

INCIDENCE AND RISK FACTORS ASSOCIATED WITH MULTIDRUG- RESISTANT PATHOGENS IN INTENSIVE CARE UNITS (ICUS)

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Abstract: Objective: Analyze the prevalence of multidrug-resistant pathogens in intensive care units, identifying and evaluating risk factors associated with the acquisition of these infections, to inform prevention and control strategies. **Methodology:** Narrative bibliographic review study where research was carried out in the PubMed - MEDLINE database with the terms (Bacterial Multidrug Resistance Infection) AND ((ICU patients) OR (Intensive Care Unit patients)), from which 22 articles were selected that met the study proposal after applying the pre-determined selection criteria. **Review:** In intensive care units (ICUs), due to invasive procedures and prolonged use of antibiotics, we have a problem of great global public health concern, which are infections caused by multidrug-resistant microorganisms (MDI). The spread of these pathogens is influenced by several factors such as prolonged exposure to hospital environments, indiscriminate use of antibiotics, and invasive medical interventions that increase the likelihood of infections associated with multidrug-resistant pathogens. The implementation of strict hygiene measures combined with outbreak control and appropriate use of antibiotics are essential to reduce the incidence and impact of multidrug-resistant infections in ICU patients. **Final considerations:** The control and implementation of measures to promote the appropriate use of antimicrobials together with strict hygiene and decontamination measures are essential for combating antimicrobial resistance.

Keywords: Bacterial Multidrug Resistance Infection, ICU patients, Intensive Care Unit patients.

INTRODUCTION

Infections caused by multidrug-resistant microorganisms (MDI) represent a serious public health problem on a global scale. Due to the difficulty of effective treatment, IMM often results in prolonged hospital stay and can lead to serious outcomes, including death (Cekin, Oncul, Bayraktar, 2023). Patients in intensive care units (ICU) are particularly susceptible to IMM due to the invasive procedures and intensive treatments they require. The indiscriminate and prolonged use of antibiotics, among other factors, significantly contributes to the selection of these resistant pathogens (Golli et al., 2022).

Studies have shown that MRSA infection in ICUs shows a notable gender difference, where male and female patients have almost equal incidences upon admission, while females are more affected during their hospital stay (Zaha et al., 2019). Furthermore, contaminated surfaces around patients function as reservoirs of bacteria, directly influencing the incidence of Healthcare-Associated Infections (HAIs) (Woźniak et al., 2024). Risk factors such as demographic characteristics, comorbidities and the use of invasive procedures are associated with an increased risk of infection or colonization (Dantas et al., 2019).

The introduction of improved patient care protocols and decontamination of equipment in the ICU can be effective preventive measures against infections caused by multidrug-resistant strains (Woźniak et al., 2024). Although many advances have been made in terms of therapies and protocols in intensive care units, there are still significant gaps in knowledge regarding the best therapy in patients requiring prolonged use of antibiotics, a practice that continues to pose an imminent risk to public health. Several risk factors for multidrug-resistant germs, such as hemodialysis catheters, central access, mechanical ventilation and the use of fomites,

are essential for maintaining hemodynamic stability in critically ill patients, but they also represent important challenges. The lack of robust data on how to manage these essential risk factors and the best therapy to apply suggests the need for further investigation.

Studies on infection by multidrug-resistant pathogens in ICUs have shown that the most common bacteria are gram-negative (59.4%) and gram-positive (36.9%), followed by *Candida* and anaerobes, with an average of resistance to antibiotics of 41.26% (Cekin; Oncul; Bayraktar, 2023). These studies reveal the frequency, resistance patterns and risk factors associated with blood infections caused by multidrug-resistant bacteria in hospitals, especially in ICUs, and highlight the urgent need for early identification, appropriate antibiotic therapy and effective prevention measures. This review aims to analyze the prevalence of multidrug-resistant pathogens in intensive care units, identifying and evaluating risk factors associated with the acquisition of these infections, to inform prevention and control strategies.

While most studies focus on the influence of risk factors on infections, it is equally important to consider predicting the acquisition of resistance, including the colonization that often precedes infections.

METHODOLOGY

Bibliographic review developed according to the criteria of the PVO strategy, an acronym that represents: population or research problem, variables and outcome. Used to prepare the research through its guiding question: "What is the incidence of infections due to multidrug-resistant pathogens in ICUs and what are the main risk factors associated with these infections?". The searches were carried out through searches in the PubMed-MEDLINE (Medical Literature Analysis and Retrieval System Online) database. The

descriptors were used in combination with the Boolean terms “AND” or “OR” through the following search strategy: (Bacterial Multidrug Resistance Infection) AND ((ICU patients) OR (Intensive Care Unit patients)). From this search, 793 articles were found, subsequently submitted to the selection criteria. The inclusion criteria were: articles in English; published between 2019 and 2024 and which addressed the themes proposed for this research, review-type studies, meta-analyses, observational studies, clinical trials, available in full. The exclusion criteria were: duplicate articles, available in abstract form, which did not directly address the proposal studied and which did not meet the other inclusion criteria. After applying the search strategy to the researched database and initial screening, a total of 59 potential articles were found. After applying the inclusion and exclusion criteria, 22 articles were selected to compose the collection of the present study.

DISCUSSION

The spread of multidrug-resistant pathogens in Intensive Care Units (ICUs) represents a significant challenge to global health. As highlighted by Sana et al. (2021) and Blasiis et al. (2024), *Acinetobacter baumannii* is responsible for 3 to 6% of nosocomial infections worldwide. Its resistance to multiple antibiotics, including carbapenems, highlights its ability to become a global concern in ICU settings (Dantas et al., 2019; Boral et al., 2019). The increase in the prevalence of multidrug-resistant pathogens reflects the expansion of antimicrobial resistance globally. Invasive procedures, prolonged use of antibiotics, and inadequate infection control practices are primary factors contributing to this spread (Tschudin-Sutter et al., 2021).

Resistance to carbapenems, considered last-line antibiotics, significantly complicates the treatment of these infections. To address

these challenges, it is crucial to implement comprehensive infection prevention strategies, promote evidence-based antibiotic prescribing practices, and strengthen antimicrobial resistance surveillance. Global and regional collaboration is also essential to address infections with multidrug-resistant pathogens in ICUs (El-Sokkary et al., 2021).

To understand the epidemiology of these pathogens and implementing effective measures are fundamental steps to reducing the spread of antimicrobial resistance, improving patient clinical outcomes, and ensuring the effectiveness of treatments in ICU settings. Epidemiological data offer valuable insights into resistance trends, underlining the urgent need for effective approaches to control these infections (Calvo; Stefani; Migliorisi, 2024).

It is imperative to recognize that antimicrobial resistance is a global problem that requires a collaborative and comprehensive approach. Strict infection control measures, promoting the rational use of antibiotics and continued surveillance are vital to address this growing threat.

Furthermore, continued education of healthcare professionals, the development of evidence-based prescribing protocols, and ongoing research are essential to identify new therapeutic strategies. A deep understanding of the epidemiology of multidrug-resistant pathogens is crucial to guide effective healthcare policies and ensure patient safety in critical hospital settings (Tomazini et al., 2023).

Multidrug-resistant pathogens are defined as non-susceptible to at least one agent across three or more different classes of antimicrobials (Zaha et al., 2019). Infections with multidrug-resistant pathogens represent a recognized threat to public health, leading to increased hospitalization, higher healthcare costs, and greater patient morbidity and mortality (Tschudin-Sutter et al., 2021; El-Sokkary et

al., 2021). The prevalence of these pathogens in ICUs varies globally, with an average of 47.8% multidrug resistance (El-Sokkary et al., 2021).

Calvo, Stefani and Migliorisi (2024) highlight that, in ICUs, gram-negative bacteria dominate, with *Klebsiella pneumoniae* being the most common, followed by *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. Regarding gram-positive bacteria, *Staphylococcus aureus* and *Enterococcus* are prevalent. The resistance of gram-negative bacteria is mainly related to the use of third-generation cephalosporins and carbapenems, while *A. baumannii* and *P. aeruginosa* are the main isolates resistant to carbapenems. MRSA and vancomycin-resistant *Enterococcus* present similar challenges in treating infections.

The review by Bassetti, Pecori, and Peghin (2016) confirms these findings by reporting that in Italy, *K. pneumoniae* is a growing threat, with 25-50% of isolates resistant to carbapenems. *Escherichia coli*, *P. aeruginosa* and *A. baumannii* also show high levels of resistance to antibiotics, including carbapenems. The epidemiological analysis by El-Sokkary et al. (2021) reveals a relationship between resistance patterns and infectious origin, with hospital infections associated with higher rates of resistance. Standardization of reporting and treatment practices for patients carrying multidrug-resistant pathogens may be necessary to prevent their spread across borders. Although analyzing epidemiological data can be challenging due to regional and economic heterogeneity, initiatives such as IMPACTO-MR in Brazil help store and analyze this data to improve understanding and control of such conditions (Tomazini et al., 2023).

In ICU environments, it is imperative to identify and analyze clinical and environmental risk factors for the acquisition of multidrug-

resistant pathogens, aiming for effective management of infections. Factors such as the indiscriminate use of antibiotics, the length of stay in the ICU and the performance of invasive procedures are significant determinants of risk. Furthermore, health conditions that compromise the patient's immune system increase this likelihood (Sakagianni et al., 2022; Lepape et al., 2020). Prolonged exposure to hospital environments and interventions such as intubation and insertion of medical devices also contribute to the increased risk of infections associated with multidrug-resistant pathogens (Lepape et al., 2020). The influence of hygiene conditions, both for patients and the hospital environment, is crucial in preventing the spread of these infections (Han et al., 2022). The implementation of strict hygiene measures and effective outbreak control plays a fundamental role in reducing the incidence and impact of multidrug-resistant infections in ICU patients, highlighting the importance of strategies adapted to this specific clinical reality (Han et al., 2022).

Furthermore, the indiscriminate use of antibiotics is a significant risk factor as it can select resistant bacterial strains. The length of ICU stay is correlated with a greater risk of multidrug-resistant infections due to prolonged exposure to hospital environments and invasive procedures. Patients undergoing procedures such as intubation, insertion of central venous catheters, and bladder catheters are more likely to develop device-associated infections, often caused by multidrug-resistant pathogens (Sakagianni et al., 2022). Hygiene conditions, both for patients and the hospital environment, play a critical role in preventing the spread of multidrug-resistant infections, highlighting the importance of rigorous hand washing practices, disinfecting equipment and surfaces, and controlling outbreaks within the ICU (Wu et al., 2022; Han et al., 2022).

The identification of risk factors, such as age, presence of chronic diseases and use of devices, is crucial to guide empirical antimicrobial therapy and seek strategies to prevent and control multidrug-resistant infections (Burillo, Muñoz and Bouza, 2019). Colonization by pathogens such as multidrug-resistant gram-negative bacteria (MDR-GN) and multidrug-resistant *Acinetobacter baumannii* (MDR-Ab) from admission significantly increases the risk of mortality during hospitalization (Burillo, Muñoz, and Bouza, 2019).

Strategies for the prevention and control of multidrug-resistant infections are essential to mitigate the impact of these infections on public health and improve clinical outcomes for patients. They include the implementation of rational antibiotic use programs, adoption of guideline-based prescribing protocols, regular monitoring of antibiotic use, and ongoing education of healthcare professionals on the appropriate management of antimicrobial agents (Sakagianni et al., 2022; Han et al., 2022). Furthermore, promoting adequate hygiene practices, such as hand washing, use of personal protective equipment, and regular cleaning and disinfection of surfaces and equipment, is crucial to prevent the spread of multidrug-resistant pathogens in the hospital environment. Implementing infection control measures, such as isolation of colonized or infected patients, active screening of asymptomatic carriers, and epidemiological surveillance of outbreaks, also plays a crucial

role in preventing the spread of multidrug-resistant infections (Lepape et al., 2020; Wu et al., 2022).

FINAL CONSIDERATIONS

To understand the environmental and clinical risk factors for the acquisition of multidrug-resistant pathogens in ICUs is essential for the management and prevention of infections in this critical environment. Prevention strategies made up of appropriate patient care protocols, ranging from the application of strict hygiene measures and decontamination of equipment to the implementation of programs for the rational use of antibiotics and the collaboration of the entire interdisciplinary network that operates in ICUs, are of vital importance for the outcome of each care, remembering that the prevention and control of multidrug-resistant infections require a continuous and joint effort from all professionals involved with the patient.

There is a relationship between resistance patterns and infectious origin, with hospital infections associated with higher rates of resistance. Standardization of reporting and treatment practices for patients carrying multidrug-resistant pathogens may be necessary to prevent their spread across borders. Implementing infection control measures, promotion and rational use of antibiotics together with continuous surveillance are essential to face the challenge of antimicrobial resistance.

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