International Journal of Clinical and Experimental Medicine Research, 2026, 10(3), 185-194
https: //www.hillpublisher.com/journals/ijcemr/
ISSN Online: 2575-7970
ISSN Print: 2575-7989

The First Comprehensive Report from Mardin, Turkey: Antimicrobial Resistance Profiles of Microorganisms Isolated from Blood Cultures in Mardin Training and Research Hospital

Kenan Arda[1,2], Halit Irmak[3], Abdurrahman Dündar[4,*]

[1]Department of Biology, Postgraduate Education Institute, Mardin Artuklu University, Mardin 47000, Turkey.
[2]Department of Medical Microbiology, Central Laboratory Unit, Mardin Training and Research Hospital, Mardin 47000, Turkey.
[3]Department of Computer Engineering, Faculty of Engineering and Architecture, Mardin Artuklu University, Mardin 47000, Turkey.
[4]Medical Documentation and Secretarial Program, Department of Medical Services and Techniques, Vocational School of Health Services, Mardin Artuklu University, Mardin 47000, Turkey.

How to cite this paper: Kenan Arda, Halit Irmak, Abdurrahman Dündar. (2026) The First Comprehensive Report from Mardin, Turkey: Antimicrobial Resistance Profiles of Microorganisms Isolated from Blood Cultures in Mardin Training and Research Hospital. *International Journal of Clinical and Experimental Medicine Research*, 10(3), 185-194.
DOI: 10.26855/ijcemr.2026.05.004

Received: February 28, 2026
Accepted: March 29, 2026
Published: May 6, 2026

***Corresponding author:** Abdurrahman Dündar, Medical Documentation and Secretarial Program, Department of Medical Services and Techniques, Vocational School of Health Services, Mardin Artuklu University, Mardin 47000, Turkey.

Abstract

Background: Mardin province has the highest antibiotic consumption rate in Turkey, yet no comprehensive antimicrobial resistance data exist for bloodstream isolates from this region. This study provides the first report on resistance profiles of microorganisms isolated from blood cultures at Mardin Training and Research Hospital. **Methods:** Blood culture results from 4790 patients (May 2024-May 2025) were retrospectively analyzed. Antimicrobial susceptibility testing was performed. Resistance rates were compared between ICU and non-ICU settings. **Results:** Of 3301 isolates, 67.8% were Gram-positive and 32.2% Gram-negative. Acinetobacter baumannii showed 100% carbapenem resistance; colistin remained effective. Klebsiella pneumoniae had 69.4% meropenem resistance (73.2% in ICU vs. 33.3% in non-ICU). Clindamycin resistance in Staphylococcus epidermidis differed markedly (67.6% in ICU vs. 0% in non-ICU). **Conclusion:** Alarmingly high resistance rates, especially among ICU Gram-negative pathogens, necessitate urgent infection control measures and local surveillance-guided antibiotic stewardship.

Keywords

Bloodstream infections; intensive care unit (ICU); antimicrobial resistance; antibiotics; Gram-negative bacteria; Mardin

1. Introduction

Antimicrobial resistance (AMR) represents one of the most critical public health threats of the 21st century, with global estimates suggesting that resistant infections could be responsible for 10 million annual deaths by 2050 if no effective interventions are implemented [1]. The World Health Organization has highlighted that resistance is increasing at alarming rates worldwide, compromising the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses, and fungi [2]. Recent global surveillance data indicate that resistance rates have increased in over 40% of monitored pathogen-antibiotic combinations, with low- and middle-income countries being disproportionately affected due to limited laboratory capacity and antimicrobial stewardship programs [3].

In Turkey, studies have documented concerning resistance patterns, with methicillin-resistant Staphylococcus aureus (MRSA) rates reaching 40% in hospital settings and carbapenem resistance among Gram-negative pathogens, presenting a major therapeutic challenge [4]. Intensive care units represent epicenters of this resistance crisis, where central line-associated bloodstream infections are increasingly caused by WHO priority pathogens requiring last-line reserve antibiotics [5]. A recent Turkish study of healthcare-associated bloodstream infections in intensive care settings reported that Gram-negative pathogens predominated (59.7%), with Acinetobacter spp. and Klebsiella spp. exhibiting alarmingly high carbapenem resistance rates of 96% and 87.5%, respectively [6].

Turkey has consistently ranked among the highest antibiotic-consuming countries globally, with a consumption rate of 42.3 defined daily doses (DDD) per 1,000 inhabitants per day in 2011—the highest among 13 non-European Union countries in the WHO European region [7]. Within Turkey, significant regional disparities exist in antibiotic utilization patterns. According to comprehensive national prescription data from 2017, Mardin province had the highest antibiotic prescription rate in the country, with 38.09% of all prescriptions written by family physicians containing at least one antibiotic, compared to the national average of 24.97% [8]. This positions Mardin as the leading province in antibiotic consumption, followed by Şanlıurfa (35.72%) and Adana (35.23%) [6]. Health Ministry data further confirmed that the highest antibiotic consumption in Turkey was reported in the southeastern region, with Mardin at the top of the list [8]. This excessive antibiotic use creates significant selective pressure for antimicrobial resistance, making local surveillance data particularly critical for guiding empirical treatment strategies [9, 10].

Despite this concerning trend, no comprehensive study has previously documented the antimicrobial resistance profiles of bloodstream isolates from ICU and non-ICU in this high-consumption region. The present study provides the first detailed report on the epidemiology and resistance patterns of pathogens isolated from blood cultures in Mardin Training and Research Hospital, offering essential data for optimizing empirical antibiotic therapy and infection control policies in this unique setting.

2. Materials and Methods

2.1 Study design and population

This retrospective observational study included patients with suspected bloodstream infection who had blood cultures collected at Mardin Training and Research Hospital between May 2024 and May 2025. Data were anonymously obtained from the Hospital Laboratory Information System. The study was approved by the Non-Interventional Clinical Research Ethics Committee (Protocol No: 2025/4-2, dated 22.04.2025).

2.2 Data collection and variables

The dataset included demographic information (age, sex), clinical data (ward), blood culture details, and microbiological results (identified microorganisms, antimicrobial susceptibility testing results).

2.3 Data processing

Microorganism and ward names were standardized. Exclusion criteria: 75 culture records with no identifiable microorganism were excluded from pathogen-based analyses. Three new variables were created:

- Ward Group: ICUs vs. non-ICU wards
- Age Group: Newborn (≤28 days), Infant (29 days-1 year), Child (>1-12 years), Adult (13-65 years), Elderly (>65 years)
- Resistance Status: Susceptible (Susceptible/High-dose Susceptible) vs. Resistant

2.4 Statistical analysis

Categorical variables were presented as numbers and percentages (n, %). Age was presented as median [IQR] due to non-normal distribution (Kolmogorov-Smirnov test, $p<0.001$). Group comparisons used Pearson Chi-Square or Fisher's Exact test when expected counts <5 in >20% of cells. Statistical significance was set at $p<0.05$. All analyses were performed using IBM SPSS version 27.

3. Results

3.1 Demographic and clinical characteristics

A total of 4790 culture records were analyzed. The median age was 67.00 years [IQR: 47.00-80.00]. Elderly patients

(>65 years) constituted the largest group (52.1%, n=2495), followed by adults (44.7%, n=2140). Males represented 54.2% (n=2595) of patients. The majority of cultures (75.3%, n=3609) originated from ICUs (Table 1).

Table 1. Demographic and Clinical Characteristics of the Study Population

Variable	Total (N=4790)
Age, Median [IQR]	67.00 [47.00-80.00]
Age Group, n (%)	
Newborn (≤28 days)	106 (2.2)
Infant (29 days-1 year)	5 (0,1)
Child (>1-12 years)	44 (0.9)
Adult (13-65 years)	2140 (44.7)
Elderly (>65 years)	2495 (52.1)
Sex, n (%)	
Male	2595 (54.2)
Female	2195 (45.8)
Ward Group, n (%)	
Non-ICU	1181 (24.7)
ICU	3609 (75.3)

3.2 Distribution of pathogens

Of 1904 blood culture samples, 415 (21.8%) were positive for microbial growth. From 415 positive cultures, 3301 isolates were obtained, indicating polymicrobial growth in some samples. Gram-positive cocci predominated (67.8%), followed by Gram-negative bacilli (31.0%). The most frequently isolated pathogens were *Klebsiella pneumoniae* (15.4%, n=507), *Staphylococcus hominis* (15.2%, n=502), and Staphylococcus epidermidis (14.9%, n=491). Coagulase-negative staphylococci (CoNS) collectively accounted for 43.3% of all isolates (Table 2).

Table 2. Distribution of Microorganisms Isolated from Positive Blood Cultures (N=3301)

Microorganism	Count (n)	Percent (%)
Klebsiella pneumoniae	507	15.4
Staphylococcus hominis	502	15.2
Staphylococcus epidermidis	491	14.9
Staphylococcus haemolyticus	240	7.3
Klebsiella oxytoca	233	7.1
Escherichia coli	227	6.9
Staphylococcus aureus	206	6.2
Diphtheroid bacilli	141	4.3
Enterococcus faecium	94	2.8
Staphylococcus saprophyticus	87	2.6
Acinetobacter baumannii	81	2.5
Enterococcus faecalis	79	2.4
Pseudomonas aeruginosa	62	1.9
Staphylococcus capitis	43	1.3

Table 2 Continued

Microorganism	Count (n)	Percent (%)
Rhizobium radiobacter	37	1.1
Staphylococcus simulans	35	1.1
Streptococcus spp.	31	0.9
Streptococcus pneumoniae	25	0.8
Candida albicans	25	0,.8
Proteus mirabilis	16	0.5
Citrobacter freundii	15	0.5
Candida glabrata	15	0.5
Staphylococcus warneri	15	0.5
Serratia marcescens	15	0.5
Streptococcus mitis/oralis	12	0.4
Candida parapsilosis	10	0.3
Candida tropicalis	9	0.3
Stenotrophomonas maltophilia	8	0.2
Acinetobacter haemolyticus	7	0.2
Other (n < 5)	26	0.8
Total	3301	100.0

3.3 Pathogen distribution by ward

Significant differences were observed in pathogen distribution between ICU and non-ICU wards. Gram-negative pathogens were more frequent in the ICU, while Gram-positive pathogens predominated in non-ICU settings (Table 3).

Table 3. Distribution of Major Pathogens by Ward Group

Microorganism	Count (n)	Percent (%)
Klebsiella pneumoniae	507	15.4
Staphylococcus hominis	502	15.2
Staphylococcus epidermidis	491	14.9
Staphylococcus haemolyticus	240	7.3
Klebsiella oxytoca	233	7.1
Escherichia coli	227	6.9
Staphylococcus aureus	206	6.2
Diphtheroid bacilli	141	4.3
Enterococcus faecium	94	2.8
Staphylococcus saprophyticus	87	2.6
Acinetobacter baumannii	81	2.5
Enterococcus faecalis	79	2.4
Pseudomonas aeruginosa	62	1.9
Staphylococcus capitis	43	1.3

Table 3 Continued

Microorganism	Count (n)	Percent (%)
Rhizobium radiobacter	37	1.1
Staphylococcus simulans	35	1.1
Streptococcus spp.	31	0.9
Streptococcus pneumoniae	25	0.8
Candida albicans	25	0.8
Proteus mirabilis	16	0.5
Citrobacter freundii	15	0.5
Candida glabrata	15	0.5
Staphylococcus warneri	15	0.5
Serratia marcescens	15	0.5
Streptococcus mitis/oralis	12	0.4
Candida parapsilosis	10	0.3
Candida tropicalis	9	0.3
Stenotrophomonas maltophilia	8	0.2
Acinetobacter haemolyticus	7	0.2
Other (n < 5)	26	0.8
Total	3301	100.0

p-values were calculated using the Pearson Chi-Square test or Fisher's Exact Test. Values with $p<0.05$ were considered statistically significant and are highlighted in bold.

4. Antimicrobial Resistance Profiles

4.1 Gram-Negative pathogens

Alarmingly high resistance rates were observed among ICU-predominant pathogens (Table 4). *Acinetobacter baumannii* isolates showed 100% resistance to all tested antibiotics, including carbapenems, with colistin remaining the only effective agent. *K. pneumoniae* exhibited 69.4% meropenem resistance overall, reaching 73.2% in the ICU compared to 33.3% in non-ICU wards.

Table 4. Antimicrobial Resistance Rates of Gram-Negative Pathogens by Ward Group

Gram-Negative Pathogens	Antibiotics	General Resistance % (n/N)	Non ICU Resistance % (n/N)	ICU Resistance % (n/N)
Klebsiella pneumoniae	Amoxicillin, Clavulanate	%82.3 (51/62)	%66.7 (4/6)	%83.9 (47/56)
	Ceftriaxone	%80.6 (50/62)	%66.7 (4/6)	%82.1 (46/56)
	Piperacillin Tazobactam	%80.6 (25/31)	%66.7 (2/3)	%82.1 (23/28)
	Ciprofloxacin	%80.0 (24/30)	%50.0 (1/2)	%82.1 (23/28)
	Ceftazidime	%77.4 (24/31)	%66.7 (2/3)	%78.6 (22/28)
	Cefepim	%74.2 (23/31)	%66.7 (2/3)	%75.0 (21/28)
	Cefoxitin	%74.2 (23/31)	%33.3 (1/3)	%78.6 (22/28)
	Ertapenem	%71.0 (22/31)	%33.3 (1/3)	%75.0 (21/28)

Table 4 Continued

Gram-Negative Pathogens	Antibiotics	General Resistance % (n/N)	Non ICU Resistance % (n/N)	ICU Resistance % (n/N)
	Meropenem	%69.4 (43/62)	%33.3 (2/6)	%73.2 (41/56)
	Trimethoprim/Sulfamethoxazole	%58.1 (18/31)	%33.3 (1/3)	%60.7 (17/28)
	Imipenem	%46.7 (14/30)	%33.3 (1/3)	%48.1 (13/27)
	Amicacin	%0.0 (0/12)	%0.0 (0/2)	%0.0 (0/10)
Escherichia coli	Ciprofloxacin	%92.3 (12/13)	%83.3 (5/6)	%100.0 (7/7)
	Ceftazidime	%84.6 (11/13)	%83.3 (5/6)	%85.7 (6/7)
	Cefuroxime	%84.6 (11/13)	%83.3 (5/6)	%85.7 (6/7)
	Ceftriaxone	%76.9 (20/26)	%66.7 (8/12)	%85.7 (12/14)
	Cefepim	%61.5 (8/13)	%50.0 (3/6)	%71.4 (5/7)
	Amoxicillin Clavulanate	%57.7 (15/26)	%41.7 (5/12)	%71.4 (10/14)
	Trimethoprim/Sulfamethoxazole	%46.2 (6/13)	%50.0 (3/6)	%42.9 (3/7)
	Piperacillin-Tazobactam	%38.5 (5/13)	%33.3 (2/6)	%42.9 (3/7)
	Cefoxitin	%23.1 (3/13)	%33.3 (2/6)	%14.3 (1/7)
	Ertapenem	%15.4 (2/13)	%0.0 (0/6)	%28.6 (2/7)
	Meropenem	%7.7 (2/26)	%0.0 (0/12)	%14.3 (2/14)
	Imipenem	%7.7 (1/13)	%0.0 (0/6)	%14.3 (1/7)
Klebsiella oxytoca	All tested antibiotics	%0.0	-	%0.0
Acinetobacter baumannii	Meropenem	%100.0 (22/22)	-	%100.0 (22/22)
	Amicacin/Imipenem etc. Trimethoprim/Sulfamethoxazole	%100.0	-	%100.0
	colistin	%90.9 (10/11)	-	%90.9 (10/11)
	Meropenem/Imipenem/Ceftazidime	%0.0 (0/2)	-	%0.0 (0/2)
Pseudomonas aeruginosa	aztreonam	%62.5 (5/8)	-	%62.5 (5/8)
	Piperacillin-Tazobactam/Cefepime/Ciprofloxacin	%57.1 (4/7)	-	%57.1 (4/7)
	Amoxicillin Clavulanate	%50.0 (4/8)	-	%50.0 (4/8)

4.2 Gram-Positive pathogens

Among coagulase-negative staphylococci, oxacillin resistance was extremely high: *S. hominis* (83.3%), *S. epidermidis* (89.5%), and *S. haemolyticus* (100%). The MRSA rate was 28.6%. Vancomycin resistance was not detected in any *Staphylococcus* species. A big difference was observed in clindamycin resistance among *S. epidermidis* isolates between ICU (67.6%) and non-ICU (0%). Diphtheroid bacilli showed 5.9% vancomycin resistance.

Table 5. Antimicrobial Resistance Rates of Gram-Positive Pathogens by Ward Group

Gram-Positive Pathogens	Antibiotics	General Resistance % (n/N)	Non ICU Resistance % (n/N)	ICU Resistance % (n/N)
Staphylococcus hominis	Fusidic Acid	%89.2 (33/37)	%75.0 (6/8)	%93.1 (27/29)
	Oxacillin (MRSH)	%83.3 (30/36)	%85.7 (6/7)	%82.8 (24/29)
	Erythromycin	%78.9 (30/38)	%87.5 (7/8)	%76.7 (23/30)

Table 5 Continued

Gram-Positive Pathogens	Antibiotics	General Resistance % (n/N)	Non ICU Resistance % (n/N)	ICU Resistance % (n/N)
	Levofloxacin	%71.1 (27/38)	%62.5 (5/8)	%73.3 (22/30)
	Clindamycin	%65.8 (25/38)	%62.5 (5/8)	%66.7 (20/30)
	vancomycin	%0.0 (0/36)	%0.0 (0/7)	%0.0 (0/29)
Streptococcus epidermidis	Oxacillin (MRSE)	%89.5 (34/38)	%75.0 (3/4)	%91.2 (31/34)
	Erythromycin	%78.9 (30/38)	%75.0 (3/4)	%79.4 (27/34)
	Fusidic Acid	%68.4 (26/38)	%50.0 (2/4)	%70.6 (24/34)
	Levofloxacin	%65.8 (25/38)	%75.0 (3/4)	%64.7 (22/34)
	Clindamycin	%60.5 (23/38)	%0.0 (0/4)	%67.6 (23/34)
	Vancomycin	%0.0 (0/38)	%0.0 (0/4)	%0.0 (0/34)
Staphylococcus haemolyticus	Oxacillin (MRSH)	%100.0 (17/17)	-	%100.0 (17/17)
	Erythromycin	%94.1 (16/17)	-	%94.1 (16/17)
	Fusidic Acid	%94.1 (16/17)	-	%94.1 (16/17)
	Levofloxacin	%88.2 (15/17)	-	%88.2 (15/17)
	Vancomycin	%0.0 (0/17)	-	%0.0 (0/17)
Staphylococcus aureus	Benzylpenicillin	%78.6 (11/14)	%80.0 (4/5)	%77.8 (7/9)
	Erythromycin	%35.7 (5/14)	%20.0 (1/5)	%44.4 (4/9)
	Oxacillin (MRSA)	%28.6 (4/14)	%20.0 (1/5)	%33.3 (3/9)
	Vancomycin	%0.0 (0/14)	%0.0 (0/5)	%0.0 (0/9)
Staphylococcus capitis	Oxacillin (MRSC)	%100.0 (3/3)	-	%100.0 (3/3)
	Clindamycin	%100.0 (3/3)	-	%100.0 (3/3)
	Vancomycin	%0.0 (3/3)	-	%0.0 (3/3)
Difteroid Bacillus	Clindamycin	%100.0 (17/17)	-	%100.0 (17/17)
	Moxifloxacin	%87.5 (14/16)	-	%87.5 (14/16)
	Penicillin	%87.5 (14/16)	-	%87.5 (14/16)
	Ciprofloxacin	%82.4 (14/17)	-	%82.4 (14/17)
	Vancomycin	%5.9 (1/17)	-	%5.9 (1/17)

K. pneumoniae isolates showed high resistance rates to most of the tested antibiotics. Resistance to commonly used antibiotics such as amoxicillin-clavulanate, ceftriaxone, piperacillin-tazobactam, and ciprofloxacin exceeded 80%. In the carbapenem group, ertapenem resistance was found to be 71%, and meropenem resistance was 69.4%. In the ICU, these rates are even higher, with meropenem resistance reaching 73.2%. In contrast, amikacin stands out as the most effective antibiotic with 0% resistance in both general and ICU isolates.

High resistance to antibiotics such as ciprofloxacin (92.3%), ceftazidime (84.6%), and cefuroxime (84.6%) was observed in *E. coli* isolates. Ceftriaxone resistance, suggesting the presence of extended-spectrum beta-lactamase (ESBL), is 76.9%, rising to 85.7% in the ICU. While resistance to carbapenems is low (7.7% meropenem), it is noteworthy that this rate increases to 14.3% in the ICU. Amoxicillin-clavulanate resistance is 57.7%, reaching 71.4% in the ICU.

The situation is quite dire in *A. baumannii* isolates. Resistance to antibiotics such as meropenem, amikacin, and imipenem is 100%, while resistance to trimethoprim-sulfamethoxazole is 90.9%. Only colistin is seen as an effective

antibiotic with 0% resistance. In Pseudomonas aeruginosa isolates, resistance to meropenem, imipenem, and ceftazidime was 62.5%, to aztreonam 57.1%, and to piperacillin-tazobactam, cefepime, and ciprofloxacin 50%.

K. oxytoca isolates were found to be susceptible to all tested antibiotics (0% resistance).

Among coagulase-negative staphylococci, *S. hominis*, *S. epidermidis*, and *S. haemolyticus* isolates showed oxacillin resistance of 83.3%, 89.5%, and 100%, respectively, and similar rates were observed in the ICU. Fusidic acid resistance ranged from 68.4% to 94.1%, erythromycin resistance from 78.9% to 94.1%, and levofloxacin resistance from 65.8% to 88.2%. Clindamycin resistance was 60.5% in *S. epidermidis*, rising to 67.6% in the ICU. Vancomycin resistance was not detected in any of these species.

In *S. aureus* isolates, penicillin resistance was 78.6%, erythromycin resistance was 35.7%, and MRSA resistance (oxacillin resistance) was 28.6%. Vancomycin resistance was absent. In S. capitis and diphtheroid bacillus isolates, clindamycin resistance was 100%. Vancomycin resistance in diphtheroid bacilli was observed at a rate of 5.9%.

5. Discussion

This study provides crucial data on the epidemiology and antimicrobial resistance patterns of bloodstream isolates from ICUs in Mardin, Turkey. The predominance of Gram-positive isolates (67.8%) aligns with previous studies reporting that approximately two-thirds of nosocomial bloodstream infections are caused by Gram-positive cocci [11, 12]. However, the high proportion of coagulase-negative staphylococci (43.3%) raises concerns about potential contamination versus true infection, a common challenge in blood culture interpretation [13, 14].

The most alarming finding is the extremely high carbapenem resistance rates. A. baumannii showing 100% resistance to meropenem mirrors the growing crisis of multidrug-resistant Acinetobacter in Turkish ICUs [15, 16]. Similar rates have been reported in other Turkish studies, with carbapenem resistance often exceeding 90% [17, 18]. The preserved susceptibility to colistin (100% susceptibility) confirms its role as a last-resort agent, though emerging colistin resistance elsewhere warrants caution [19].

K. pneumoniae with 69.4% meropenem resistance represents a major therapeutic challenge. The striking difference between ICU (73.2%) and non-ICU (33.3%) isolates highlights the role of ICU environments as reservoirs for resistant strains [20]. These rates are higher than those reported in the 2022 Turkish National Antimicrobial Resistance Surveillance System (UAMDS) data, which showed approximately 40-50% carbapenem resistance in ICU isolates [21].

The 62.5% meropenem resistance in P. aeruginosa is consistent with Turkish studies reporting 50-70% resistance rates [22]. This severely limits treatment options, often necessitating combination therapy [23].

Among Gram-positives, the 28.6% MRSA rate is relatively low compared to previous Turkish ICU studies (40-60%) [24], possibly reflecting improved infection control. However, the extremely high oxacillin resistance in coagulase-negative staphylococci (83-100%) is expected given their role as opportunistic pathogens in device-related infections [25, 26].

The difference in clindamycin resistance among *S. epidermidis* between ICU (67.6%) and non-ICU (0%) suggests clonal spread of resistant strains within the ICU. This finding has important implications for empirical therapy choices in suspected catheter-related infections [26].

The complete susceptibility to vancomycin among all Gram-positive isolates is reassuring and consistent with national data showing <1% vancomycin resistance in staphylococci [18]. However, the emergence of vancomycin-resistant enterococci (VRE) in Turkey (10.3% in E. faecium per meta-analysis) [27, 28] requires continued vigilance.

This study has limitations: its retrospective design, potential inclusion of contaminants (particularly coagulase-negative staphylococci), and lack of clinical correlation to distinguish infection from colonization. Additionally, molecular characterization of resistance mechanisms was not performed.

6. Conclusion

This study reveals alarmingly high antimicrobial resistance rates among bloodstream isolates from the ICU in Mardin, particularly among Gram-negative pathogens. The 100% carbapenem resistance in *A. baumannii* and 69.4% in *K. pneumoniae* represent a critical threat, leaving few therapeutic options. The significant differences between ICU and non-ICU isolates underscore the need for unit-specific antibiograms to guide empirical therapy.

The rates of multidrug resistance in pathogens isolated from patients hospitalized, especially in the ICU, are quite high. The prevalence of carbapenem resistance in gram-negative bacilli, particularly *K. pneumoniae* and *A. baumannii*, is noteworthy. In gram-positive bacteria, while methicillin resistance is high in MRSA and coagulase-negative

staphylococci, vancomycin remains an effective option. Amikacin is the most reliable antibiotic for gram-negative bacteria, while vancomycin is the most reliable for gram-positive bacteria.

These data indicate the need to review empirical antibiotic treatment protocols in the hospital, update them according to resistance rates, especially in the ICU, and strengthen antibiotic stewardship programs. Furthermore, tightening infection prevention measures is essential for controlling carbapenem-resistant Enterobacterales and highly resistant A. baumannii infections.

Our findings emphasize the urgent need for:

1. Strict infection control measures to prevent cross-transmission of resistant strains
2. Rational antibiotic use guided by local surveillance data
3. Continuous monitoring of resistance patterns through national surveillance systems (UAMDS)
4. Development of antibiotic stewardship programs tailored to ICU settings

Local surveillance data are essential for informing empirical treatment guidelines and infection control policies. Multi-center studies with molecular characterization of resistance mechanisms are needed to better understand the epidemiology and transmission dynamics of resistant pathogens in Turkish ICUs.

Ethical approval

The study was approved by the Non-Interventional Clinical Research Ethics Committee of Mardin Artuklu University (Protocol No: 2025/4-2, dated 22.04.2025).

Declaration of competing interest

The authors declare no competing interests.

Acknowledgements

The authors gratefully acknowledge the administration and medical personnel of Mardin Training and Research Hospital for their invaluable contribution in providing access to the blood culture data and laboratory records. Their collaboration and support made this comprehensive regional report possible.

References

[1] O'Neill J. Tackling drug-resistant infections globally: final report and recommendations. London: Review on Antimicrobial Resistance; 2016.

[2] World Health Organization. Antimicrobial resistance: global report on surveillance. Geneva: WHO; 2014.

[3] World Health Organization. Global antimicrobial resistance and use surveillance system (GLASS) report. Geneva: WHO; 2025.

[4] Kock R, Becker K, Cookson B, van Gemert-Pijnen JE, Harbarth S, Kluytmans J, et al. Methicillin-resistant staphylococcus aureus (MRSA): burden of disease and control challenges in Europe. Euro Surveill. 2010;15:19688.

[5] World Health Organization. Prioritization of pathogens to guide discovery, research and development of new antibiotics for drug-resistant bacterial infections, including tuberculosis. Geneva: WHO; 2017.

[6] Turkish Ministry of Health. National antimicrobial resistance surveillance system report. Ankara: General Directorate of Public Health; 2023.

[7] Doğanay M. Hospital infections. In: Doğanay M, Ünal S, editors. Hospital infections book. Ankara: Bilimsel Tıp Yayınevi; 2003. (Turkish)

[8] Höl Kılınç M. The most common microorganisms and resistance patterns in the adult intensive care unit of Tepecik training and research hospital [master's thesis]. Van: Yüzüncü Yıl University; 2010. (Turkish)

[9] Nicasio AM, Kuti JL, Nicolau DP. The current state of multidrug-resistant gram-negative bacilli in North America. Pharmacotherapy. 2008;28:235-249.

[10] Şenol A, Balin ŞÖ. Common infections in intensive care units, gram-negative microorganisms, antibiotic resistance. KSÜ Tip Fak Derg. 2021;16:35-39. (Turkish)

[11] Versporten A, Bolokhovets G, Ghazaryan L, Abilova V, Pyshnik G, Spasojevic T, et al. Antibiotic use in eastern Europe: a cross-national database study in coordination with the WHO regional office for Europe. Lancet Infect Dis. 2014;14:381-387.

[12] İşli F, Aksoy M, Emre Aydıngöz S, Kadı E. Antibiotic prescription pattern of family physicians across Turkey: a cross-sectional analysis through the prescription information system. Turk J Fam Med Prim Care. 2020;14:87-95.

[13] WHO Regional Office for Europe. Antimicrobial medicines consumption (AMC) network: AMC data 2011–2014. Copenhagen: WHO Regional Office for Europe; 2017.

[14] Wisplinghoff H, Bischoff T, Tallent SM, Seifert H, Wenzel RP, Edmond MB, et al. Nosocomial bloodstream infections in US hospitals: analysis of 24,179 cases from a prospective nationwide surveillance study. Clin Infect Dis. 2004;39:309-317.

[15] Kirn TJ, Weinstein MP. Update on blood cultures: how to obtain, process, report, and interpret. Clin Microbiol Infect. 2013;19:513-520.

[16] Peleg AY, Seifert H, Paterson DL. Acinetobacter baumannii: emergence of a successful pathogen. Clin Microbiol Rev. 2008;21:538-582.

[17] Cesur S, Işık ME, Çimen SS, Aslan T, Demiröz AP, Büyükkocak Ü, et al. Antibiotic susceptibilities of Acinetobacter baumannii strains isolated from various culture samples of patients hospitalized in the intensive care unit. Ortadogu Tip Derg. 2017;9:51-55. (Turkish)

[18] Uğur M, Genç S. Three-year resistance profile of Acinetobacter baumannii and Pseudomonas aeruginosa strains isolated from intensive care units. J Turk Soc Intens Care. 2019;17:130-137. (Turkish)

[19] Kayış A, Orhan Z, Küçük B, Sur H. Acinetobacter baumannii strains isolated from various clinical samples of patients hospitalized in intensive care units and their four-year resistance profiles. Harran Üniv Tip Fak Derg. 2023;20:560-565. (Turkish)

[20] Doğanay D, Aydın M, Avşar İS. Investigation of antibiotic resistance profile of Klebsiella pneumoniae isolates isolated from different clinical samples: one-year data during the Covid-19 pandemic. Ankara Ecz Fak Derg. 2023;47:185-195. (Turkish)

[21] Republic of Turkey Ministry of Health. National healthcare-associated infections surveillance network (USHİESA) pathogen distribution and antibiotic resistance report 2022. Ankara: T.C. Sağlık Bakanlığı; 2022. (Turkish)

[22] Coşar M, Tuncer İ, Arslan U. Antibiotic resistance profile of Pseudomonas aeruginosa strains isolated from blood cultures. Infeksiyon Derg. 2009;23:47-50. (Turkish)

[23] Yücel M, Yavuz T, Kaya D, Koçoğlu E. Monitoring the changes in antibiotic resistance rates of Pseudomonas aeruginosa isolates over the years. Ankem Derg. 2006;20:152-155. (Turkish)

[24] Güngör S, Karaayak Uzun B, Yurtsever S, Baran N. Antibiotic resistance in Staphylococcus aureus strains isolated from cultures. Ankem Derg. 2012;26:171-175. (Turkish)

[25] Ziyad MA. Investigation of antimicrobial susceptibilities and some virulence factors of coagulase negative staphylococci isolated from clinical samples [master's thesis]. İstanbul: İstanbul University Cerrahpaşa; 2023. (Turkish)

[26] Diekema DJ, Pfaller MA, Schmitz FJ, Smayevsky J, Bell J, Jones RN, et al. Survey of infections due to staphylococcus species: frequency of occurrence and antimicrobial susceptibility of isolates collected in the United States, Canada, Latin America, Europe, and the Western Pacific region for the SENTRY antimicrobial surveillance program, 1997–1999. Clin Infect Dis. 2001;32(Suppl 2):S114-S132.

[27] Kilbas I, Ciftci IH. Antimicrobial resistance of enterococcus isolates in Turkey: a meta-analysis of current studies. J Glob Antimicrob Resist. 2018;12:26-30.

[28] Opota O, Croxatto A, Prod'hom G, Greub G. Blood culture-based diagnosis of bacteraemia: state of the art. Clin Microbiol Infect. 2015;21:313-322.