

INFECTIONS CAUSED BY MULTIDRUG-RESISTANT MICROORGANISMS IN CRITICALLY ILL PATIENTS: CLINICAL, ECONOMIC, AND HEALTHCARE IMPACTS ON THE SUS

 <https://doi.org/10.63330/aurumpub.058-008>

**Cristiane Fonseca Freitas¹, Fagner de Camargo Gonçalves², Ana Paula Carneiro de Sousa Silva³,
Karina Barbosa Pinheiro⁴, Cleverson José Ferreira Araújo⁵ and Edna Aparecida Rosa⁶**

Abstract

Infections caused by multidrug-resistant microorganisms represent one of the main contemporary challenges for healthcare, especially among critically ill patients admitted to intensive care units. This study aimed to analyze the clinical, economic, and healthcare impacts of infections caused by multidrug-resistant microorganisms within the context of the Brazilian Unified Health System (SUS). This is a narrative literature review conducted through the analysis of national and international scientific publications available in indexed health databases, as well as institutional documents related to infection control and antimicrobial resistance. The results showed that the dissemination of these agents is associated with increased morbidity and mortality, prolonged hospital stays, greater need for intensive support, and higher hospital costs resulting from the use of more complex therapies and expanded consumption of healthcare resources. A significant impact on hospital management was also observed,

¹ Degree in Pharmacy-Biochemistry from UNIFAL
Specialization in Microbiology from PUC Minas
Master's Degree in Pharmacology from FCM - UNICAMP
PhD in Pharmacology from FCM - UNICAMP
Postdoctoral studies at FCM - UNICAMP

² Nursing Student, Universidade Estadual do Centro Oeste do Paraná, Guarapuava - Paraná
E-mail: fagner.enf.unicentro@gmail.com

³ Bachelor's Degree in Biomedicine
Fortaleza - Ceará
E-mail: enrico jose.81@outlook.com

⁴ Fortaleza
E-mail: karinabarbosa1512@gmail.com

⁵ Nursing
Universidade Estadual do Centro Oeste
Guarapuava - PR
E-mail: cleverson654321@outlook.com

⁶ Undergraduate Nursing Student - IMEPAC
Araguari - MG
E-mail: ednaaprosa36@gmail.com

with overload of healthcare teams and challenges in the effective implementation of prevention and control protocols. It is concluded that addressing infections caused by multidrug-resistant microorganisms requires integrated strategies involving epidemiological surveillance, antimicrobial stewardship programs, strengthening of patient safety practices, and structural investments in the SUS.

Keywords: Brazilian Unified Health System, Critically ill patients, Healthcare, Infection control, Microbial resistance.

INTRODUCTION

Healthcare-associated infections (HAIs) constitute an important public health problem on a global scale, especially when associated with the spread of multidrug-resistant microorganisms (MDRMs). The increase in antimicrobial resistance has been recognized as a growing threat to therapeutic effectiveness, directly affecting clinical outcomes, healthcare costs, and the sustainability of health systems (World Health Organization, 2023). Among critically ill patients admitted to intensive care units (ICUs), this scenario becomes even more concerning due to greater clinical vulnerability, the frequent presence of invasive procedures, and the intensive use of antimicrobials.

Microbial resistance is understood as the acquired or natural capacity of microorganisms to survive the action of drugs that were previously effective in controlling or eliminating them (PAHO, 2021). Among the main agents associated with infections in critical care settings are bacteria such as *Acinetobacter baumannii*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus aureus*, which are frequently related to increased clinical severity, higher morbidity and mortality, and longer hospital stays (Magiorakos et al., 2012).

In the Brazilian context, the Unified Health System (SUS) faces significant challenges in light of the growing incidence of these infections, especially because of the need to expand resources allocated to treatment, acquire higher-cost antimicrobials, and strengthen prevention and control measures. In addition

to the financial impact, repercussions are observed in the quality of care, prolonged bed occupancy, and increased demand for specialized care (ANVISA, 2023).

Given this context, the following research problem is established: what are the clinical, economic, and healthcare impacts resulting from infections caused by multidrug-resistant microorganisms in critically ill patients treated within the scope of the Unified Health System?

The general objective of this study is to analyze the clinical, economic, and healthcare impacts of infections caused by multidrug-resistant microorganisms in critically ill patients in the SUS. The specific objectives are to identify the main microorganisms associated with infections in critically ill patients; discuss the clinical repercussions related to morbidity and mortality and prolonged hospitalizations; assess the economic impacts on hospital services; and understand healthcare strategies aimed at preventing and controlling microbial resistance.

The development of this study is justified by the epidemiological, scientific, and social relevance of the topic, considering that antimicrobial resistance has been identified as one of the greatest contemporary challenges for health systems. According to O'Neill (2016), without effective interventions, resistant infections may become an important cause of mortality and increased global healthcare costs in the coming decades. In the context of the SUS, understanding the impacts of these infections is essential to support decisions related to care planning, epidemiological surveillance, and the qualification of care.

In the theoretical field, different studies indicate that integrated strategies involving antimicrobial stewardship programs, infection control, continuing education for teams, and the strengthening of public policies have the potential to reduce adverse events and improve healthcare indicators (Allegranzi et al., 2017). Thus, discussing the problem of infections caused by multidrug-resistant microorganisms in critically ill patients is essential to promote greater efficiency in health services and the sustainability of the SUS.

METHODOLOGY

TYPE OF RESEARCH

The present study is characterized as an integrative literature review, a methodological approach that allows the gathering, analysis, and synthesis of research results on a given topic, enabling a broad understanding of the knowledge produced and favoring the incorporation of scientific evidence into health practice. As proposed by Souza, Silva, and Carvalho (2010), this method contributes to integrating studies with different designs and expanding the critical analysis of the phenomenon under investigation.

The choice of the integrative review is justified by the need to comprehensively understand the clinical, economic, and healthcare impacts related to infections caused by multidrug-resistant microorganisms in critically ill patients treated in the Unified Health System (SUS), considering the multiplicity of factors involved in antimicrobial resistance.

SEARCH STRATEGY AND DATA SOURCES

The review was constructed through a bibliographic survey in databases recognized in the health field, selected for their scientific relevance and thematic scope. Publications indexed in the Virtual Health Library (VHL), Latin American and Caribbean Health Sciences Literature (LILACS), Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE/PubMed), and official institutional documents related to the topic were considered.

To define the search terms, standardized Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH) were used, combined with the Boolean operators AND and OR. Among the main descriptors employed were: “microbial resistance,” “critically ill patients,” “hospital infection,” “intensive care unit,” “multidrug-resistant organisms,” and “Unified Health System.”

According to Mendes, Silveira, and Galvão (2008), the use of systematized search strategies contributes to greater methodological rigor and reduces bias in the selection of evidence.

ELIGIBILITY CRITERIA

Previously defined inclusion and exclusion criteria were adopted for the composition of the bibliographic sample.

Inclusion criteria

Studies were included if they:

- addressed infections caused by multidrug-resistant microorganisms in critically ill patients;
- presented a relationship with clinical, economic, or healthcare impacts;
- were available in full text;
- were published in Portuguese, English, or Spanish;
- were published within the period previously established for analysis.

Exclusion criteria

The following were excluded:

- articles duplicated across databases;
- studies with no direct relationship to the research objective;
- editorials, letters to the editor, simple abstracts, and works without full-text availability;
- publications without sufficient methodological detail.

The adoption of these criteria aimed to increase the scientific consistency of the findings and ensure greater reliability in the analysis process.

DATA COLLECTION, ORGANIZATION, AND ANALYSIS

After the initial selection of studies, an exploratory reading of titles and abstracts was carried out, followed by a full reading of the eligible texts. The extracted information included author, year of

publication, objective, method employed, main results, and contributions to understanding the impacts of infections caused by multidrug-resistant microorganisms.

Data analysis was conducted through descriptive synthesis and critical interpretation of the literature, allowing the identification of convergences and divergences among the selected studies. According to Bardin (2016), the thematic organization of findings favors the systematic interpretation of content and the construction of grounded inferences.

METHODOLOGICAL FOUNDATION AND DISCUSSION OF THE METHOD

The integrative review was adopted because it allows a broad approach to a complex and multifactorial problem, such as antimicrobial resistance in critically ill patients. This method favors the articulation of different scientific evidence and makes it possible to identify trends, gaps, and contributions to the strengthening of public health policies.

According to Whittemore and Knafl (2005), integrative reviews have the potential to consolidate knowledge and support clinical and managerial decision-making. In the context of the SUS, understanding the effects of infections caused by multidrug-resistant microorganisms is essential to support epidemiological surveillance strategies, the rational use of antimicrobials, and the qualification of hospital care.

RESULTS AND DISCUSSION

The findings of the present integrative review show that infections caused by multidrug-resistant microorganisms in critically ill patients constitute one of the main patient safety problems in intensive care units, with significant impacts on morbidity and mortality, length of hospital stay, and hospital costs. The literature demonstrates that the combination of patients' clinical severity, frequent use of invasive devices, and prolonged exposure to antimicrobials favors the selection of resistant microorganisms, especially in highly complex hospital settings (World Health Organization, 2023).

The studies analyzed indicate a predominance of multidrug-resistant Gram-negative microorganisms, especially *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*, in addition to methicillin-resistant *Staphylococcus aureus* (MRSA). These agents are frequently associated with severe infections, such as ventilator-associated pneumonia, bloodstream infections, and sepsis, and they have a high capacity for environmental persistence and resistance to multiple classes of antimicrobials.

The distribution of the main microorganisms identified in the analyzed literature is presented below.

Table 1

Main multidrug-resistant microorganisms in critically ill patients

Microorganism	Type	Main infections	Clinical relevance
<i>Klebsiella pneumoniae</i>	Gram-negative	Pneumonia, sepsis, UTI	High resistance to carbapenems
<i>Acinetobacter baumannii</i>	Gram-negative	Ventilator-associated pneumonia	High hospital persistence
<i>Pseudomonas aeruginosa</i>	Gram-negative	Respiratory and systemic infections	High environmental adaptability
<i>Staphylococcus aureus</i> (MRSA)	Gram-positive	Skin and bloodstream infections	Methicillin resistance

Source: Prepared by the authors, based on Magiorakos et al. (2012).

Magiorakos et al. (2012) emphasize that these microorganisms are classified as priorities by the World Health Organization due to their high resistance and significant clinical impact, especially in critical hospital environments.

Regarding clinical impacts, it is observed that infections caused by multidrug-resistant microorganisms are associated with increased mortality, a higher incidence of severe sepsis, the need for prolonged ventilatory support, and therapeutic failures. These factors contribute to the worsening of clinical outcomes and to the increased complexity of care in ICUs.

Table 2

Clinical impacts of infections caused by multidrug-resistant microorganisms

Clinical impact	Description	Healthcare consequence
Increased mortality	Greater risk of death in critically ill patients	Need for prolonged intensive care
Severe sepsis	Exacerbated systemic inflammatory response	Use of last-line antibiotics
Prolonged hospitalization	Longer hospital stay	Reduced bed turnover
Therapeutic failure	Resistance to multiple antimicrobials	Need for rescue therapies

Source: Prepared by the authors, based on World Health Organization (2023).

In addition to clinical impacts, the results reveal important economic and healthcare repercussions within the Unified Health System (SUS). Increased costs are mainly related to the use of high-cost antimicrobials, the need for patient isolation, and prolonged hospitalization in intensive care units. This scenario results in overburdened health services and reduced bed availability.

Table 3

Economic and healthcare impacts on the SUS

Dimension	Observed impact	Consequence for the health system
Economic	Increased costs with antimicrobials	Higher hospital expenditure per patient
Healthcare	Overload of healthcare teams	Reduced quality of care
Structural	Prolonged ICU bed occupancy	Lower hospital turnover
Organizational	Need for patient isolation	Pressure on hospital infrastructure

Source: Prepared by the authors, based on the Brazilian Health Regulatory Agency – ANVISA (2023).

According to ANVISA (2023), microbial resistance represents a growing threat to the sustainability of health systems, requiring structured infection prevention and control policies, as well as the strengthening of epidemiological surveillance.

The integrated discussion of the findings shows that the problem goes beyond the clinical dimension, affecting structural and organizational aspects of health services. Studies indicate that the implementation of antimicrobial stewardship programs, associated with rigorous infection control

measures, can significantly reduce the dissemination of multidrug-resistant microorganisms and improve clinical outcomes (Allegranzi et al., 2017).

Furthermore, the literature reinforces the importance of hand hygiene, the rational use of invasive devices, and adherence to isolation protocols as fundamental prevention measures. Mendes, Silveira, and Galvão (2008) emphasize that the integration of scientific evidence and clinical practice is essential for improving care quality and reducing adverse events.

Thus, it is observed that infections caused by multidrug-resistant microorganisms in critically ill patients represent a systemic challenge for the SUS, requiring integrated actions involving clinical management, epidemiological surveillance, and public health policies aimed at the sustainability of care and patient safety.

CONCLUSION

The present study aimed to analyze the clinical, economic, and healthcare impacts of infections caused by multidrug-resistant microorganisms in critically ill patients within the context of the Unified Health System (SUS). Overall, the findings of the integrative review demonstrated that these infections represent an important public health problem, especially in intensive care units, where patients' clinical severity and the high use of invasive devices favor the dissemination of resistant microorganisms.

The main results showed that infections caused by multidrug-resistant microorganisms are associated with increased mortality, a higher incidence of severe sepsis, prolonged hospital stays, and therapeutic failures due to the limitation of effective antimicrobial options. In addition, a significant impact on the health system was observed, with increased hospital costs, greater consumption of high-cost antimicrobials, and overload of healthcare teams, compromising the efficiency and response capacity of the SUS.

In view of this, it is concluded that antimicrobial resistance constitutes a complex and multifactorial challenge that goes beyond the clinical dimension and directly affects the economic and

organizational aspects of health services. The contributions of this research reinforce the importance of integrated infection prevention and control strategies, with emphasis on the rational use of antimicrobials, strict adherence to hygiene practices, and the implementation of effective epidemiological surveillance programs.

As a suggestion for future studies, the development of field research and multicenter studies within the scope of the SUS is recommended, capable of more accurately quantifying the costs associated with infections caused by multidrug-resistant microorganisms, as well as evaluating the effectiveness of specific infection-control interventions in intensive care units.

REFERENCES

- Alleganzi, B. et al. *Health-care associated infection in intensive care units: global perspectives*. Geneva: World Health Organization, 2017.
- Agência Nacional de Vigilância Sanitária (ANVISA). *Segurança do paciente e controle de infecções relacionadas à assistência à saúde* [Patient safety and control of healthcare-associated infections]. Brasília: ANVISA, 2023.
- Bardin, L. *Análise de conteúdo* [Content analysis]. São Paulo: Edições 70, 2016.
- Magiorakos, A. P. et al. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. *Clinical Microbiology and Infection*, v. 18, n. 3, p. 268–281, 2012.
- Mendes, K. D. S.; Silveira, R. C. C. P.; Galvão, C. M. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem [Integrative review: research method for incorporating evidence in health and nursing]. *Texto & Contexto Enfermagem*, v. 17, n. 4, p. 758–764, 2008.
- Organização Pan-Americana da Saúde (OPAS). *Antimicrobial resistance: global report*. Washington, DC: OPAS, 2021.

Souza, M. T.; Silva, M. D.; Carvalho, R. Revisão integrativa: o que é e como fazer [Integrative review: what it is and how to do it]. *Einstein (São Paulo)*, v. 8, n. 1, p. 102–106, 2010.

World Health Organization (WHO). *Antimicrobial resistance: global report on surveillance*. Geneva: WHO, 2023.

O'Neill, J. *Tackling drug-resistant infections globally: final report and recommendations*. London: Review on Antimicrobial Resistance, 2016.