

**PREVALENCE AND RESISTANCE PROFILE OF
BACTERIA ASSOCIATED WITH URINARY TRACT
INFECTIONS IN INTENSIVE CARE UNIT PATIENTS AT
A HOSPITAL IN SANTO ÂNGELO, BRAZIL, IN 2023**

*PREVALÊNCIA E PERFIL DE RESISTÊNCIA DE
BACTÉRIAS ASSOCIADAS A INFECÇÕES DO TRATO URINÁRIO EM
PACIENTES EM UNIDADES DE TERAPIA INTENSIVA DE
UM HOSPITAL DE SANTO ÂNGELO, BRASIL, EM 2023*

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ABSTRACT

Urinary tract infections (UTIs) account for approximately 35-45% of healthcare-associated infections, with urinary catheterization representing one of the primary predisposing factors. Globally, UTIs affect around 150 million individuals each year. Intensive care units (ICUs) exhibit the highest incidence of nosocomial infections, driven by multiple contributing factors such as the extensive use of invasive medical devices and the immunocompromised status of patients. This study aimed to identify the predominant bacterial pathogens isolated from UTIs and to characterize their antimicrobial resistance profiles among patients hospitalized in the ICU of a hospital in Santo Ângelo, Brazil, during 2023. A descriptive, cross-sectional, and retrospective analysis was conducted based on urine culture reports. Demographic variables (sex and date of birth) and microbiological data were collected. A total of 36 bacterial isolates were identified, with *Escherichia coli* being the most prevalent pathogen. UTIs were more frequent among female patients, particularly in the 70-89-year age group. Gram-negative bacilli exhibited the highest resistance rates, mainly against β -lactams and quinolones. *Pseudomonas aeruginosa* showed the highest level of antimicrobial resistance, whereas *Staphylococcus aureus* presented the lowest. Understanding the local prevalence and antimicrobial susceptibility patterns of UTI pathogens is crucial for optimizing empirical therapy and preventing the emergence and dissemination of multidrug-resistant strains within hospital settings.

Keywords: antimicrobial susceptibility testing; bacterial drug resistance; hospital-acquired infection; urine culture.

RESUMO

As infecções do trato urinário (ITUs) representam cerca de 35% a 45% das infecções relacionadas à assistência à saúde, sendo a cateterização urinária um dos principais fatores predisponentes. Estima-se que, mundialmente, aproximadamente 150 milhões de pessoas sejam acometidas por ITUs a cada ano. As Unidades de Terapia Intensiva (UTIs) concentram as maiores taxas de infecções hospitalares, resultado de diversos

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fatores, como o uso frequente de dispositivos invasivos e a condição imunológica fragilizada dos pacientes internados nesses setores. Este estudo teve como objetivo identificar os principais patógenos bacterianos isolados em casos de infecção do trato urinário e descrever seus perfis de resistência aos antimicrobianos em pacientes internados na UTI de um hospital localizado em Santo Ângelo, Brasil, no ano de 2023. Trata-se de uma pesquisa descritiva, transversal e retrospectiva, realizada a partir da análise de laudos de uroculturas. Foram coletadas variáveis demográficas (sexo e data de nascimento) e dados microbiológicos. Foram identificados 36 isolados bacterianos, sendo *Escherichia coli* o microrganismo mais prevalente. As ITUs ocorreram com maior frequência em pacientes do sexo feminino, especialmente na faixa etária de 70 a 89 anos. Os bacilos Gram-negativos apresentaram os maiores índices de resistência antimicrobiana, sobretudo aos antibióticos da classe dos β -lactâmicos e das quinolonas. *Pseudomonas aeruginosa* destacou-se como a bactéria com maior nível de resistência, enquanto *Staphylococcus aureus* apresentou os menores índices. O conhecimento da prevalência local e do perfil de sensibilidade aos antimicrobianos dos agentes causadores de ITU é fundamental para orientar a escolha adequada da terapia empírica, além de contribuir para a prevenção do surgimento e da disseminação de cepas multirresistentes no ambiente hospitalar.

Palavras-chave: Teste de susceptibilidade a antimicrobianos; resistência bacteriana; infecções hospitalares; cultura de urina.

INTRODUCTION

Globally, approximately 150 million individuals are diagnosed with urinary tract infections (UTIs) each year. These infections are primarily caused by microorganisms introduced from external sources. Due to the anatomical proximity between the anus and urethra, intestinal bacteria are the most frequent etiological agents, particularly *Escherichia coli*, *Enterococcus* spp., *Klebsiella* spp., and *Pseudomonas aeruginosa* (Tortora, Funke, & Case, 2017; Stinghel *et al.*, 2022).

Urinary tract infections (UTIs) are among the most common bacterial infections worldwide and occur when pathogenic microorganisms colonize and multiply within the urinary tract. These infections represent a significant cause of morbidity and are associated with substantial health-care utilization and costs (Oliveira *et al.*, 2014; Haddad & Fernandes, 2019).

Between 35% and 45% of all UTIs are healthcare-associated infections (HAIs), occurring in hospital or outpatient settings. Major risk factors include urinary catheterization, prolonged hospitalization, underlying comorbidities, and empirical antibiotic use (Rocha *et al.*, 2023; Da Silva, Martins, & Galvão, 2024).

In hospitals, intensive care units (ICUs) admit critically ill patients who require continuous monitoring and undergo multiple invasive procedures. Urinary catheterization - where a device is inserted through the urethra into the bladder to drain urine - is performed in 16-25% of hospitalized patients. Catheters are frequently maintained for unnecessarily long periods, which increases the risk of UTIs (Mota, 2019; Rocha *et al.*, 2023). ICUs exhibit the highest incidence of hospital-acquired infections, with UTIs being the most common and associated with elevated complication rates (Genário *et al.*, 2022).

The initial diagnosis of UTIs is based on urinalysis, which assesses physical, chemical, and microscopic parameters. Confirmation requires a urine culture, considered positive when $\geq 100,000$ colony-forming units (CFU) per mL are detected. This test enables pathogen identification and antimicrobial susceptibility testing (AST), or antibiogram, which is essential for guiding appropriate antimicrobial therapy (Oliveira *et al.*, 2014; Genário *et al.*, 2022).

AST plays a pivotal role in the context of rising antimicrobial resistance. In 2017, the World Health Organization (WHO) published a list of priority pathogens for antimicrobial research and development, designating several bacteria commonly associated with UTIs—such as *E. coli*, *Klebsiella*, *Serratia*, and *Proteus* spp.—as “critical priority” organisms (Schiesari Júnior *et al.*, 2021). Resistance mechanisms include decreased membrane permeability, enzymatic degradation, efflux pump activation, and genetic modifications of antimicrobial targets (Genário *et al.*, 2022).

Antimicrobial resistance represents a major global challenge in infection control, with a steady increase in multidrug-resistant (MDR) organisms (Oliveira *et al.*, 2017). In ICUs, bacterial resistance is a leading contributor to patient mortality due to limited therapeutic options, higher treatment costs, prolonged hospital stays, and increased morbidity and mortality rates (Mota, Oliveira, & Souto, 2018).

Monitoring antimicrobial susceptibility is essential for guiding rational prescription practices and mitigating the emergence of multidrug resistance resulting from indiscriminate antibiotic use (Oliveira *et al.*, 2014). For antimicrobial therapy to be effective, drug concentrations at the infection site must reach adequate therapeutic levels (Madigan *et al.*, 2016).

Therefore, providing up-to-date data on the epidemiological characteristics of UTIs among ICU patients is crucial. Identifying the predominant microorganisms and their resistance patterns supports infection control strategies, strengthens antimicrobial stewardship programs, and informs evidence-based therapeutic decision-making.

METHODOLOGY

This study was a descriptive, cross-sectional, and retrospective analysis based on urine culture reports with antimicrobial susceptibility testing (AST) from patients admitted to the Intensive Care Unit (ICU) of a hospital located in Santo Ângelo, Rio Grande do Sul, Brazil. Urine cultures performed between January 1st and December 31, 2023, were included, and the data were provided by the institution's clinical laboratory.

The research protocol was approved by the Research Ethics Committee (CEP) under approval number 7.122.824. In accordance with CEP requirements, the study also received approval from the ethics committee of the participating hospital. Patient identity and collected data were kept strictly confidential throughout all stages of the research. In accordance with Resolution CNS No. 466/2012,

paragraph IV.8, the use of an informed consent form was waived, as this was a retrospective review of existing medical records.

The following variables were collected: demographic information (date of birth and sex), hospital unit, sample type, and results of urine cultures and ASTs. These data were recorded using a standardized collection form.

Inclusion criteria: all urine culture reports from ICU patients between January 1 and December 31, 2023. Exclusion criteria: reports from patients in other hospital units; reports lacking unit identification; reports with no bacterial growth; and reports in which the isolated organism was not bacterial.

Urine cultures and antimicrobial susceptibility testing (AST) were performed by the hospital laboratory using disk diffusion or broth microdilution methods, according to the recommendations of the Brazilian Committee on Antimicrobial Susceptibility Testing (BrCAST). Antimicrobial susceptibility results were interpreted using the BrCAST clinical breakpoints and categorized as Susceptible (S), Susceptible, Increased Exposure (I), or Resistant (R), according to the current BrCAST recommendations (BrCAST, 2023).

Data analysis was conducted using simple descriptive statistics, and the results were expressed as absolute (n) and relative (%) frequencies, presented in tables. Microsoft Excel and Microsoft Word software were used for data organization and analysis.

RESULTS

A total of 819 urine culture reports from hospitalized patients in 2023 were initially screened. Of these, 459 were excluded because they belonged to units other than the ICU, 52 due to lack of information regarding the prescribing sector, 274 because they showed no bacterial growth, and one due to fungal growth. Thus, 34 reports met the inclusion criteria and were analyzed. Among these, two samples presented growth of two distinct bacterial species, resulting in a total of 36 bacterial isolates.

The analysis of patient characteristics revealed a predominance of female individuals (n=21; 61.8%) compared to males (n=13; 38.2%). Regarding age distribution, a higher frequency of urinary tract infections was observed among elderly patients, particularly in the age groups of 70-79 years (35.3%) and 80-89 years (35.3%), which together accounted for the majority of cases. In contrast, younger age groups showed substantially lower frequencies.

Table 1 - Sex and age of patients with urinary tract infection (UTI) admitted to the ICU of the study hospital in 2023.

Age Sex	40-49	50-59	60-69	70-79	80-89	90-99	Total Geral n (%)
Female		4 (11.8%)	2 (5.9%)	9 (26.5%)	6 (17.6%)		21 (61.8%)
Male	1 (2.9%)		1 (2.9%)	3 (8.8%)	6 (17.6%)	2 (5.9%)	13 (38.2%)
TOTAL	1 (2.9%)	4 (11.8%)	3 (8.8%)	12 (35.3%)	12 (35.3%)	2 (5.9%)	34 - 100%

Source: authors.

Antimicrobial	Gram-negative bacteria									Gram-positive bacteria								
	<i>E. coli</i>			<i>Klebsiella spp.</i>			<i>Proteus spp.</i>			<i>P. aeruginosa</i>			<i>Enterococcus spp.</i>			<i>S. aureus</i>		
	(n=13)			(n=6)			(n=2)			(n=6)			(n=5)			(n=4)		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
β-lactams																		
Ampicillin	-	-	-	-	-	-	-	-	-	-	-	-	100	-	0	-	-	-
Amoxicillin/ Clavulanate	69.2	-	30.8	50	-	50	50	-	50	-	-	-	-	-	-	-	-	-
Cefepime	84.6	7.7	7.7	83.3	0	16.7	100	0	0	0	66.7	33.3	-	-	-	-	-	-
Ceftriaxone	84.6	0	15.4	66.7	0	33.3	50	0	50	-	-	-	-	-	-	-	-	-
Ceftazidime	100	0	0	50	16.7	33.3	50	50	0	0	50	50	-	-	-	-	-	-
Cefuroxime IV	0	76.9	23.1	0	50	50	0	50	50	-	-	-	-	-	-	-	-	-
Aztreonam	-	-	-	-	-	-	-	-	-	0	100	0	-	-	-	-	-	-
Piperacillin/ Tazobactam	92.3	0	7.7	66.7	0	33.3	100	0	0	0	66.7	33.3	-	-	-	-	-	-
Carbapenems																		

Ertapenem	100	0	0	100	0	0	100	0	0	-	-	-	-	-	-	-	-	-
Imipenem	-	-	-	-	-	-	-	-	-	0	66.7	33.3	-	-	-	-	-	-
Meropenem	100	0	0	100	0	0	100	0	0	50	16.7	33.3	-	-	-	-	-	-
Aminoglycosides																		
Amikacin	100	-	0	100	-	0	100	-	0	66.7	-	33.3	-	-	-	-	-	-
Gentamicin	92.3	0	7.7	100	0	0	100	0	0	-	-	-	-	-	-	100	0	0
Fluoroquinolones																		
Ciprofloxacin	61.5	7.7	30.8	66.7	0	33.3	100	0	0	0	66.7	33.3	80	0	20	-	-	-
Levofloxacin	-	-	-	-	-	-	-	-	-	0	66.7	33.3	80	0	20	0	100	0
Other agents																		
Linezolid	-	-	-	-	-	-	-	-	-	-	-	-	100	0	0	100	0	0
Oxacillin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	0	0
Teicoplanin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	0	25
Tigecycline	100	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vancomycin	-	-	-	-	-	-	-	-	-	-	-	-	100	0	0	100	0	0
Sulfamethoxazole/Trimethoprim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	0	0

ICU, intensive care unit; S, susceptible; I, susceptible, increased exposure; R, resistant. Values are expressed as percentages of isolates tested for each antimicrobial agent. The number of isolates analyzed for each bacterial species is indicated in the respective column headings. The symbol (-) indicates that the antimicrobial was not tested or was not applicable for the respective bacterial species. Susceptibility categories were interpreted according to the Brazilian Committee on Antimicrobial Susceptibility Testing (BrCAST) clinical breakpoints.

The antimicrobial susceptibility profiles of the main bacterial species isolated from urine cultures are summarized in Table 3. Among Enterobacterales, *E. coli* exhibited complete susceptibility (100%) to amikacin, ceftazidime, ertapenem, meropenem, and tigecycline, while reduced susceptibility was observed for amoxicillin-clavulanate (69.2%) and ciprofloxacin (61.5%). Resistance was highest to amoxicillin-clavulanate (30.8%) and ciprofloxacin (30.8%), whereas most isolates were categorized as susceptible, increased exposure to cefuroxime IV (76.9%).

Among *Klebsiella* spp., *K. pneumoniae* accounted for 83% (n = 5) of isolates and *K. oxytoca* for 17% (n = 1). Complete susceptibility (100%) was observed for amikacin, gentamicin, ertapenem, and meropenem, whereas the highest resistance rates were detected for amoxicillin-clavulanate (50%) and cefuroxime IV (50%). Intermediate susceptibility profiles were also observed for ceftazidime (16.7%) and cefuroxime IV (50%).

P. aeruginosa exhibited the broadest resistance profile among the Gram-negative bacteria. No antimicrobial demonstrated complete susceptibility, with amikacin showing the highest susceptibility rate (66.7%), followed by meropenem (50%). Most isolates were categorized as susceptible, increased exposure to aztreonam (100%), cefepime (66.7%), ciprofloxacin (66.7%), imipenem (66.7%), levofloxacin (66.7%), and piperacillin-tazobactam (66.7%). Resistance was most pronounced to ceftazidime (50%) and reached 33.3% for amikacin, cefepime, ciprofloxacin, imipenem, levofloxacin, meropenem, and piperacillin-tazobactam.

In contrast, *Proteus* spp. displayed high susceptibility to most antimicrobial agents, with complete susceptibility (100%) to amikacin, cefepime, ciprofloxacin, ertapenem, gentamicin, meropenem, and piperacillin-tazobactam. Resistance was observed only for amoxicillin-clavulanate (50%), ceftriaxone (50%), and cefuroxime IV (50%), while ceftazidime and cefuroxime IV each showed 50% of isolates classified as susceptible, increased exposure.

Among Gram-positive cocci, *Enterococcus* spp. remained fully susceptible (100%) to ampicillin, linezolid, and vancomycin, with resistance detected only to ciprofloxacin (20%) and levofloxacin (20%). Similarly, *S. aureus* demonstrated complete susceptibility (100%) to gentamicin, linezolid, oxacillin, vancomycin, and trimethoprim-sulfamethoxazole. All isolates were classified as susceptible, increased exposure to levofloxacin, whereas resistance was detected only to teicoplanin (25%).

Overall antimicrobial resistance varied considerably among the bacterial species (Table 4). *P. aeruginosa* presented the highest overall resistance rate (31.5%), followed by *Klebsiella* spp. (22.7%) and *Proteus* spp. (13.6%). In contrast, lower resistance rates were observed for *E. coli* (10.3%), *Enterococcus* spp. (8.0%), and *S. aureus* (3.6%).

Table 4 - Overall resistance profile of bacterial isolates from urinary tract infections in ICU patients at the study hospital in 2023.

Microrganism	Resistant test/ Total test	Overall resistance (%)
<i>Escherichia coli</i>	16 / 156	10,2
<i>Klebsiella</i> sp.	15 / 66	22,72
<i>Pseudomonas aeruginosa</i>	17 / 54	31,48
<i>Enterococcus</i> sp.	2 / 25	8
<i>Staphylococcus aureus</i>	1 / 28	3,57
<i>Proteus</i> sp.	3 / 22	13,63

Souce: author.

A total of four isolates (11.1%) were classified as multidrug-resistant (MDR). These included two *P. aeruginosa* isolates, one *E. coli* isolate, and one *Klebsiella* spp. isolate. According to the adopted MDR definition, these isolates exhibited resistance to at least three antimicrobial classes, predominantly involving β -lactams, fluoroquinolones, and aminoglycosides. Notably, the two MDR *P. aeruginosa* isolates also demonstrated resistance to carbapenems, reinforcing the clinical relevance of this species as the principal multidrug-resistant pathogen identified in the present study.

DISCUSSION

The predominance of urinary tract infections in female patients observed in this study is consistent with previous reports (Schiesari Júnior *et al.*, 2021; Oliveira & Souto, 2018), which attribute this finding mainly to anatomical factors such as the shorter urethra and its proximity to the anus (Tortora, Funke & Case, 2017, p. 749).

The higher frequency of infections among elderly individuals also corroborates findings from Schiesari Júnior *et al.* (2021) and Mota, Oliveira & Souto (2018). Aging is associated with increased susceptibility to infections due to physiological decline, frailty, and reduced homeostatic capacity (Maciel *et al.*, 2016; Bizo *et al.*, 2021), contributing to worse clinical outcomes such as hospitalization and mortality (Véliz & Vergara, 2020).

Regarding etiological agents, the predominance of *E. coli* and other Enterobacteriaceae aligns with the literature, which identifies these microorganisms as the main causative agents of UTIs (Genário *et al.*, 2022; Oliveira *et al.*, 2014). However, differences in prevalence compared to studies such as Raraz-Vidal, Gomez & Raraz-Vidal (2021) and Leite *et al.* (2020) may reflect regional variations, patient profiles, and hospital settings, particularly ICU environments.

The antimicrobial susceptibility profile observed in this study highlights important clinical considerations. *E. coli* demonstrated high susceptibility to carbapenems and aminoglycosides, but notable resistance to commonly used antibiotics such as ciprofloxacin and amoxicillin-clavulanate. This finding is clinically relevant, as these drugs are frequently used in empirical therapy (Genário *et al.*, 2022).

Klebsiella spp. exhibited a similar pattern, with preserved susceptibility to carbapenems and aminoglycosides but increased resistance to β -lactams, suggesting possible production of β -lactamases. In contrast, *P. aeruginosa* showed the highest resistance rates, which is consistent with its intrinsic resistance mechanisms and ability to acquire resistance genes through mutation and horizontal gene transfer (Murray, Rosenthal & Pfaller, 2017, p. 451). Its association with ICU settings and invasive devices such as catheters further explains its clinical relevance (Mota, 2019).

The relatively lower resistance observed in Gram-positive cocci suggests that these pathogens remain largely susceptible to first-line agents such as vancomycin and linezolid. However, the presence of resistance to quinolones and teicoplanin indicates the need for continued surveillance, especially considering the opportunistic nature of organisms such as *S. aureus* (Lima, Resgalla Júnior & da Silva, 2022).

The high resistance rates observed among Gram-negative bacilli, particularly to fluoroquinolones and β -lactams, reinforce findings from previous studies (Mota, Oliveira & Souto, 2018; Stinghel *et al.*, 2022; Raraz-Vidal, Gomez & Raraz-Vidal, 2021) and highlight the growing challenge of antimicrobial resistance in hospital settings. Although carbapenem resistance was uncommon overall, resistance to imipenem and meropenem was detected exclusively among *P. aeruginosa* isolates. This finding is clinically relevant because carbapenems are often reserved as last-line agents for severe Gram-negative infections. Resistance in *P. aeruginosa* may be associated with multiple mechanisms, including carbapenemase production, loss or modification of outer membrane porins, overexpression of efflux pumps, or the combined action of these mechanisms, all of which have been widely described in this species (Murray, Rosenthal & Pfaller, 2017; Genário *et al.*, 2022). These find-

ings reinforce the importance of continuous surveillance of carbapenem susceptibility in ICU settings, where resistant *P. aeruginosa* strains represent a significant therapeutic challenge.

The identification of multidrug-resistant isolates further emphasizes the ICU as a critical environment for the emergence and dissemination of resistant pathogens (Oliveira *et al.*, 2017). Mechanisms such as enzymatic inactivation, particularly via β -lactamases and extended-spectrum β -lactamases (ESBLs), play a central role in this process (Genário *et al.*, 2022; Leite *et al.*, 2020). Although combinations with β -lactamase inhibitors, such as amoxicillin-clavulanate and piperacillin-tazobactam, are designed to overcome these mechanisms (Madigan *et al.*, 2016, p. 824), the resistance observed in this study suggests reduced effectiveness in certain cases.

In Brazil, antimicrobial resistance (AMR) has become an increasingly important public health concern, particularly in tertiary-care hospitals and intensive care units (ICUs), where extensive antimicrobial use and invasive procedures favor the selection and dissemination of multidrug-resistant organisms. In the recent ASCENSION multicenter study, conducted in 14 tertiary hospitals across four Brazilian regions, 45.5% of Enterobacterales isolates recovered from ICU bloodstream infections were carbapenem-resistant, while carbapenem resistance reached 30.6% in *P. aeruginosa* and 94.4% in *Acinetobacter baumannii* complex isolates. These findings underscore the substantial burden of antimicrobial resistance in Brazilian hospitals and reinforce the importance of continuous local epidemiological surveillance to guide empirical antimicrobial therapy and strengthen antimicrobial stewardship programs (Antochevis *et al.*, 2025).

The resistance patterns identified in the present study have important implications for empirical antimicrobial therapy in critically ill patients. The reduced susceptibility of Enterobacterales to commonly prescribed agents, particularly fluoroquinolones and β -lactams, may compromise the effectiveness of first-line treatment and increase the likelihood of therapeutic failure when empirical regimens are not guided by local epidemiological data (ANVISA, 2024; Rossi *et al.*, 2021). In ICU patients, delays in initiating appropriate antimicrobial therapy have been consistently associated with prolonged hospitalization, increased healthcare costs, progression to sepsis, and higher mortality rates (Machado *et al.*, 2017; ILAS, 2023). Therefore, continuous monitoring of local antimicrobial susceptibility profiles is essential to support evidence-based empirical treatment and optimize patient outcomes.

The findings of this study also reinforce the importance of antimicrobial stewardship programs and infection prevention strategies in hospital settings. Regular surveillance of local resistance patterns enables periodic revision of empirical treatment protocols, reducing unnecessary exposure to broad-spectrum antibiotics and minimizing the selective pressure that drives the emergence of resistant microorganisms (ANVISA, 2023). In addition, strict adherence to infection prevention measures, including appropriate urinary catheter management, hand hygiene, and antimicrobial stewardship interventions, is fundamental to limiting the dissemination of multidrug-resistant pathogens in ICUs (ANVISA, 2017; Mendonça *et al.*, 2018). Although this study was conducted at a single institution,

the results provide valuable local epidemiological data that may support clinical decision-making and contribute to regional surveillance efforts (BrCAST, 2023).

Finally, the overall resistance profile confirms that *P. aeruginosa* represents the greatest therapeutic challenge among the analyzed pathogens, followed by *Klebsiella* spp. and *Proteus* spp., reinforcing the need for targeted antimicrobial stewardship strategies in ICU settings.

CONCLUSIONS

A predominance of urinary tract infections (UTIs) was observed among female patients, primarily within an elderly population. The bacterial prevalence profile identified in Santo Ângelo, Rio Grande do Sul, was consistent with that reported in the literature, with *E. coli* emerging as the most frequent etiological agent.

The study revealed notable resistance to the antibiotics most commonly prescribed for the treatment of UTIs, emphasizing the critical importance of rational antimicrobial prescription to prevent the emergence of additional resistant strains. Multidrug-resistant Gram-negative bacilli (MDR-GNB) isolates were also identified, exhibiting resistance to β -lactam/ β -lactamase inhibitor combinations such as amoxicillin-clavulanate and piperacillin-tazobactam.

Accordingly, comprehensive knowledge of the prevalence and antimicrobial resistance profiles of UTI-causing microorganisms in intensive care units (ICUs) is essential to mitigate the development and dissemination of multidrug-resistant strains. ICU patients are critically ill and frequently subjected to invasive procedures that increase susceptibility to infection. Furthermore, information regarding the most prevalent pathogens provides valuable support for infection control strategies, including regular maintenance of urinary catheters, strict adherence to hand hygiene protocols, and the disinfection of patient-surrounding surfaces.

REFERENCES

- AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA (ANVISA). Relatório de Resistência Microbiana em Serviços de Saúde: Monitoramento dos perfis de sensibilidade em Unidades de Terapia Intensiva (UTI) adultas. Brasília: ANVISA, 2024. Disponível em: <https://www.gov.br/anvisapt-br>.
- AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA (ANVISA). Diretriz Nacional para Elaboração de Programa de Gerenciamento de Antimicrobianos em Serviços de Saúde. Brasília: ANVISA, 2023. Disponível em: <https://www.gov.br/anvisapt-br>.
- BIZO, M. *et al.* Recorrência da internação por infecção do trato urinário em idosos. **Enfermagem em Foco**, v. 12, n. 4, p. 767-772, 2021. DOI: 10.21675/2357-707X.2021.v12.n4.4562.

BRAZILIAN COMMITTEE ON ANTIMICROBIAL SUSCEPTIBILITY TESTING (BrCAST). Term of cooperation and creation of the committee, 2023. <http://brcast.org.br/documentos>.

DA SILVA, A. M. V.; MARTINS, D. L.; GALVÃO, B. H. A. Infecções urinárias e processo do cuidado: perfil etiológico e de sensibilidade no setor de clínica médica de um hospital público da Paraíba. **Arquivos de Ciências da Saúde da UNIPAR**, v. 28, n. 1, p. 483-499, 2024. DOI: 10.25110/arqsaude.v28i1.2024-9656.

GENÁRIO, L.R. *et al.* Resistência antimicrobiana na infecção urinária em unidade de terapia intensiva. **Arquivos de Ciências da Saúde da UNIPAR**, v. 26, n. 3, p. 1325-1342, 2022. DOI: 10.25110/arqsaude.v26i3.20229007.

INSTITUTO LATINO-AMERICANO DE SEPSE (ILAS). Relatório Nacional: A seps e no Brasil - Panorama epidemiológico e adesão aos pacotes de tratamento em unidades de terapia intensiva. São Paulo: ILAS, 2023. Disponível em: <https://www.ilas.org.br>.

LEITE, M. S. *et al.* Perfil de resistência aos antimicrobianos de *Escherichia coli* isoladas de amostras de urina de pacientes de uma Unidade de Terapia Intensiva. **Revista Brasileira de Análises Clínicas**, 2020.

LIMA, A. C. D.; RESGALLA JUNIOR, C.; DA SILVA, M. A. C. Avaliação do perfil de resistência aos antimicrobianos em cepas de *Escherichia coli* e *Staphylococcus* spp. no canal do Marambaia em Balneário Camboriú, Santa Catarina. **Vigilância Sanitária em Debate**, v. 10, n. 3, p. 122-132, 2022. DOI: 10.22239/2317-269x.02026.

MACIEL, G. M. C. *et al.* Avaliação da fragilidade no idoso pelo enfermeiro: revisão integrativa. **Revista de Enfermagem do Centro-Oeste Mineiro**, v. 6, n. 3, 2016. DOI: 10.19175/recom.v6i3.1010.

MACHADO, F. R. *et al.* Sepsis Prevalence Assessment Database (SPREAD): epidemiological study of sepsis in Brazilian intensive care units. **Critical Care**, v. 21, n. 1, p. 118, 2017. DOI: 10.1186/s13054-017-1717-3.

MADIGAN, T. M. *et al.* **Microbiologia de Brock**. 14. ed. Porto Alegre: Artmed, 2016.

MENDONÇA, A. E. O. *et al.* Infecção do trato urinário associada ao cateterismo vesical de demora em unidade de terapia intensiva. **Revista de Enfermagem UFPE on line**, v. 12, n. 4, p. 954-963, 2018. DOI: 10.5205/1981-8963-v12i4a230985p954-963-2018.

MOTA, E. C. **Infecção do trato urinário associada ao uso do cateter vesical em paciente crítico: impacto do bundle na prevenção**. 2019. 158 f. Tese (Doutorado em Enfermagem) - Universidade Federal de Minas Gerais, Minas Gerais, 2019.

- MOTA, F. S.; OLIVEIRA, H. A.; SOUTO, R. C. F. Perfil e prevalência de resistência aos antimicrobianos de bactérias Gram-negativas isoladas de pacientes de uma unidade de terapia intensiva. **Revista Brasileira de Análises Clínicas**, v. 50, n. 3, p. 270-277, 2018.
- MURRAY, P. R.; ROSENTHAL, K. S.; PFALLER, M. A. **Microbiologia médica**. 8. ed. Rio de Janeiro: Elsevier, 2017.
- OLIVEIRA, A. L. D. *et al.* Mecanismos de resistência bacteriana a antibióticos na infecção urinária. **Revista UNINGÁ Review**, v. 20, n. 3, p. 65-71, 2014.
- OLIVEIRA, A. D. *et al.* Perfil dos microrganismos associados à colonização e infecção em Terapia Intensiva. **Revista de Epidemiologia e Controle de Infecção**, v. 7, n. 2, p. 101-106, 2017. DOI: 10.17058/reci.v7i2.8302.
- OLIVEIRA, L. C. A.; SOUTO, R. C. F. Prevalência de infecção do trato urinário em pacientes ambulatoriais e sua relação com os valores de nitrito e leucócitos. **Revista Brasileira de Análises Clínicas**, v. 50, n. 3, p. 237-243, 2018.
- RARAZ-VIDAL, J.; GOMEZ, H. A.; RARAZ-VIDAL, O. Resistencia antibiótica de *Escherichia coli* y *Staphylococcus saprophyticus* en la infección urinaria de un hospital público. **Boletín de Malariología y Salud Ambiental**, v. 61, n. 4, p. 633-641, 2021.
- ROCHA, A. F. *et al.* Incidência de infecção do trato urinário em unidade de terapia intensiva: implementação de um checklist assistencial. **Enfermagem em Foco**, v. 14, 2023.
- ROSSI, F. *et al.* Antimicrobial susceptibility profiles of Gram-negative bacilli isolated from intensive care units in Brazil: results from the SENTRY Antimicrobial Surveillance Program. **The Brazilian Journal of Infectious Diseases**, v. 25, n. 4, p. 101580, 2021. DOI: 10.1016/j.bjid.2021.101580.
- SCHIESARI JÚNIOR, A. *et al.* Perfil de resistência microbiana em infecções do trato urinário adquiridas na comunidade em uma cidade do noroeste paulista. **CuidArte Enfermagem**, v. 15, n. 2, p. 165-173, 2021.
- STINGHEL *et al.* Infecção do trato urinário: estudo de sensibilidade e resistência bacteriana em pacientes internados. **Revista de Medicina (São Paulo)**, v. 101, n. 1, p. 1-6, 2022. DOI: 10.11606/issn.1679-9836.v101ilpe-171057.
- TORTORA, G.; FUNKE, B.; CASE, C. **Microbiologia**. 12. ed. Porto Alegre: Artmed, 2017.
- VÉLIZ, E.; VERGARA, T. Factores de riesgo para infección del tracto urinario asociado al uso de catéter urinario permanente en pacientes adultos hospitalizados. **Revista Chilena de Infectología**, v. 37, n. 5, p. 509-514, 2020. DOI: 10.4067/S0716-10182020000500509.