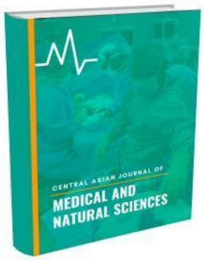


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*Article*

# Multidrug-Resistant *Acinetobacter baumannii* Isolated from Clinical Samples in Al-Najaf City, Iraq

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**Abstract:** Acinetobacter baumannii has emerged as a major cause of opportunistic pathogens associated with hospital-acquired infections and multidrug resistance worldwide. The currwnt study aimed to determine the antimicrobial susceptibility patterns of Acinetobacter baumannii isolated from different clinical samples at Al-Najaf city, Iraq. A cross-sectional study was conducted over a six-month period (March to September 2024). A total of 25 clinical isolates A. baumannii were obtained from various clinical specimens. Antimicrobial susceptibility testing was conducted using minimum inhibitory concentration (MIC) methods using the VITEK-2 automated system according to standard guidelines. Statistical analysis was performed using SPSS software, with a p-value ≤ 0.05 was considered statistically significant. Females revealed a slightly higher infection rate (56%) than males (44%). Sputum were the most common source of isolation (32%), followed by urine (28%) and blood samples (20%). A high resistance levels were observed against ceftazidime (80%), cefotaxime (72%), and imipenem (68%). Colistin showed the highest sensitivity rate (92%) with highly significant difference (P=0.0001). The study showed a high prevalence of multidrug-resistant Acinetobacter baumannii particularly in intensive care units settings. Colistin remains the most effective antimicrobial agent. Continuous surveillance and effective antibiotic stewardship are needed to limit the spread of resistant strains.

**Keywords:** *Acinetobacter baumannii*, Antimicrobial Susceptibility, Multi-Drug Resistance, *ICU*

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## 1. Introduction

*Acinetobacter baumannii* is an aerobic Gram-negative coccobacillus that has emerged as one of the most important opportunistic pathogens associated with hospital-acquired infections [1], especially in hospitalized and critically ill patients [2], [3]. Its clinical importance is largely attributed to its extraordinary ability to survive in hospital environments, colonize medical devices, and resist desiccation and disinfectants, facilitating its persistence and transmission within healthcare settings [4], [5]. These characteristics make it a leading cause of hospital-acquired infections, specifically in intensive care units (ICUs), where it is responsible for a wide range of infections especially infections that difficult to treat such as ventilator-associated pneumonia, bloodstream infections, urinary tract infections, and wound infections [6], [7]. These infections associated with higher patient morbidity rates, death, and treatment expenses [8]. Mortality rates from *A. baumannii* infections have risen during the last ten years, ranging from 30% to 75% in various parts of the globe [9].

Multidrug-resistant *A. baumannii* is particularly prevalent in intensive care units due to the extensive use of invasive medical devices and broad-spectrum antibiotics [4], [10], [11]**.** In recent years, Multidrug-resistant (MDR) *A. baumannii* strains have increasingly been reported worldwide, showing high resistance rates to commonly used antibiotics, particularly cephalosporins, carbapenems, and fluoroquinolones [12]. The emergence of carbapenem-resistant strains reported a serious threat to community health because carbapenems are often used as last-line treatment for severe infections [13]. Different mechanisms of resistance may be acquired by *A. baumannii*, which can eventually become resistant to all routinely used antibiotics in certain situations which significantly limit therapeutic options [14].

However, some antibiotics such as colistin still demonstrate relatively preserved activity against certain isolates. Bostanghadiri·s meta-analysis study reported a low prevalence of colistin resistance among *A. baumannii* isolates responsible for infections worldwide from 2000 to 2023 [15]. However, there is a high prevalence of colistin-resistant isolates in certain countries [16]. The wide use of antibiotics in immunocompromised patients at intensive care units and the absence of antibiotic stewardship programs in hospital settings have led to the occurrence of pathogens that are multiple drug-resistant (MDR) and the rise of extensively drug-resistant (XDR) strains. Therefore, clinicians were forced to depend on colistin as the last antibiotic option to combat infections caused by *A. Baumannii* [15], [17].

In Iraq and many developing countries, limited data are available regarding the resistance patterns of *A. baumannii*. Therefore, continuous monitoring of antimicrobial susceptibility is essential for effective treatment and infection control. Hence, this study aimed to evaluate the distibution and antimicrobial susceptibility patterns of *A. baumannii* isolated from clinical samples in Al-Najaf City, Iraq, in order to provide valuable data for improving patient management and controlling the spread of resistant strains.

## 2. Materials and Methods

This cross-sectional study was conducted in Al Najaf city, Iraq over a six-month period (March to September 2024). A total of 25 *A. baumannii* isolates were recovered from various clinical specimens including sputum, urine, blood, wound swabs, and ear swabs. Microbiological standard diagnostic criteria were used to isolate and identify the clinical isolates of *A. baumannii*, which included colony morphology, gram staining and conventional tests of biochemical. All samples were subjected to antimicrobial susceptibility testing using automated system (VITEK-2).

## 3. Results

The A total of 25 clinical isolates of *Acinetobacter baumannii* from different specimens and locations, different age groups and different sex. Females constituted a slightly higher proportion of cases than males. The wide age range indicates that *A. baumannii* infections affect all age groups, with a higher frequency among adults and elderly patients, (Table 1).

Respiratory samples represented the most common source of isolation, indicating that *A. baumannii* is predominantly associated with respiratory tract infections, particularly in hospitalized patients, (Table 2).

**Tables 1.** Demographic characteristics of patients infected with Acinetobacter baumannii.

| Variable | Category | No. (%) |
|---|---|---|
| Gender | Male | 11 (44.0) |
| | Female | 14 (56.0) |
| | Minimum | 10 |

| | | |
|---|---|---|
| Age (years) | Maximum | 77 |
| | Mean (approx.) | 41 |

**Table 2.** Distribution of A. baumannii isolates according to clinical sample

| Clinical sample | No. (%) |
|---|---|
| Sputum | 8 (32 %) |
| Urine | 7 (28 %) |
| Blood | 5 (20 %) |
| Wound swab | 4 (16 %) |
| Other (ear swab) | 1 (4 %) |
| Total | 25 (100 %) |

Nearly half of the isolates were recovered from ICU patients, highlighting the role of intensive care units as a major reservoir for *A. baumannii* infections (Table 3).

The distribution of resistant and sensitive isolates, along with corresponding p-values, is summarized in Table 4. Among the 25 tested isolates, the highest level of resistance was observed to ceftazidime in 80% (20/25), followed by cefotaxime at 72% (18/25) with statistically significant ($p = 0.003$ and $p = 0.028$, respectively), indicating a non-random distribution of resistance patterns.

Among carbapenems, resistance to imipenem and meropenem was observed in 68% (17/25) and 64% (16/25) of isolates, respectively. Although these findings did not reach statistical significance ($p > 0.05$), the high prevalence of carbapenem resistance was notable. Fluoroquinolone resistance was also common, with ciprofloxacin resistance identified in 60% (15/25) of isolates and levofloxacin resistance in 52% (13/25). No statistically significant differences were observed for this antibiotic class ($p > 0.05$).

Regarding aminoglycosides, amikacin demonstrated comparatively higher activity, with 60% (15/25) of isolates remaining sensitive, whereas gentamicin sensitivity was observed in 52% (13/25) of isolates. These differences were not statistically significant ($p > 0.05$). Resistance to trimethoprim/sulfamethoxazole was detected in 56% (14/25) of isolates, indicating limited effectiveness against the studied strains. In contrast, colistin exhibited the highest antimicrobial activity (92%). This finding was highly statistically significant ($p < 0.001$).

**Table 3.** Distribution of isolates according to hospital location

| No. (%) | Hospital location |
|---|---|
| 11 (44 %) | Intensive Care Unit (RCU/ICU) |
| 9 (36 %) | Outpatient department (OP) |
| 5 (20 %) | Inpatient wards (IP) |
| 25 (100 ) | Total |

**Table 4.** Antimicrobial Susceptibility Pattern of Acinetobacter baumannii Isolates (n = 25)

| Antibiotic | 25 isolates | | p value |
|---|---|---|---|
| | Resistant (%) | Sensitive (%) | |
| Amoxicillin/Clavulanic acid | 11 (44%) | 14 (56%) | 0.548 |

| | | | |
|---|---|---|---|
| Piperacillin–Tazobactam | 15 (60%) | 10 (40%) | 0.317 |
| Ceftazidime | 20 (80%) | 5 (20%) | 0.003 |
| Cefotaxime | 18 (72%) | 7 (28%) | 0.028 |
| Ceftriaxone | 16 (64%) | 9 (36%) | 0.161 |
| Cefepime | 14 (56%) | 11 (44%) | 0.548 |
| Imipenem | 17 (68%) | 8 (32%) | 0.073 |
| Meropenem | 16 (64%) | 9 (36%) | 0.161 |
| Ciprofloxacin | 15 (60%) | 10 (40%) | 0.317 |
| Levofloxacin | 13 (52%) | 12 (48%) | 0.841 |
| Gentamicin | 12 (48%) | 13 (52%) | 0.841 |
| Amikacin | 10 (40%) | 15 (60%) | 0.317 |
| Trimethoprim/Sulfamethoxazole | 14 (56%) | 11 (44%) | 0.548 |
| Colistin | 2 (8%) | 23 (92%) | 0.0001 |

## 4. Discussion

The present study demonstrates the significant burden of multidrug-resistant (MDR) *Acinetobacter baumannii* in clinical settings in Al-Najaf City, Iraq, confirming its role as a major opportunistic pathogen associated with healthcare-associated infections. The demographic findings showed that infection occurred in both males (44%) and females (56%), with a mean age of approximately 41 years and a wide age range (10–77 years). A Saudi study recorded *A. Baumannii* among differing age means and gender across various regions throughout several years [18]. These findings support the concept that *A. baumannii* is an opportunistic pathogen whose epidemiology is closely linked to healthcare environments [3], [19], [20], rather than intrinsic host demographic factors.

In the current study, the predominance of isolates recovered from respiratory samples (32%), particularly sputum samples in line with similar studies by **Adeyemi** et al. [21] is consistent with previous reports indicating that *A. baumannii* confirms its strong association with respiratory infections, particularly ventilator-associated pneumonia (VAP) in hospitalized and ICU patients. Similar findings have been reported in studies from diffrent countries where respiratory tract infections accounted for the majority of *A. baumannii* isolations [18], [22].

The high proportion of urinary and bloodstream (28% and 20% respectinely) isolates observed in the present study further highlights the organism's ability to cause severe invasive infections, including bacteremia and catheter-associated urinary tract infections, which are associated with increased mortality rates. These findings emphasize the invasive potential and clinical severity of *A. baumannii* infections [8], [23], [25].

The present study showed a high prevalence of multidrug-resistant *A. baumannii*, particularly among ICU patients. Similar findings were reported globally, where ICU settings represent the primary reservoir for this pathogen [4], [11], [18], [26].

Selecting an efficient antibiotic treatment for *A. baumannii* infections has become challenging due to the widespread occurrence of MDR, Extensive Drug Resistance (XDR), and Pandrug Resistance (PDR) infections. Analyzing this organism's patterns of antibiotic resistance over time may provide important information on the best course of action. This research took into account the prevalence rate of MDR-AB in *Al-Najaf city, Iraq.*

The antimicrobial susceptibility results revealed alarmingly high resistance rates to β-lactam antibiotics, particularly third-generation cephalosporins. Resistance to ceftazidime (80%) and cefotaxime (72%) was statistically significant (P=0.003 and P=0.028, respectively), indicating widespread resistance to these commonly used agents. These findings are consistent with recent global reports demonstrating resistance rates exceeding 70% for third-generation cephalosporins [27] According to a recent study, it was found that over 90% of the isolates of *A. baumannii* displayed resistance to ticarcillin/clavulanic acid, piperacillin/tazobactam, ceftazidime, ciprofloxacin, imipenem, and meropenem [28], [29]. In comparison, our results showed less resistance to ceftazidime (80%), to imipenem (68%), meropenem (64%), and 60% to both piperacillin/ tazobactam and ciprofloxacin (Table 2).

The high resistance to carbapenems observed in this study is particularly concerning, as carbapenems have historically been considered the drugs of choice for severe *A. baumannii* infections. Comparable resistance rates have been reported with recent global studies showing carbapenem resistance exceeding 85% in several countries, mostly in developing countries [28]-[33].

The increasing resistance observed in this study reflects the global emergence of carbapenem-resistant *A. baumannii* (CRAB), which has been classified by the World Health Organization as a critical priority pathogen [34].

Aminoglycosides showed relatively lower resistance rates, with gentamicin and amikacin resistance observed in 48% and 40% of isolates, respectively. The relatively better activity of aminoglycosides observed in this study is consistent with previous reports identifying amikacin as one of the more effective antibiotic against MDR *A. Baumannii* [21]. However, the moderate resistance rate still limits its effectiveness as a reliable empirical treatment option.

Colistin exhibits the highest sensitivity, colistin remained the most effective antibiotic, with susceptibility observed in more than 90% of isolates, These findings are consistent with recent reports in Iraq, Sudia, Iran, Jourden, India [18], [20], [35]-[37]. This finding is consistent with local and international studies that continue to recognize colistin as a last-line therapeutic option against MDR and XDR *A. Baumannii* [35], [38]-[41].

The emergence of multidrug resistance may be attributed to excessive antibiotic use, biofilm formation, production of degradative enzymes, change in metabolic status, a decrease in bacterial membrane permeability, the alteration of anti biotic targets, the overexpression of efflux pumps, and gene transfer mechanisms [42]-[46].

However, the emergence of colistin-resistant strains worldwide [16], raises serious concerns regarding future treatment options, emphasizing the need for cautious and judicious use due to its nephrotoxic and neurotoxic potential.

## 5. Conclusion

This study revealed a high prevalence of multidrug-resistant Acinetobacter baumannii as an important nosocomial pathogen in Al-Najaf city, particularly in ICU settings. Colistin remains the most effective antibiotic. Continuous monitoring is needed to identify emerging A. baumannii resistance patterns and to implement effective antibiotic management to limit the spread of resistant strains.

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