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Susceptibility Patterns of Multidrug-Resistant Acinetobacter *Baumannii* among, Intensive Care, Unit Patients

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Abstract: **Background:** In intensive care units (ICUs), Acinetobacter baumannii is a prevalent cause of healthcare-associated infections, and antibiotic resistance significantly constrains treatment alternatives.

The objectives of this study were to assess the antimicrobial susceptibility profiles of A. baumannii isolates from intensive care unit patients, determine the prevalence of extensively drug-resistant (XDR) and multidrug-resistant (MDR) phenotypes, and quantify the resistance burden across critical antibiotic classes.

Methods: The results of antimicrobial susceptibility testing were analyzed following CLSI guidelines. Five types of antimicrobials were employed to evaluate resistance, and isolates were classified as multidrug-resistant (MDR) or extensively drug-resistant (XDR) according to standardized criteria. The resistance load of MDR and XDR isolates was analyzed, and mean resistance scores along with standard deviations were calculated.

Findings: All primary classes of antibiotics exhibited elevated resistance rates, particularly towards carbapenems, fluoroquinolones, and cephalosporins. The majority of isolates were classified as XDR, indicating resistance to nearly all tested antibiotic classes. XDR isolates had consistently higher resistance scores than MDR isolates, signifying more advanced resistance profiles.

Conclusion: Enhanced antibiotic stewardship, continuous resistance monitoring, and rigorous infection control protocols are urgently required, as demonstrated by the prevalence of XDR A. baumannii in intensive care units.

Introduction:

Acinetobacter baumannii is an aerobic, non-fermentative, Gram-negative coccobacillus that has emerged as a significant global contributor to healthcare-associated infections, particularly within intensive care units (ICUs).

In critically ill patients, it is frequently associated with wound infections, bloodstream infections, urinary tract infections, and ventilator-associated pneumonia. The organism's remarkable ability to survive for prolonged durations on dry surfaces and medical equipment enhances its persistence in hospital environments and facilitates its transmission in intensive care units. (Wong et al., 2022).

A. baumannii has demonstrated a significant capacity to acquire resistance to multiple classes of antimicrobial agents in recent years, leading to the widespread emergence of extensively drug-resistant (XDR) and multidrug-resistant (MDR) strains. Multidrug-resistant A. baumannii (MDR-AB) is defined as A. baumannii that exhibits resistance to a minimum of three major classes of antibiotics, including β-lactams, aminoglycosides, and fluoroquinolones. The World Health

Organization has classified carbapenem-resistant A. baumannii as a critical priority pathogen due to limited treatment options and its association with increased morbidity and mortality rates (Tacconelli et al., 2023; World Health Organization [WHO], 2024).

Patients in intensive care units are at increased risk of infections caused by MDR A. baumannii due to prolonged hospitalizations, mechanical ventilation, invasive procedures, immunosuppression, and repeated exposure to broad-spectrum antibiotics. Prolonged ICU admissions, increased healthcare costs, and adverse clinical outcomes are associated with these infections.

Despite the fact that carbapenems were originally thought to be the mainstay of treatment, resistance rates have sharply increased, requiring the use of last-line medications like colistin, tigecycline, and combination regimens, which may be linked to nephrotoxicity and inconsistent clinical efficacy.((Wong et al., 2022) , (Paul et al., 2022)).

In many healthcare settings, empirical antibiotic therapy is being started without updated local susceptibility data, despite the increasing global incidence of MDR *A. baumannii*. A. baumannii's antimicrobial resistance patterns fluctuate greatly between hospitals, geographical areas, and even within ICUs within the same facility, underscoring the significance of ongoing local surveillance. (Wong et al., 2022), (Tacconelli et al., 2023).

Recent information on the antibiotic susceptibility patterns of MDR *A. baumannii* isolated from ICU patients in the Middle East, particularly Iraq, is still scant and inconsistent. The Current studies predominantly focus on the molecular identification of resistance genes, rather than comprehensive susceptibility profiling relevant to clinical practice. Alibrahim et al. (2025); Habash and Jabir (2025).

The lack of current, institution-specific data represents a significant research gap that limits evidence-based empirical therapy, hinders antimicrobial stewardship efforts, and obstructs the implementation of effective infection control strategies. Continuous monitoring of antimicrobial susceptibility patterns is essential for identifying new resistance trends, guiding the selection of appropriate antibiotics, and preventing the development of multidrug-resistant A. baumannii in critical care settings.

The current study aims to evaluate the antimicrobial susceptibility patterns of multidrug-resistant Acinetobacter baumannii isolated from ICU patients. This assessment seeks to provide current local epidemiological data to support clinical decision-making, optimize antimicrobial use, and contribute to strategies for controlling antimicrobial resistance in ICU settings.

Methodology:

1-Study Design

This study evaluated *Acinetobacter baumannii* isolates collected over a six-year period using a cross-sectional laboratory-based design. The study adhered to international standards, focusing on antimicrobial susceptibility patterns and laboratory confirmation through automated.

The study was carried out in the hospital's clinical microbiology laboratory, where routine procedures include bacterial isolation, identification, and antimicrobial susceptibility testing (AST).

2- Sample Collection and Bacterial Identification

The microbiology laboratory analyzed various patient specimens to generate clinical isolates of *A. baumannii*. Standard biochemical techniques and automated systems were used for routine identification in accordance with laboratory protocols.

3- Data Collection Method

Information was gathered between January 2020 and January 2026.

From January 2020 to August 2025, laboratory results were obtained from archived microbiology records that had previously been produced as part of standard diagnostic procedures.

By using the VITEK® 2 Compact system to conduct antimicrobial susceptibility testing (AST) on newly obtained isolates from september 2025 to January 2026. The most recent CLSI guidelines in effect at the time of testing were used to interpret all AST procedures.

To guarantee accuracy and consistency in all newly generated and retrieved laboratory results, a single template was used for data recording.

4- Antimicrobial Susceptibility Testing (AST)

The VITEK® 2 Compact automated system was used to carry out AST. The Clinical and Laboratory Standards Institute (CLSI) performance standards were followed in the interpretation of the results. To verify test reliability, CLSI-recommended quality control strains were used.

Results:

Table 1. Susceptibility pattern of A. baumannii isolates to tested antibiotics

Antibiotic	Sensitive (%)	Intermediate (%)	Resistant (%)
Gentamycin	6.8	1.7	91.5
Piperacillin_Tazobactam	1.1	2.8	96.0
Ciproflaxicin	0.0	0.0	100.0
Cefepime	3.4	8.5	88.1
Imipenem	2.3	0.0	97.7
Meropenem	15.8	1.1	83.1
Ceftazidem	3.4	0.0	96.6

High resistance rates were observed for most β-lactams and carbapenems, indicating limited therapeutic options.

Table 2. Distribution of Multidrug-Resistant and Extensively Drug-Resistant Isolates

Resistance Status	Frequency	Percentage (%)
XDR	159	89.8
MDR	18	10.2

The majority of isolates were identified as multidrug-resistant (MDR), with a significant proportion fulfilling the criteria for extensively drug-resistant (XDR).

Table 3. Antimicrobial susceptibility patterns of A. baumannii isolates

Antibiotic	Sensitive n (%)	Intermediate n (%)	Resistant n (%)	Total
Gentamycin	12 (6.8)	3 (1.7)	162 (91.5)	177
Piperacillin_Tazobactam	2 (1.1)	5 (2.8)	170 (96.0)	177
Ciproflaxicin	0 (0.0)	0 (0.0)	177 (100.0)	177
Cefepime	6 (3.4)	15 (8.5)	156 (88.1)	177
Imipenem	4 (2.3)	0 (0.0)	173 (97.7)	177
Meropenem	28 (15.8)	2 (1.1)	147 (83.1)	177
Ceftazidem	6 (3.4)	0 (0.0)	171 (96.6)	177
Cat_BLBLI_R	0 (0.0)	0 (0.0)	0 (0.0)	177
Cat_Ceph_R	0 (0.0)	0 (0.0)	0 (0.0)	177
Cat_Carb_R	0 (0.0)	0 (0.0)	0 (0.0)	177
Cat_FQ_R	0 (0.0)	0 (0.0)	0 (0.0)	177
Cat_AG_R	0 (0.0)	0 (0.0)	0 (0.0)	177
Resistant_Cat_Count	0 (0.0)	0 (0.0)	0 (0.0)	177

Resistance rates were highest for carbapenems and fluoroquinolones, underscoring the significant drug resistance profile of ICU A. baumannii isolates.

Table 4. Distribution of resistance by antimicrobial categories

Antimicrobial category	Resistant isolates (n)	Non-resistant isolates (n)	Resistance (%)
Carbapenems	174	3	98.3
Aminoglycosides	162	15	91.5
Fluoroquinolones	177	0	100.0
Cephalosporins	177	0	100.0
BL-BLI	170	7	96.0

Carbapenems are the most compromised antimicrobial class, followed by fluoroquinolones and aminoglycosides.

Table 5. Distribution of multidrug-resistant and extensively drug-resistant *Acinetobacter baumannii* isolates

Resistance classification	Number of isolates	Percentage (%)
XDR	**159**	**89.8**
MDR	**18**	**10.2**

The prevalence of MDR and XDR isolates highlights the critical necessity for rigorous antimicrobial stewardship in ICU environments.

Table 6. Mean and Standard Deviation of Resistance Scores

Antimicrobial susceptibility results were numerically encoded for statistical description, with S assigned a value of 0, I a value of 0.5, and R a value of 1. Mean resistance scores and standard deviations were computed for each category of antimicrobial agents.

Antimicrobial Category	Mean resistance score	Standard Deviation (SD)
Carbapenems	0.91	0.21
Aminoglycosides	0.92	0.26
Fluoroquinolones	1.00	0.00
Cephalosporins	0.94	0.14
BL-BLI	0.97	0.13

Higher mean resistance scores signify an increased resistance burden. Carbapenems exhibited the highest mean resistance score, indicating a significant reduction in their efficacy.

Table 7. Mean and Standard Deviation by MDR and XDR Status

Antimicrobial susceptibility results were represented using numerical encoding: S = 0, I = 0.5, R = 1. Mean resistance scores and standard deviations were computed independently for MDR and XDR isolates to evaluate the resistance burden across antimicrobial categories.

Resistance Group	Antimicrobial Category	Mean resistance score	Standard Deviation (SD)	No. of isolates
MDR	Carbapenems	0.83	0.38	18
MDR	Aminoglycosides	0.25	0.39	18
MDR	Fluoroquinolones	1.00	0.00	18
MDR	Cephalosporins	0.88	0.20	18
MDR	BL-BLI	0.86	0.29	18
XDR	Carbapenems	0.92	0.19	159
XDR	Aminoglycosides	1.00	0.00	159
XDR	Fluoroquinolones	1.00	0.00	159
XDR	Cephalosporins	0.95	0.13	159
XDR	BL-BLI	0.99	0.10	159

XDR isolates exhibited consistently elevated mean resistance scores across all antimicrobial categories in comparison to MDR isolates, indicating significant therapeutic constraints.

Discussion:

The present study indicates that Acinetobacter baumannii isolates obtained from intensive care unit patients exhibit a troubling antimicrobial resistance profile, characterized by a notable prevalence of extensively drug-resistant (XDR) strains and markedly high resistance rates among various antibiotic classes.These results are consistent with the growing worldwide problem of *A. baumannii* resistance that has been documented in recent literature since 2024, especially in critical care environments.

Table 1 illustrates that resistance to the majority of tested antibiotics exceeded 85–100% with carbapenems exhibiting resistance rates exceeding 80–97% and fluoroquinolones exhibiting total resistance (100%). These results show that in the ICU population under study, first-line and second-line treatment options for *A. baumannii* infections are essentially useless. Similar resistance patterns have been reported in recent global surveillance studies, highlighting the endemic nature of carbapenem-resistant A. baumannii (CRAB) in intensive care units around the globe.(World Health Organization [WHO], 2024), (Centers for Disease Control and Prevention [CDC], 2024).

The extensive distribution of strains that produce carbapenemase and the weak protective impact of β-lactamase inhibitors against *A. baumannii* are further reflected in the exceptionally high resistance to piperacillin-tazobactam and cephalosporins. (Bonomo et al., 2024).

89.8% of isolates were classified as XDR, whereas only 10.2% were MDR, according to the resistance classification analysis (Tables 2 and 5). Although this percentage of XDR isolates is significantly greater than that found in previous pre-2020 research, it is becoming more in line with recent ICU-based data from 2024 that show a move toward XDR dominance in areas with heavy antimicrobial pressure. (Al-Hassan et al., 2024), (Rodríguez-Baño et al., 2024).

The prevalence of XDR isolates indicates a crucial point in A. baumannii's resistance evolution, where isolates are still susceptible to one or none of the other antimicrobial classes, severely restricting treatment options.

The findings presented in Table 3 demonstrate extremely high resistance rates among Acinetobacter baumannii isolates to most tested antibiotics, particularly carbapenems and fluoroquinolones, indicating severely limited therapeutic options. The complete resistance to ciprofloxacin and significant resistance to imipenem and piperacillin–tazobactam underscore the diminishing efficacy of standard treatments in intensive care unit environments. The findings align with recent global reports that classify carbapenem-resistant A. baumannii as a critical priority pathogen (Bonomo et al., 2024; World Health Organization [WHO], 2024). Comparable resistance patterns have been observed in ICU-based studies, indicating persistent antimicrobial pressure and clonal spread of resistant strains (Al-Hassan et al., 2024). The data highlight the necessity for stringent antimicrobial stewardship and ongoing resistance surveillance in critical care units (Tacconelli et al., 2024). Analysis of categorical resistance indicated near-universal resistance to cephalosporins and fluoroquinolones at 100%, with carbapenems at 98.3% and β-lactam/β-lactamase inhibitor combinations at 96.0%.These results are consistent with recent genomic and epidemiological research showing widespread horizontal gene transfer and clonal proliferation of high-risk *A. baumannii* lineages in hospital settings.(Hamidian & Holt, 2024), (Zarrilli et al., 2025).

The persistent high resistance in all categories indicates that the selection and persistence of highly resistant clones are still influenced by antimicrobial pressure in intensive care units.

All antibiotic categories showed consistently high mean values in the quantitative evaluation of resistance using mean resistance scores (Table 6), with fluoroquinolones obtaining a mean score of 1.00 and zero standard deviation, indicating uniform resistance across all isolates. Additionally, aminoglycosides and carbapenems had high mean scores with little variation, indicating a population that was uniformly resistant.

Recent antimicrobial resistance research has increasingly suggested using this numerical methodology to supplement categorical AST reporting since it offers a reliable and repeatable way to measure the burden of resistance. (Karakonstantis & Kritsotakis, 2024).

XDR isolates exhibited higher mean resistance scores than MDR isolates across all antimicrobial categories, as indicated by the stratified analysis (Table 7). MDR isolates exhibited partial susceptibility to aminoglycosides, whereas XDR isolates demonstrated complete resistance to both fluoroquinolones and aminoglycosides.

Recent clinical research published in 2024 indicates that XDR A. baumannii infections are associated with poorer clinical outcomes compared to MDR infections, including increased fatality rates, extended ICU stays, and elevated healthcare costs. Sousa et al. (2024); Bassetti et al. (2025).

The prevalence of XDR A. baumannii isolates identified in this study presents a significant threat to healthcare systems and patient safety. To mitigate the transmission of XDR strains in ICU environments, current research emphasizes the urgent implementation of rigorous antimicrobial stewardship programs, enhanced infection prevention and control strategies, and continuous resistance monitoring. Tacconelli et al. (2024); Isler et al. (2025).

Conclusions

This investigation reveals a concerning prevalence of antimicrobial resistance in Acinetobacter baumannii isolates within intensive care units, characterized by a significant proportion of highly drug-resistant organisms and limited treatment options. The findings indicate that A. baumannii significantly jeopardizes ICU patient outcomes and highlight the urgent necessity for rigorous antimicrobial stewardship, continuous resistance monitoring, and enhanced infection control strategies.

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