 – 94,25	9	1.20 – 67,77	0.0068	0.0143
ANOTHER FACTOR	9	31	1	0.35 –2,86	1	0.44 – 2,26	1	1

Source: Researchers database

Discussion

The results of this research show a high mortality rate (66.7%) in adult patients who developed ventilator-associated infections in the Intensive Care Units (ICUs) of Neiva during 2023, exceeding that reported in previous international and national studies, where mortality from ventilator-associated pneumonia (VAP) generally ranges between 20% and 50% (13), although some surgical cohorts and systematic reviews have documented rates close to 65% (Mumtaz et al., 2023; Semet, 2023). This finding suggests that the studied population represents a very high-risk group, possibly due to the coexistence of factors such as delayed management, multidrug-resistant agents, and limitations in diagnostic resources, aspects also identified in the specialized literature. Notably, "previous infection" emerged in this analysis as the main predictor of mortality, surpassing the impact of classic comorbidities such as cancer, malnutrition or immunosuppression, which coincides with recent reports where nosocomial infections and their inadequate management, rather than underlying chronic conditions, determine the outcome in the ICU (Sadigov et al., 2019; Khan et al., 2017).

These findings are consistent with those reported by Rodríguez et al. (2025) in a ten-year retrospective analysis conducted in Spain, where the presence of nosocomial infections, and especially ventilator-associated pneumonia (VAP), was associated with a doubling of the hospital mortality rate, particularly in patients with pre-existing comorbidities. Similarly, Sadigov et al. (2019) reported that VAP is the leading cause of in-hospital mortality in critically ill patients, surpassing chronic diseases such as renal failure or cancer. In the present study, prior device-associated infection showed an even greater impact on mortality, which may be related to both the clinical severity of the analyzed population and contextual factors specific to the local hospital environment, including potential limitations in diagnostic and therapeutic resources (Kafazi et al., 2025; Indriasari et al., 2024).

Recent literature has underscored the relevance of antimicrobial resistance as an aggravating factor in the progression of ventilator-associated infections. A study by Sadigov et al. (2019) estimated that the presence of multidrug-resistant pathogens significantly increases mortality and the costs associated with ICU care, a result consistent with the high proportion of Klebsiella pneumoniae isolates and other multidrug-resistant organisms observed in our cohort. The lack of etiological identification in 45% of the cases in this study represents a significant limitation and could be linked to diagnostic delays, prolonged empirical treatments, or lack of access to specialized laboratory tests—phenomena also described by Rego et al. (2020) in Latin American contexts.

Regarding the demographic profile, the preponderance of male sex and advanced age as factors associated with higher mortality has been documented in other studies, which could be related to differences in immunity, the frequency of comorbidities, and exposure to occupational or environmental risk factors. Indriasari et al. (2024) reported this, stating that among patients with pulmonary vascular effusion (PVE) who died, 63.3% were men and the mean age was 61 years, suggesting that mortality tends to be concentrated in older male patients. In contrast, Li et al. (2024) reported that male sex is identified as an independent factor for developing PVE, attributing this difference to hormonal modulations in the immune response (e.g., the protective effects of estrogen versus the immunosuppressive effects of testosterone) and to a higher prevalence of risk factors (tobacco, alcohol) in men.
Thus, the present research provides local evidence that confirms the impact of prior infection as the main determinant of lethality in critically ill patients on mechanical ventilation, while emphasizing the importance of strengthening prevention, diagnosis, and comprehensive management actions in this context, in accordance with current international recommendations.

Conclusion

The study determined a case fatality rate of 66.7% in patients with ventilator-associated infections, a figure considerably higher than that reported in other national and international studies. Risk analysis showed that the presence of a prior infection was the greatest risk factor for death, with significantly higher odds ratios and relative risks compared to other comorbidities. These results reaffirm the importance of prior infection as a critical determinant of mortality and the need to implement interventions aimed at preventing and detecting this event early in ICUs.

Thus, the research confirms the severity of device-associated infections in critically ill patients undergoing mechanical ventilation, especially when there is a history of previous infection, and highlights the importance of strengthening infection surveillance, prevention, and control programs in the local hospital setting, with the aim of reducing mortality and improving the quality of healthcare.

Thus, the research confirms the severity of device-associated infections in critically ill patients undergoing mechanical ventilation, especially when there is a history of previous infection, and highlights the importance of strengthening infection surveillance, prevention, and control programs in the local hospital setting, with the aim of reducing mortality and improving the quality of healthcare.

Finally, the authors suggest promoting multicenter research and the exchange of experiences among different institutions in the country, in order to generate local and regional evidence that allows for comparing results, identifying areas for improvement, and adapting strategies to the specific needs of the Colombian context. Developing educational campaigns aimed at both healthcare personnel and patients and their families can contribute to strengthening a culture of safety and prevention in the hospital setting, positively impacting the reduction of mortality associated with nosocomial infections.

Declaration of Interests

The authors declare no conflicts of interest.

Contribution to Authorship

The authors were responsible for drafting the manuscript and approved the final version.

Ethical Approval Details

The study protocol was approved by the Ethics Committee of the Uninavarra Research and Innovation Center (CIINA).

Funding

None.

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