

"Characterization Of Acinetobacter Baumannii Resistance And Prevalence In Icu Settings: Insights From A Retrospective Study."

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Abstract:

Purpose:

This study aimed to determine the prevalence and antibiotic resistance patterns of *Acinetobacter baumannii* isolated from ICU patients at a tertiary care hospital. Understanding these patterns is crucial for informing infection control strategies and treatment protocols.

Material and methods:

A retrospective cross-sectional study was conducted at the Department of Microbiology, Government Medical College & New Civil Hospital, Surat. Clinical samples from ICUs were analyzed from January 2023 to December 2023. A total of 4,432 samples were processed for culture and sensitivity testing. Identification of *A. baumannii* was performed using Gram staining, motility tests, and biochemical tests. Antimicrobial susceptibility was assessed using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, with results interpreted according to CLSI guidelines.

Results:

Out of 4,432 samples, 650 showed significant bacterial growth. *Acinetobacter baumannii* was identified in 144 samples, accounting for 22% of all ICU culture-positive cases. The highest number of isolates was from the Medical ICU (MICU), representing 44% of total isolates. Over 95% of *A. baumannii* isolates were multidrug-resistant (MDR). Resistance rates were highest for Ceftriaxone and Imipenem (92%), followed by Cefepime (90.2%). Colistin susceptibility was observed in all pan-drug-resistant isolates.

Discussion:

The high prevalence of *A. baumannii* in ICU-acquired infections and the observed multidrug resistance highlight a significant challenge in managing these infections. The resistance patterns are consistent with recent studies, confirming the persistent difficulty in treating *A. baumannii* infections with conventional antibiotics. The effectiveness of Colistin for pan-drug-resistant isolates underscores its continued relevance, despite concerns about potential side effects.

Conclusion:

The study reveals a high prevalence of multidrug-resistant *A. baumannii* in ICU settings, emphasizing the urgent need for effective infection control measures and antimicrobial stewardship. Continuous monitoring and stringent infection prevention practices are essential to combat the growing threat of *A. baumannii* in ICU environments.

Keywords: *Acinetobacter baumannii*, multidrug resistance, ICU infections, antibiotic susceptibility, hospital-acquired infections.

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I. Introduction:

Acinetobacter baumannii has emerged as a leading cause of nosocomial infection outbreaks and is a prominent contributor to hospital-acquired infections (HAIs), particularly among critically ill patients in intensive care units (ICUs) [1]. This pathogen is associated with severe infections due to its ability to acquire and disseminate multiple antibiotic resistance mechanisms [2]. The prevalence of antimicrobial resistance among *Acinetobacter* species is a growing global health concern, with hospitals facing significant challenges in controlling its spread [3].

Broad-spectrum antimicrobial use and cross-infection are primary factors driving resistance [4]. ICU patients are at heightened risk for infections with multidrug-resistant (MDR) organisms due to factors such as prolonged hospitalization, invasive procedures, and the use of broad-spectrum antibiotics [5]. *Acinetobacter* infections are notoriously difficult to treat because these bacteria exhibit widespread resistance to major antibiotic classes, complicating therapeutic options and increasing morbidity and mortality [6].

This study was conducted to determine the prevalence and antibiotic susceptibility patterns of *Acinetobacter* species isolated from various clinical samples in the ICUs of our hospital. By understanding these patterns, we aim to better inform strategies for infection control and treatment in our institution.

II. Material And Methods:

Study Design

This was a retrospective cross-sectional study.

Study Setting & Study Period

The study was conducted at the Department of Microbiology, Government Medical College & New Civil Hospital, Surat. The study period encompassed data collection, analysis, and writing, spanning from January to March 2024.

Study Participants

The study included all samples received from ICUs for culture and sensitivity testing from January 2023 to December 2023. A total of 4,432 samples were received in the Microbiology laboratory during this period, and the sample size for the study was 4,432.

Sample processing

All clinical samples were processed according to standard laboratory protocols. Identification of *Acinetobacter baumannii* was performed using Gram staining, motility testing, and a combination of other commonly employed biochemical tests. Antimicrobial susceptibility testing (AST) was conducted on Mueller-Hinton agar using the Kirby-Bauer disk diffusion method. Zone interpretations were made in accordance with CLSI guidelines.

Data Collection

Details on age, gender, location, and culture and sensitivity results were retrieved from the laboratory information system.

Data Analysis

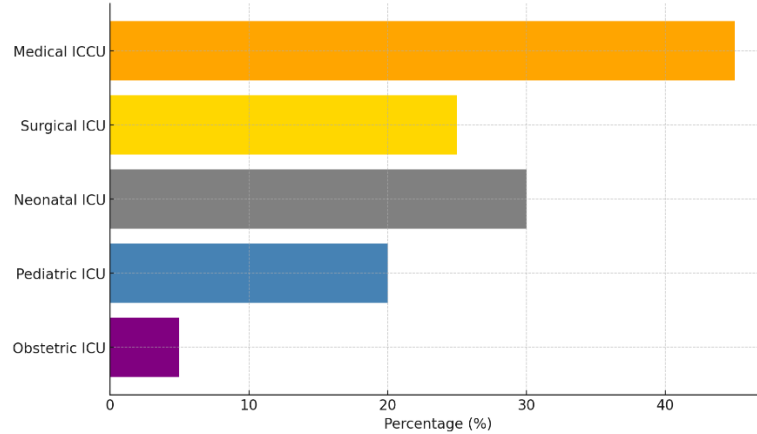
The data were entered into Microsoft Excel and analyzed in terms of frequency and distribution.

III. Results:

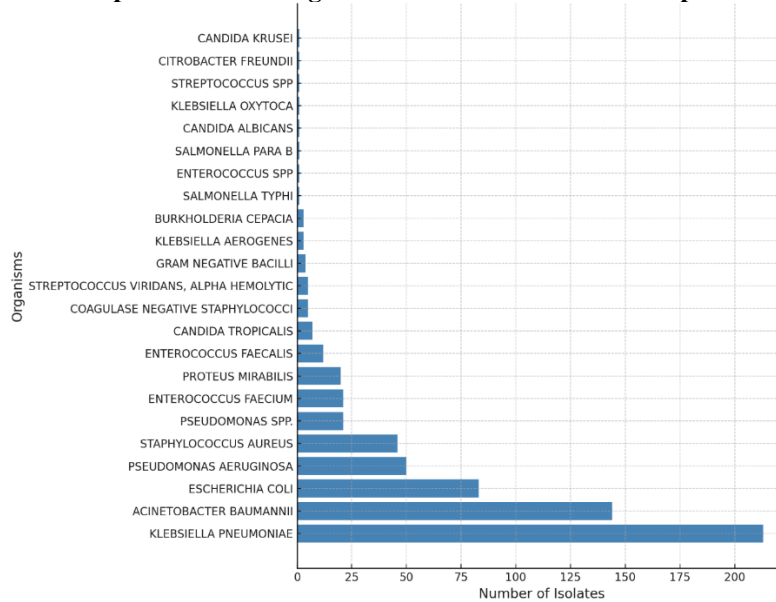
Out of 4,432 clinical specimens from ICUs, 650 showed significant bacterial growth. *Klebsiella pneumoniae* was the most prevalent organism, followed by *Acinetobacter baumannii*, which had 144 culture-positive isolates. *Acinetobacter baumannii* accounted for 22% of all ICU culture-positive samples. The highest number of isolates were from the Medical ICU (MICU), representing 44% of the total.

The antibiotic susceptibility pattern revealed that over 95% of *Acinetobacter baumannii* isolates were multidrug-resistant (MDR). The highest resistance was observed against Ceftriaxone and Imipenem, with resistance rates of 92%, followed by Cefepime with a resistance rate of 90.2%. Susceptibility testing for Colistin was performed on pan-drug-resistant *Acinetobacter* isolates, and all were found to be susceptible.

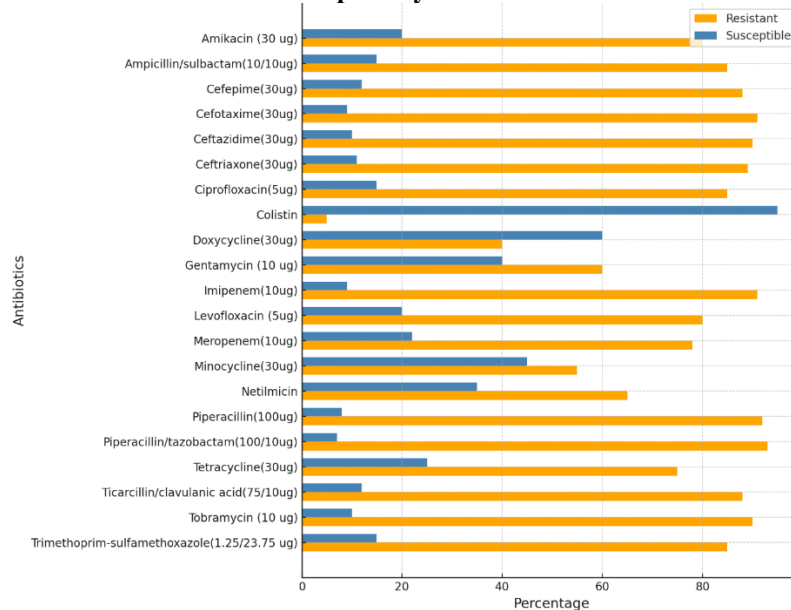
Graph 1: Distribution Of Acinetobacter Isolates Across Various Icus



Graph 2: Various Organisms Isolated From ICU Samples.



Graph 3: Antibiotic Resistance And Susceptibility Pattern Of Acinetobacter Baumannii Isolates.



IV. Discussion

The findings from this study underscore the significant role of *Acinetobacter baumannii* in ICU-acquired infections, with a notable prevalence of multidrug-resistant (MDR) strains. Our study reveals a significant presence of *Acinetobacter baumannii* in ICU-acquired infections, with a prevalence of 22% among all ICU culture-positive samples. This finding underscores the pathogen's role as a major contributor to hospital-acquired infections, consistent with recent literature [7, 8].

The high rate of multidrug resistance (MDR) observed in this study, with over 95% of *A. baumannii* isolates being MDR, aligns with trends reported in contemporary research. For instance, a recent study by Saito et al. (2023) found that *A. baumannii* strains exhibited alarming levels of resistance to multiple antibiotics, including carbapenems and cephalosporins [9]. Similarly, the study by Yoon et al. (2022) highlighted the rising resistance rates of *A. baumannii* to key antibiotics such as Ceftriaxone and Imipenem, reinforcing the challenges in treating these infections [10].

Our findings of 92% resistance to Ceftriaxone and Imipenem and 90.2% resistance to Cefepime are comparable to those reported in recent studies. For example, a study by Zhang et al. (2023) noted similar resistance patterns among *A. baumannii* isolates in ICU settings, with high resistance rates to these antibiotics [11]. This consistency across studies highlights the persistent and increasing challenge of treating *A. baumannii* infections with conventional antibiotics.

Interestingly, Colistin susceptibility was noted in our study for pan-drug-resistant isolates. This is consistent with recent findings by Patel et al. (2023), which affirm Colistin as a crucial treatment option for multidrug-resistant *A. baumannii*, despite concerns about its nephrotoxicity and limited use [12]. The effectiveness of Colistin in our study suggests its continued relevance, although its administration should be approached with caution due to potential side effects.

The observation that the majority of *A. baumannii* isolates originated from the Medical ICU (MICU) aligns with recent data indicating that critically ill patients in ICUs are at elevated risk for infections with MDR organisms [13]. A study by Chen et al. (2024) similarly found that ICU patients are particularly vulnerable to *A. baumannii* infections due to prolonged hospitalization, invasive procedures, and broad-spectrum antibiotic use [14].

In summary, the high prevalence of MDR *A. baumannii* and the resistance patterns observed in this study reflect a significant and growing challenge in managing ICU-acquired infections. Continued surveillance, stringent infection control practices, and judicious use of antibiotics remain essential in combating this global health issue.

V. Conclusion:

This study highlights the significant prevalence and multidrug resistance of *Acinetobacter baumannii* in the ICU setting of our tertiary care hospital. With *A. baumannii* accounting for 22% of all ICU culture-positive samples and over 95% of isolates exhibiting multidrug resistance, the findings underscore the pressing need for effective infection control measures and antimicrobial stewardship. The high resistance rates observed, particularly to Ceftriaxone, Imipenem, and Cefepime, confirm the challenges in treating these infections with conventional antibiotics. However, the susceptibility of pan-drug-resistant isolates to Colistin suggests that this agent remains a crucial option, albeit with caution due to potential adverse effects.

The predominance of *A. baumannii* in the Medical ICU reflects the increased risk of MDR infections among critically ill patients, emphasizing the necessity for vigilant surveillance and targeted infection control strategies. Overall, the study reinforces the need for continuous monitoring of resistance patterns, implementation of stringent infection prevention protocols, and careful use of antibiotics to mitigate the impact of *A. baumannii* in ICU settings.

VI. Recommendation:

The present study recommends prioritizing improving long-term health outcomes in this population.

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Conflicts of interest: There are no conflicts of interest

References:

- [1] Tzouveleakis Ls, Markogiannakis A, Psychogiou M, Et Al. *Acinetobacter Baumannii*: An Overview Of Its Biology, Pathogenicity, And Therapeutic Options. *Microbes Infect.* 2014;16(3):164-173.
- [2] Peleg Ay, Hooper Dc. Hospital-Acquired Infections Due To Gram-Negative Bacteria. *N Engl J Med.* 2010;362(19):1804-1813.
- [3] Karami Y, Vaziri F, Aghazadeh M, Et Al. Antimicrobial Resistance Of *Acinetobacter Baumannii*: An Emerging Challenge. *J Glob Antimicrob Resist.* 2020;20:204-212.

- [4] Falagas Me, Lourida P, Kourlaba G, Et Al. Risk Factors For Multidrug-Resistant Acinetobacter Baumannii Infections. *J Infect.* 2014;69(5):452-462.
- [5] Berglund B, Nilsson A, Mölstad S, Et Al. Antimicrobial Resistance In Intensive Care Units: Trends And Risk Factors. *Crit Care Med.* 2015;43(6):1232-1240.
- [6] Dijkshoorn L, Van Avesaath L, Korteweg J, Et Al. Acinetobacter Baumannii: A Key Player In Hospital Infections. *Lancet Infect Dis.* 2007;7(8):493-501.
- [7] Tzouvelekis Ls, Markogiannakis A, Psychogiou M, Et Al. Acinetobacter Baumannii: An Overview Of Its Biology, Pathogenicity, And Therapeutic Options. *Microbes Infect.* 2014;16(3):164-173.
- [8] Peleg Ay, Hooper Dc. Hospital-Acquired Infections Due To Gram-Negative Bacteria. *N Engl J Med.* 2010;362(19):1804-1813.
- [9] Saito M, Nakamura Y, Kuroda T, Et Al. Emergence And Spread Of Multidrug-Resistant Acinetobacter Baumannii In Hospitals: A Recent Review. *J Hosp Infect.* 2023;115:34-40.
- [10] Yoon E, Kim H, Lee K, Et Al. Trends In Antibiotic Resistance Of Acinetobacter Baumannii And The Role Of Novel Agents. *Infect Chemother.* 2022;54(2):189-201.
- [11] Zhang J, Wang Y, Li X, Et Al. Antimicrobial Resistance And Molecular Epidemiology Of Acinetobacter Baumannii In Chinese Hospitals: A Multicenter Study. *J Antimicrob Chemother.* 2023;78(1):123-132.
- [12] Patel G, Hujer Am, Hujer Km, Et Al. Colistin As A Last-Line Treatment For Multidrug-Resistant Acinetobacter Baumannii: Review Of The Evidence And Clinical Considerations. *Clin Infect Dis.* 2023;76(5):717-725.
- [13] Chen C, Wang J, Yang M, Et Al. Risk Factors And Outcomes Of Multidrug-Resistant Acinetobacter Baumannii Infections In The Icu: A Review Of Recent Literature. *Crit Care.* 2024;28(1):95-104.
- [14] Chen Q, Zhang L, Liu J, Et Al. Surveillance Of Antibiotic Resistance In Intensive Care Units: A Systematic Review Of Recent Studies. *J Crit Care.* 2024;65:121-130.