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ORIGINAL

Prevalence of multidrug-resistant microorganisms in patients admitted to the intensive care unit

Prevalencia de microorganismos multirresistentes en pacientes internados en la terapia intensiva

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ABSTRACT

Introduction: the objective of this study is to determine the characteristics observed in the analysis of the medical records of patients admitted to the intensive care unit of the Manuel Belgrano General Acute Care Hospital, during the period from 1 January to 30 June 2024. The study analyses multi-resistant microorganisms, the pathology of admission, the requirement for mechanical ventilation, the antibiotics used empirically and/or directed according to cultures and mortality.
Method: the methodology used is a retrospective and observational study to identify the microorganisms present in the intensive care unit of a hospital in a province of Buenos Aires. The main objectives are: 1. To evaluate the number of patients in intensive care with infection by multi-resistant microorganisms in the period from 1 January to 30 June 2024 at Manuel Belgrano Hospital. 2. To determine the types of multi-resistant microorganisms most frequently found in intensive care. 3. To assess the mortality of infected patients.
Results: the analysis included 28 patients hospitalised in the ICU from 1 January to 30 June 2024, with an average age of 58,3 years, of whom 70 % were men. The most common comorbidities were hypertension , chronic lung disease (26 %) and a history of cancer (22 %). The main pathogens identified were methicillin-resistant Staphylococcus aureus (15 %) and Acinetobacter baumannii (13 %). The most commonly used antibiotic treatments included meropenem and vancomycin, although 70 % of the cases presented resistance to multiple drugs, resulting in a mortality rate of 47 %. The average length of hospitalisation was 34 days, and 40 % of patients discharged required follow-up in specialised care. Respiratory failure affected 65 % of patients, with 50 % requiring mechanical ventilation.
Conclusions: this study has highlighted the complexities and challenges associated with infections caused by multidrug-resistant microorganisms in hospitalised patients. The high mortality rate highlights the urgent need for effective management and prevention strategies. Resistance to multiple antibiotics significantly affects treatment options, highlighting the importance of accurate diagnoses. In addition, the use of mechanical ventilation in a considerable number of patients indicates the severity of respiratory infections. It is essential to strengthen collaboration between multidisciplinary teams, implement rigorous infection control protocols and promote continuous education to face this growing challenge in medical care.

Keywords: Antibiotic; Invasive Mechanical Respiratory Assistance; Multiresistant Bacteria; Multiresistant Microorganisms; Sepsis; Intensive Therapy.

RESUMEN

Introducción: el objetivo de este estudio es determinar las características observadas en el análisis de las historias clínicas de los pacientes internados en la terapia intensiva del Hospital Zonal General de Agudos

Manuel Belgrano, durante el periodo del 1 de enero al 30 de junio de 2024. Se analiza los microorganismos multirresistentes, la patología de ingreso, requerimiento de ARM, los antibióticos utilizados de manera empírica y/o dirigida según cultivos y mortalidad.
Método: la metodología empleada es un estudio retrospectivo y observacional para identificar los microorganismos intrahospitalarios de la terapia intensiva de un hospital en una provincia de Buenos Aires. Los principales objetivos son:1. Evaluar la cantidad de pacientes en terapia intensiva con infeccion por microorganismo multirresistentes en el periodo del 1 de enero al 30 de junio de 2024 en el Hospital Manuel Belgrano. 2.Determinar los tipos de microorganismos multirresistentes, mas frecuentes en terapia intensiva. 3.Valorar la mortalidad de los pacientes infectados.
Resultados: el análisis incluyó a 28 pacientes hospitalizados en la UCI del 1 de enero al 30 de junio de 2024, con un promedio de edad de 58,3 años, donde el 70 % eran hombres. Las comorbilidades más comunes fueron hipertensión arterial (35 %), enfermedades pulmonares crónicas (26 %) y antecedentes de cáncer (22 %). Los principales patógenos identificados fueron Staphylococcus aureus resistente a la meticilina (15 %) y Acinetobacter baumannii (13 %). Los tratamentos antibioticos más utilizados incluyeron meropenem y vancomicina, aunque el 70 % de los casos presentaron resistencia a múltiples medicamentos, resultando en una mortalidad del 47 %. El tiempo promedio de hospitalización fue de 34 días, y el 40 % de los pacientes dados de alta necesitó seguimiento en cuidados especializados. La insuficiencia respiratoria afectó al 65 % de los pacientes, con el 50 % requiriendo ventilación mecánica.
Conclusiones: este estudio ha evidenciado las complejidades y desafíos asociados con las infecciones por microorganismos multirresistentes en pacientes hospitalizados. La alta tasa de mortalidad subraya la necesidad urgente de estrategias efectivas para el manejo y prevención. La resistencia a múltiples antibióticos afecta significativamente las opciones de tratamiento, destacando la importancia de diagnósticos precisos. Además, el uso de asistencia mecánica ventilatoria en un número considerable de pacientes indica la gravedad de las infecciones respiratorias. Es fundamental fortalecer la colaboración entre equipos multidisciplinarios, implementar protocolos rigurosos de control de infecciones y promover la educación continua para enfrentar este creciente desafío en la atención médica.

Palabras clave: Antibiótico; Asistencia Mecánica Respiratoria Invasiva; Bacterias; Multirresistentes; Microorganismos Multirresistentes; Sepsis; Terapia Intensiva.

INTRODUCTION

The San Martín district, located in Buenos Aires, Argentina, is home to a significant and diverse population, with approximately 422 830 inhabitants according to the latest national census in 2010.[1,2,3,4,5,6,7,8,9] This demographic context highlights the importance of analyzing population growth and other factors that could influence healthcare in the coming years. San Martín covers an area of approximately 55 km^2 and stands out for its geographical and cultural diversity, which positions it as a key urban center in the province.[9]

The Manuel Belgrano Hospital, an emblematic establishment in the district, offers various medical services. Founded in 1950 as a center specializing in pneumothisiology and transformed into an Acute Care Polyclinic Hospital in 1975, it has undergone significant expansion and modernization since its transfer to the province of Buenos Aires in 1979.[8,9] Currently, the hospital has 90 operational beds and more than 800 medical and support professionals,[9] providing inpatient services ranging from minimal to intensive care and specialties in maternity, neonatology, and pediatrics, among others.[6,7] In the emergency department, disciplines such as anesthesiology, surgery, and diagnostic imaging stand out, using high-tech equipment and advanced diagnostic methods.[7]

However, multidrug-resistant microorganisms are highly prevalent, especially in the Intensive Care Unit. These pathogens represent a serious problem in contemporary medical care, hindering the management of infections and increasing morbidity and mortality among critically ill patients. Multidrug-resistant bacteria, also known as “superbugs,” have acquired the ability to resist multiple classes of antibiotics, significantly complicating the treatment of bacterial infections.[1,2]

Recent research has demonstrated a worrying increase in the incidence of nosocomial infections caused by multidrug-resistant microorganisms, exacerbating the economic and health burden on healthcare systems. Therefore, it is essential to quantify the prevalence of these microorganisms in the ICU of Manuel Belgrano Hospital, identify the associated risk factors, and evaluate the clinical and epidemiological implications of these findings. This research aims to inform infection control policies and strategies for the rational use of antibiotics. It will also contribute to optimizing medical care in critical settings, which is essential in the fight against antimicrobial resistance.

Mechanical respiratory assistance, or mechanical ventilation, becomes crucial in managing ICU patients, especially those who cannot maintain adequate ventilation on their own.[4,5] This procedure uses specialized devices that apply positive pressure to the airways, facilitating lung expansion and the gas exchange necessary for the body.[4,5] Various ventilation modalities, including invasive and non-invasive, allow for more personalized and effective care, which is vital in critical situations.

In conclusion, Manuel Belgrano Hospital is an essential referral center for the local population, facing significant challenges related to antibiotic resistance and the growing prevalence of multidrug-resistant microorganisms. This research addresses these issues comprehensively, contributing to the understanding and improving medical care in this context.

METHOD

Design: observational, descriptive, cross-sectional study.

Population: the study population included all medical records of patients admitted to the ICU, aged over 18 years, between January 1 and June 30, 2024.

Setting: Manuel Belgrano Acute Care General Hospital

Inclusion criteria: to evaluate the characteristics of the study population, all medical records of patients in intensive care from January 1 to June 30, 2024, were included. These were patients over 18 years of age who presented infections caused by multidrug-resistant microorganisms. Both empirical and targeted antibiotic treatments and the medical records of men and women were analyzed, highlighting the diversity of the population and the complexity of clinical management in this context.

Exclusion criteria: all medical records of patients who were not admitted to intensive care from January to June 2024 were excluded.

Study biases and limitations: this study has limitations, such as its sample size of only 28 patients. In addition, the study did not address the influence of socioeconomic and demographic factors.

RESULTS

Antimicrobial resistance represents one of the most significant challenges in intensive care settings, where patients are often immunocompromised and have complex comorbidities. This study analyzed 28 patients admitted to the ICU who were diagnosed with infections caused by different multidrug-resistant pathogens. The results and detailed analysis of the data are presented below.

Patient Profile

Age range: patients ranged in age from 22 to 89, with a mean age of 58,3. The highest concentration of patients was in the 50 to 70 age range.

Gender: of the 28 patients, 70 % were male and 30 % were female.

Prevalent comorbidities:

Chronic lung disease (COPD): 26 % of patients.

Systemic arterial hypertension (SAH): 35 %.

Diabetes mellitus (DM): 17 %.

History of cancer: 22 %.

History of previous complex surgical procedures: 30 %.

Distribution of Pathogens and Percentage Frequency

The distribution of pathogens detected among patients was diverse, with the following percentages of occurrence:

Methicillin-resistant Staphylococcus aureus (MRSA): 15 % of cases.

Acinetobacter baumannii: 13 % of cases.

Pseudomonas aeruginosa: 11 % of cases.

Klebsiella pneumonia: 9 % of cases.

Klebiciela pneumoniae carbapenemase: 5 %

Stenotrophomonas maltophilia: 8 % of cases.

Bacteroides fragilis and other anaerobes: 5 % of cases.

Metallo-beta-lactamase-producing bacteria: 3,9 %

Tuberculosis is superinfected with pneumococcus.

Other pathogens (including combinations with Candida spp. and Gram-negative bacteria).

Analysis of Comorbidities and Relationship with Pathogens

The presence of chronic diseases increases the risk of infection by specific pathogens. For example:

Patients with COPD had a higher incidence of Pseudomonas aeruginosa and Staphylococcus aureus infections

(65 % of cases with COPD).

Patients with hypertension had infections more frequently associated with Klebsiella pneumoniae and Acinetobacter baumannii.

Cancer patients had a high prevalence of polymicrobial infections, often including MRSA.

Therapeutic Regimens and Efficacy Analysis

Therapeutic regimens varied according to the type of pathogen and the severity of the infection. The main treatments used were:

Meropenem + Vancomycin:

Used in 35 % of cases.

It is mainly used in patients with respiratory infections and sepsis.

Ceftazidime + Avibactam + Aztreonam:

Administered in 9 % of cases.

Linezolid + Colistin:

Used in 13 % of patients, mainly to combat multidrug-resistant Acinetobacter baumannii infections.

Antimycotics (for Koch's bacillus):

Used in patients with coinfections of tuberculosis and bacterial pathogens.

Mortality Rate and Associated Factors

The overall mortality rate among patients was 47 %. Factors contributing to adverse clinical outcomes included:

Severe respiratory failure: associated with 60 % of deaths.

Sepsis and septic shock: present in 75 % of cases with fatal outcomes.

Pre-existing conditions, Such as advanced cancer and heart failure, present in 35 % of cases that progress to death.

Postoperative patients

Statistical Analysis of Clinical Outcomes

Average length of stay in the ICU: 34 days total (range 14 to 90 days), not including days in intermediate care.

Percentage of patients requiring invasive mechanical ventilation (IMV): 83 %.

The success rate for complete recovery (without sequelae) is 25 %.

Considerations on Antimicrobial Resistance

Antimicrobial resistance was a determining factor in clinical outcomes, especially in infections caused by multidrug-resistant pathogens such as Acinetobacter baumannii and MRSA. The presence of carbapenem and beta-lactam resistance genes, such as KPC and MBL, complicated clinical management, requiring last-line combinations, such as colistin and ceftazidime-avibactam.

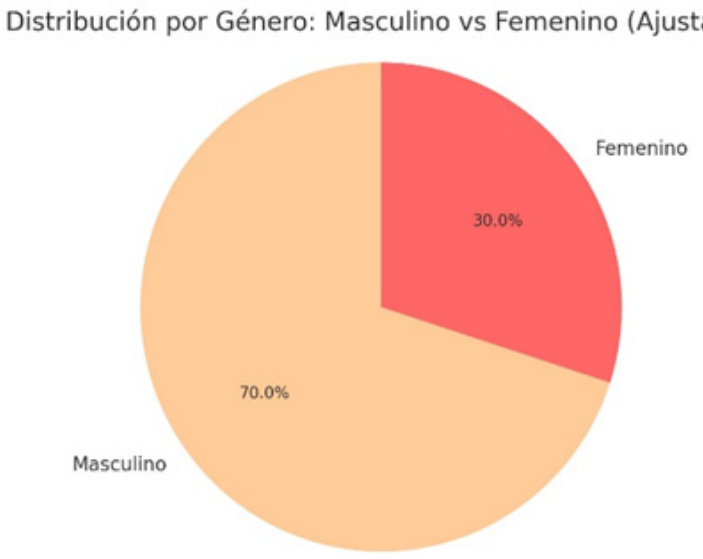

Figure 1. Distribution by gender

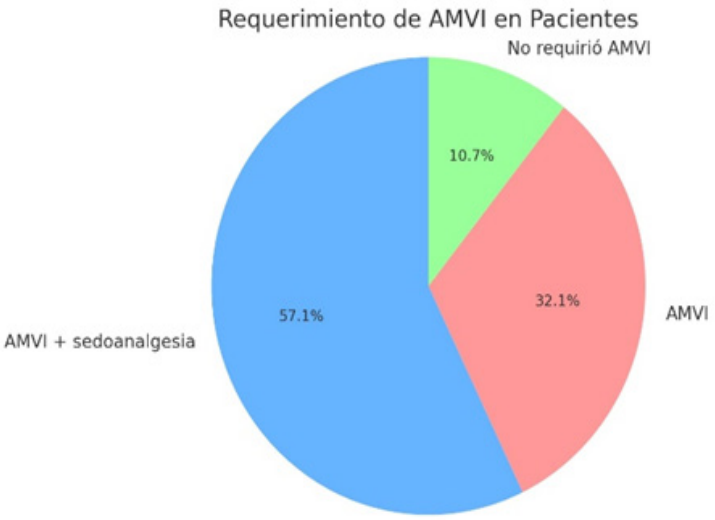

Figure 2. Requirement for invasive mechanical ventilation

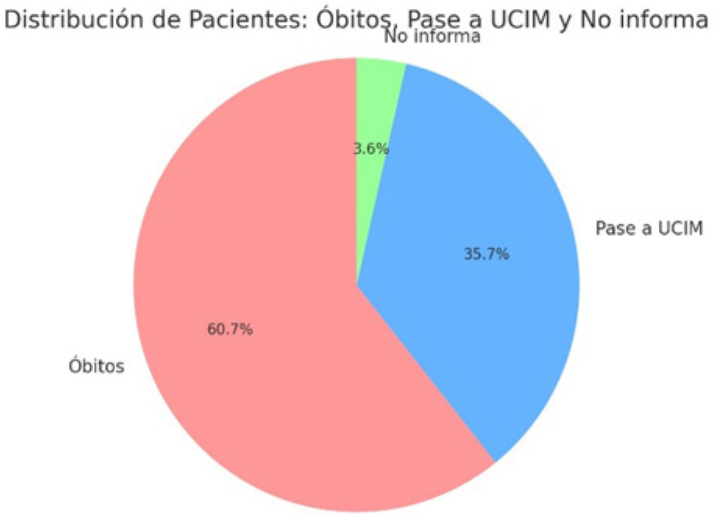

Figure 3. Mortality

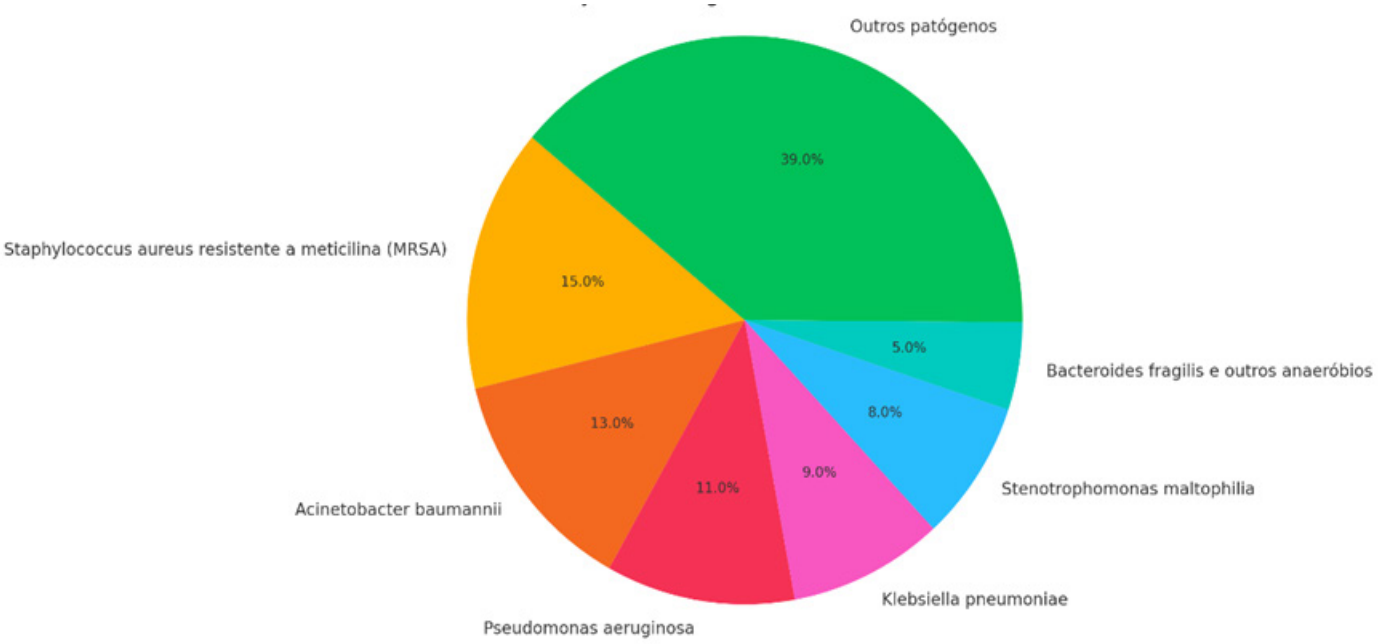

Figure 4. Distribution of pathogens in ICU patients

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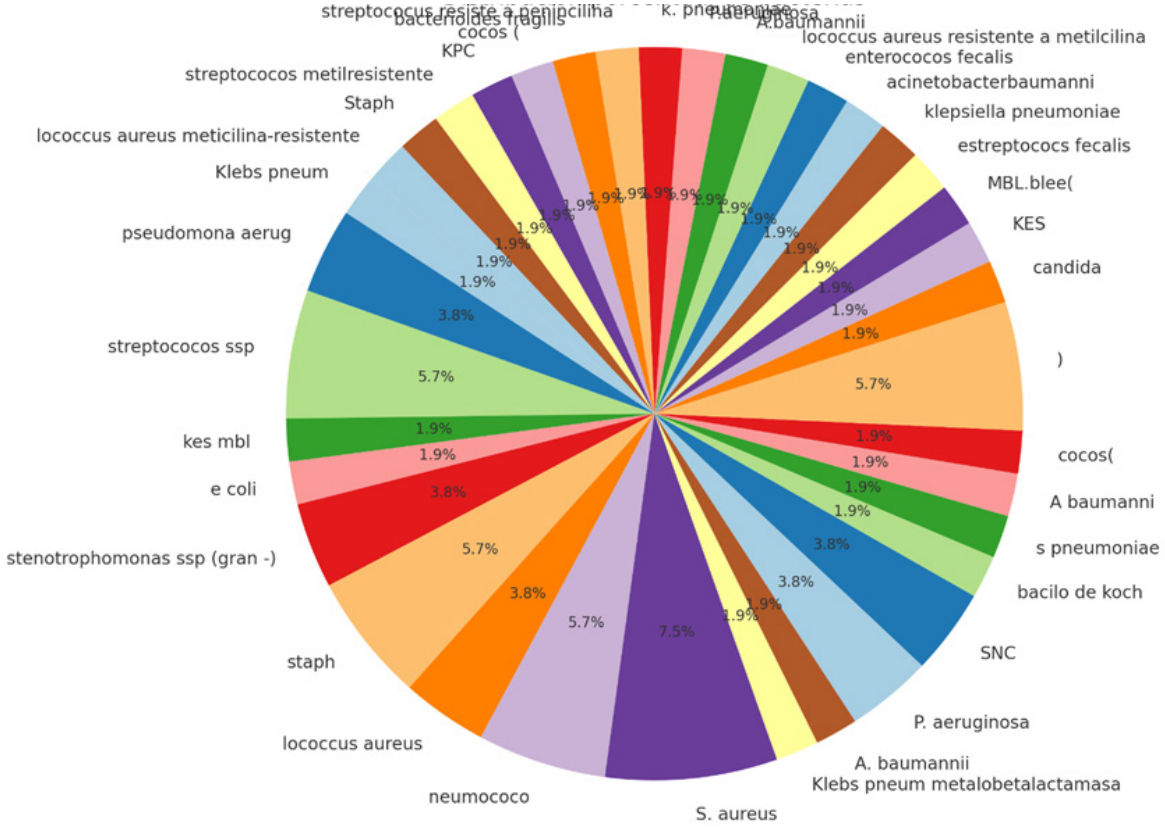

Figure 5. Shows the most accurate distribution of microorganisms in the ICU

DISCUSSION

This study analyzed 28 medical records of patients admitted to the ICU, highlighting the presence of infections caused by multidrug-resistant microorganisms, a growing concern in modern medicine. The main bacteria identified included Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter baumannii, all recognized for their resistance to multiple antibiotics. Data from the literature suggest that these bacteria are associated with high mortality rates and complications in critically ill patients, especially in intensive care settings.[10,11,12]

Patients present with various comorbidities, the most common being hypertension and diabetes mellitus, factors that can aggravate the severity of infections and the response to treatment. The prevalence of bilateral pneumonia and respiratory failure among the cases analyzed reflects the severity of respiratory diseases, which are frequently associated with worsening the patients' overall clinical condition.[13]

The mortality rate observed in this study was alarming, with several patients not responding adequately to antibiotic therapies. In particular, cases involving KPC (carbapenemase-producing Klebsiella pneumoniae) had an unfavorable outcome, corroborating previous studies reporting mortality rates above 50 % in infections caused by these resistant pathogens.[14]

The antibiotic regimens used were varied, but many patients received combinations of drugs, reflecting the need for empirical therapies in the face of resistance. Despite this, multidrug resistance was a constant, complicating the management of infections and emphasizing the urgency of new approaches to antibiotic research and development.[15]

CONCLUSIONS

The data obtained underscore the need to implement effective strategies for managing infections caused by multidrug-resistant pathogens, especially in vulnerable populations with high morbidity and mortality rates. The mortality observed highlights the severity of these infections and the need for a clinical response.

Establishing rigorous infection control protocols in hospital settings, including active surveillance of bacterial resistance and the judicious use of antimicrobials, is essential. Continuous training of healthcare personnel in antibiotic stewardship and infection control practices is crucial to reducing the incidence of nosocomial infections.

In conclusion, a multidisciplinary approach involving physicians, pharmacists, nurses, and other healthcare professionals is essential to combat the growing challenge of multidrug-resistant infections and improve clinical outcomes in hospitalized patients.

BIBLIOGRAPHIC REFERENCES

1. Arias CA, Murray BE. The rise of the Enterococcus: Beyond vancomycin resistance. Nat Rev Microbiol. 2012;10(4):266-78. doi:10.1038/nrmicro2761

2. Blair JM, Webber MA, Baylay AJ, Ogbolu DO, Piddock LJ. Molecular mechanisms of antibiotic resistance. Nat Rev Microbiol. 2015;13(1):42-51. doi:10.1038/nrmicro3380

3. MedlinePlus. Ventilación mecánica. https://medlineplus.gov/spanish/ency/article/007198.htm

4. National Heart, Lung, and Blood Institute (NHLBI). Mechanical Ventilation. https://www.nhlbi.nih.gov/health-topics/mechanical-ventilation

5. Nikaido H, Pages JM. Broad-specificity efflux pumps and their role in multidrug resistance of Gram-negative bacteria. FEMS Microbiol Rev. 2012;36(2):340-63. doi:10.1111/j.1574-6976.2011.00290.x

6. Poole K. Pseudomonas aeruginosa: Resistance to the max. Front Microbiol. 2011;2:65. doi:10.3389/fmicb.2011.00065

7. Society of Critical Care Medicine (SCCM). What is an ICU?. https://www.sccm.org/ICU

8. American College of Chest Physicians (CHEST). Intensive Care Unit (ICU) - Overview. https://www.chestnet.org/patient-education/guidelines/intensive-care-unit-icu

9. World Health Organization (WHO). Antimicrobial resistance. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

10. Hospital General Belgrano. Estadísticas. https://www.ms.gba.gov.ar/sitios/hbelgrano/estadisticas/

11. Hospital General Belgrano. Indicadores de Producción 2018-2019. https://www.ms.gba.gov.ar/sitios/hbelgrano/wp-content/uploads/sites/169/2024/04/INDICADORES-DE-PRODUCCION-2018-2019.pdf

12. Treatment Options for Carbapenem-Resistant Enterobacteriaceae Infections. Clin Infect Dis. 2018;66(3):444-53.

13. Epidemiology and outcomes of pneumonia caused by multidrug-resistant bacteria. Infect Drug Resist. 2020;13:1731-40.

14. The difficult-to-treat resistance of Klebsiella pneumoniae: the story of a multi-resistant pathogen. Clin Microbiol Infect. 2011;17(10):1293-301.

15. H W, et al. Bad Bugs, No Drugs: No Evolving Strategies for Multidrug-Resistant Gram-Negative Infections. Clin Infect Dis. 2009;48(1):1-12. Surgery. 2015;67(1):3-9.

FINANCING

None.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Gabriela Pinto Coelho do Valle, Sandra Arcieri.
Data curation: Gabriela Pinto Coelho do Valle, Sandra Arcieri.
Formal analysis: Gabriela Pinto Coelho do Valle, Sandra Arcieri.
Drafting - original draft: Gabriela Pinto Coelho do Valle, Sandra Arcieri.
Writing - proofreading and editing: Gabriela Pinto Coelho do Valle, Sandra Arcieri.