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Original Research Article

Antimicrobial resistance patterns in *Acinetobacter baumannii*: A study from a tertiary care center in Vadodara, Gujarat

Saurabh Chhotalal Norris¹, Himani Bhardwaj Pandya¹, Binda Prakashbhai Pipaliya¹*, Tanuja Bakul Javadekar¹

¹Smt. B. K. Shah Medical Institute & Research Centre, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India



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ABSTRACT

Background: Acinetobacter species are a major cause of nosocomial infections, contributing significantly to morbidity and mortality globally.

Aim: This study aimed to evaluate the antibiotic susceptibility profiles of *Acinetobacter* isolates derived from various clinical specimens at a tertiary care hospital in Vadodara, Gujarat.

Materials and Methods: Specimens were cultured on 5% sheep blood agar and MacConkey agar, followed by identification and antibiotic susceptibility testing using the VITEK 2 automated system (BioMerieux, France).

Results: Among 107 positive samples collected from January 2021, to October, 2021, the highest frequency of isolates was observed in urine samples (48, 44.86%). A significant majority of isolates (89, 83.17%) exhibited resistance to three or more classes of antibiotics. Colistin susceptibility was observed in 101 isolates (94.4%). The susceptibility rates for *Acinetobacter baumannii* were 75.7% for tigecycline and 47.7% for carbapenems.

Conclusion: The combination of colistin and tigecycline remains crucial for treating multidrug-resistant *Acinetobacter baumannii* until new therapeutic options become available. This study underscores the necessity of ongoing antimicrobial resistance surveillance and the strengthening of antibiotic stewardship programs to reduce the prevalence of resistant Acinetobacter strains and other bacteria.

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1. Introduction

* Corresponding author.

Acinetobacter are aerobic, gram-negative, non-fermenting, non-fastidious, non-motile, catalase-positive, and oxidase-negative coccobacilli that thrive in moist environments. ¹*Acinetobacter baumannii* is one of the most challenging pathogens among the ESKAPE group, which includes Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Enterobacteriaceae.² These pathogens are known for their ability to evade common antibacterial treatments due

to their antibiotic resistance mechanisms.³ Acinetobacter species have emerged as common pathogens causing hospital-acquired both community-acquired and infections.⁴Acinetobacter baumannii, in particular, is increasingly associated with hospital-acquired infections, especially in intensive care units (ICUs).⁵ These infections, which include wound infections, urinary tract infections, pneumonia, and bacteremia, are linked to trauma, urinary catheters, mechanical ventilators, and central venous access catheters. They result in prolonged hospital stays and increased mortality rates.⁶ Acinetobacter infections are difficult to treat due to the rapid acquisition and spread of multidrug-resistant strains among hospitalized

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E-mail address: bindapipaliya@gmail.com (B. P. Pipaliya).

patients and the diverse mechanisms of antimicrobial resistance employed by these bacteria.⁷The ability of Acinetobacter to produce biofilms facilitates their survival in hospital environments, and they are frequently found on the skin and in the respiratory and urinary tracts of patients.⁸ Globally, the prevalence of multidrug-resistant Acinetobacter, particularly Acinetobacter baumannii, has been documented in several epidemiological studies⁹ with resistance rates of 10-15% to carbapenems, penicillins, and fluoroquinolones.^{10,11} Even in countries with high awareness and active national infection surveillance programs, Acinetobacter species exhibit relatively high resistance to carbapenems.^{12,13}Despite this, carbapenems remain the preferred treatment for Acinetobacter infections.⁵ The management of hospital-acquired infections remains challenging due to the increasing resistance to antimicrobials.14

2. Objectives

- 1. To determine the prevalence of *Acinetobacter baumannii* infections among the study population.
- 2. To identify the most common sample types and systems involved in *Acinetobacter baumannii* infections.
- 3. To assess the types and levels of antimicrobial drug susceptibility of *Acinetobacter baumannii* in patients at a tertiary care hospital.
- 4. To determine the hospital-acquired infection rate of *Acinetobacter baumannii*.

3. Materials and Methods

This study was conducted in the tertiary care Hospital, Vadodara, Gujarat, from January 2021, to October, 2021. Samples were collected aseptically and transferred to the laboratory. Isolation of *Acinetobacter* species was performed on nutrient agar, 5% sheep blood agar, and MacConkey agar. Urine samples were inoculated onto UTI Chrome agar. Identification of clinical isolates was performed using Gram staining, colony morphology, and biochemical reactions. *Acinetobacter* species were identified as non-lactose fermenting, non-motile, oxidasenegative, gram-negative coccobacilli colonies. Species differentiation was done based on biochemical reaction tests.¹⁵

Identification was confirmed using the VITEK 2 automated system (BioMerieux, France), which employs Advanced Colorimetry principles. Identification was performed with a pure overnight subculture, as recommended by the manufacturer, and results were provided according to the instrument's regularly updated database.

Antibiotic susceptibility testing was conducted using the VITEK 2 system (BioMerieux, France) bv the microbroth dilution method. **Bacterial** suspensions of each sample were compared with 0.5 McFarland turbidity standards. The antibiotics tested included piperacillin/tazobactam, ceftazidime, cefoperazone/sulbactam, cefepime, carbapenems, amikacin, gentamicin. ciprofloxacin, minocycline, tigecvcline. colistin, and trimethoprim/sulfamethoxazole. Minimum inhibitory concentrations (MICs) were calculated and interpreted according to the Clinical and Laboratory Standards Institute (CLSI) 2023 guidelines.¹⁶ Isolates of Acinetobacter resistant to three or more classes of antibiotics were considered multidrug-resistant (MDR).¹⁷

4. Result

The distribution of *Acinetobacter baumannii* across various clinical samples is detailed in Table 1. The highest percentage was observed in urine and catheter samples, constituting 44.86% (48 out of 107) of the positive cases. Pathogenicity was confirmed based on a significant colony count of 100,000 cfu/ml. This was followed by pus/wound swabs with a prevalence of 33.64% (36 out of 107), blood samples at 10.28% (11 out of 107), and respiratory tract samples (including sputum, BAL fluid, and endotracheal tube secretions) at 8.41% (9 out of 107). The lowest prevalence was recorded in miscellaneous samples, at 2.80% (3 out of 107).

Table 1: Distribution of Acinetobacter baumannii in various clinical samples

1		
Samples	Positive (n=107)	Percentage
Urine and catheter	48	44.86%
Pus/wound swab	36	33.64%
Blood	11	10.28%
Respiratory tract (Sputum,	09	8.4%
BAL fluid, Endotracheal		
tube secretion)		
Miscellaneous	3	2.8%

Table 2 outlines the distribution of *Acinetobacter baumannii* across hospital departments. The majority of the cases were reported from the wards, with a percentage of 57.94% (62 out of 107). Intensive Care Units (ICUs) reported 31.78% (34 out of 107) of the cases, while the Outpatient Department (OPD) had the lowest prevalence at 10.28% (11 out of 107).

The distribution of multidrug-resistant (MDR) and non-MDR *Acinetobacter baumannii* isolates is presented in Table 3. A significant proportion of the isolates were identified as MDR, accounting for 89.71% (96 out of 107) of the total. Non-MDR isolates comprised 10.28% (11 out of 107) of the total isolates.

Table 4 provides a detailed account of antibiotic susceptibility and resistance among the clinical isolates of *Acinetobacter baumannii*. The resistance rates were

 Table 2: Distribution of Acinetobacter baumannii across hospital departments

Department	Positive (n=107)	Percentage
OPD (Outpatient Department)	11	10.28%
Ward	62	57.94%
ICU (Intensive Care Unit)	34	31.78%

Table 3: Distribution rates of MDR and non-MDR Acinetobacter baumannii isolates

Strain Type	Number of Isolates (n=107)	Percentage (%)
MDR Strain	96	89.71
Non-MDR Strain	11	10.28

notably high for Piperacillin/Tazobactam (85.1%), Ceftazidime (77.6%), and Cefepime (82.3%). Other antibiotics with significant resistance rates included Cefoperazone/Sulbactam (69.2%), Gentamicin (78.5%), and Ciprofloxacin (74.8%). On the other hand, the highest sensitivity was observed for Colistin (94.4%) and Tigecycline (75.7%), indicating these antibiotics as potential therapeutic options. Amikacin also showed moderate sensitivity with 40.2%, whereas Minocycline exhibited sensitivity in 38.3% of the isolates.

Table 4: Antibiotic susceptibility and resistance in clinical isolates of *Acinetobacter baumanni*

Antibiotic	Sensitive	Percentage (%)	Resistant	Percentage (%)	
Carbapenems	51	47.7	56	52.3	
Piperacillin	16	14.9	91	85.1	
/					
Tazobactam					
Ceftazidime	24	22.4	83	77.6	
Cefoperazone	33	30.8	74	69.2	
/ Sulbactam					
Cefepime	19	17.7	88	82.3	
Amikacin	43	40.2	64	59.8	
Gentamicin	23	21.5	84	78.5	
Ciprofloxacin	21	25.2	86	74.8	
Minocycline	41	38.3	66	61.7	
Tigecycline	81	75.7	26	24.3	
Colistin	101	94.4	06	5.6	
Trimethoprim/	33	30.8	74	69.2	
Sulfamethoxazole					

These findings highlight the critical issue of high percentage and extensive multidrug resistance of *Acinetobacter baumannii* in hospital settings, particularly in wards and ICUs. The significant resistance to commonly used antibiotics necessitates stringent infection control measures and the exploration of alternative therapeutic strategies to effectively manage and treat infections caused by this pathogen.

5. Discussion

Acinetobacter baumannii is a significant pathogen in nosocomial infections, known for its ability to acquire multidrug resistance (MDR) and its role in hospital outbreaks. Our study provides an overview of the antimicrobial susceptibility patterns of *A. baumannii* isolates from various clinical samples at a tertiary care hospital in Piparia, Vadodara.

5.1. Distribution and Resistance Patterns

In our study, 44.86% were isolated from urine samples, followed by wound swabs (33.64%), blood (10.28%), and respiratory samples (8.4%). This is consistent with other studies where urinary tract infections and wound infections are common sites for *A. baumannii* isolation in healthcare settings.¹⁸

Our findings indicate that 87.8% of the isolates were multidrug-resistant (MDR), with significant resistance observed against commonly used antibiotics. Similar high MDR rates have been reported globally documented a high prevalence of MDR *A. baumannii* in their study, highlighting the global challenge of resistance.¹⁹

Likewise, a study by Peleg and Hooper (2019) also reported high levels of resistance to multiple antibiotics, reinforcing the need for effective infection control strategies.⁸

5.2. Antibiotic susceptibility

The susceptibility of *A. baumannii* isolates to tigecycline was 75.7%, while susceptibility to colistin was higher at 94.4%. This finding is consistent with other regional studies.²⁰ However, resistance to carbapenems was observed in 47.7% of the isolates, which aligns with findings from various global studies.^{21,22}

5.3. Implications for treatment and control

The high MDR rates observed in our study reinforce the necessity for ongoing surveillance and robust infection control measures. The effectiveness of colistin and tigecycline as treatment options is supported by our data, but their use should be carefully monitored to prevent further resistance development. Our findings suggest the need for continuous antimicrobial resistance surveillance and the strengthening of antibiotic stewardship programs, as recommended by the recent expert proposal by Magiorakos et al. (2021).¹⁷

6. Conclusion

The high resistance of *A. baumannii* to commonly used antibiotics necessitates a comprehensive approach to infection control and antimicrobial stewardship. Our study provides valuable insights into the resistance patterns

and emphasizes the importance of regular monitoring and effective management strategies.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Author biography

Saurabh Chhotalal Norris, Associate Professor ^(b) https://orcid.org/0000-0002-9813-4132

Himani Bhardwaj Pandya, Associate Professor D https://orcid.org/0000-0001-9444-9279

Binda Prakashbhai Pipaliya, Associate Professor https://orcid.org/0009-0000-2681-6698

Tanuja Bakul Javadekar, Professor

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