



Prevalence and Antibiotic Resistance Profile of *Acinetobacter* Species Isolated from Patients Attending Murtala Muhammad Specialist Hospital, Kano, Nigeria

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ABSTRACT

Antimicrobial resistance among hospital-associated pathogens is a growing threat to patient care, with *Acinetobacter* spp. increasingly implicated in difficult-to-treat nosocomial infections, data from Northern Nigeria are limited. This study was aimed to determine the prevalence and antibiotic resistance profile of *Acinetobacter* species isolated from patients attending Murtala Muhammad Specialist Hospital, Kano. A descriptive cross-sectional study was conducted where 200 clinical specimens (urine, catheter urine, wound swabs, sputum, blood) were collected from selected wards and processed by standard microbiological culture and biochemical methods; species-level identification used established phenotypic criteria, and antimicrobial susceptibility testing was performed by disk diffusion following CLSI guidelines. Thirteen *Acinetobacter* isolates were recovered (prevalence 6.5%); *A. baumannii* predominated (10/13, 76.9%), followed by *A. lwoffii* (2/13, 15.4%) and *A. calcoaceticus* (1/13, 7.7%). Isolates were mainly recovered from the medical (38.5%) and surgical (30.8%) wards, with catheter-associated urine (30.7%) as the leading specimen source. Twelve of the isolates (92.3%) were multidrug resistant, with complete resistance to ampicillin, cefotaxime, and trimethoprim-sulfamethoxazole (100% each). High resistance was also observed to ceftazidime (92.3%), ceftriaxone (84.6%), cefepime (76.9%), and imipenem (76.9%). Resistance to meropenem was 61.5% and to piperacillin-tazobactam 69.2%. Gentamicin and amikacin showed lower resistance rates of 30.8% and 38.5%, respectively, while ciprofloxacin had the lowest resistance rate at 15.4%. These findings document a notable burden of multidrug-resistant *Acinetobacter* in this tertiary hospital and underscore the need for strengthened antimicrobial stewardship, targeted infection-control measures, and routine antibiogram-driven surveillance to limit transmission and preserve remaining therapeutic options.

ARTICLE INFO

Article History

Received: March, 2025

Received in revised form: June, 2025

Accepted: August, 2025

Published online: September, 2025

KEYWORDS

Acinetobacter, Antimicrobial Resistance,
Surveillance, Infection, Kano

INTRODUCTION

Antimicrobial resistance (AMR) has emerged as a major global health crisis, threatening the effective management of infectious diseases. In 2019 alone, bacterial AMR was directly responsible for 1.27 million deaths and associated with nearly 5 million deaths worldwide, with the highest burden recorded in

sub-Saharan Africa (Murray *et al.*, 2022; WHO, 2023). The situation is particularly severe in low- and middle-income countries, including Nigeria, where unregulated access to antibiotics, limited diagnostic capacity, and inadequate infection control practices contribute to the spread of resistant organisms (Eze & Iheanacho, 2022).

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Among the priority pathogens, *Acinetobacter* species, particularly *A. baumannii*, have become prominent nosocomial agents due to their persistence in hospital environments and their resistance to multiple classes of antibiotics. Their ability to survive on dry surfaces, colonize medical devices, and acquire resistance through multiple mechanisms makes them difficult to eradicate (Karah *et al.*, 2020; Kyriakidis *et al.*, 2021). Antibiotic resistance in *Acinetobacter* species, particularly *A. baumannii*, has become a critical global health concern due to the organism's ability to develop and acquire resistance to nearly all major classes of antibiotics.

The World Health Organization (WHO) has classified carbapenem-resistant *A. baumannii* as a "critical priority pathogen", highlighting the urgent need for new therapeutic options (WHO, 2023). This designation underscores its high resistance potential and strong association with severe hospital-acquired infections that are notoriously difficult to treat. Reports from Nigeria highlight increasing isolation of multidrug-resistant *Acinetobacter* spp., including strains resistant to carbapenems, which are often regarded as last-line agents (Odih *et al.*, 2023; Ajoseh *et al.*, 2025). Despite their clinical importance, data on the prevalence and resistance profiles of *Acinetobacter* species remain limited in Northern Nigeria (Ajoseh *et al.*, 2025). Such information is critical for guiding empirical therapy, updating hospital antibiograms, and informing infection-prevention strategies (Muhammad *et al.*, 2018; Tobin *et al.*, 2024). This study therefore aimed to determine the prevalence and antibiotic resistance profile of *Acinetobacter* species isolated from patients at Murtala Muhammad Specialist Hospital, Kano, a major tertiary referral center in the region.

MATERIALS AND METHODS

Study Design

A descriptive cross-sectional study was conducted over a six-month period (October 2024 to March 2025) at Murtala Muhammad Specialist Hospital (MMSH), Kano, Nigeria. MMSH is a

major tertiary healthcare institution in Northern Nigeria with a bed capacity of over 800 and specialized units/wards. It has high patient turnover and serves as a referral center for Kano State and neighboring regions (Yahya, 2020).

Sample Size

The minimum required sample size was calculated using Fisher's formula, based on estimated prevalence of 10.1% for *Acinetobacter* spp. infections reported by Bashir *et al.* (2019). The calculated sample size was 140, but to improve statistical power and account for possible culture losses, 200 clinical specimens were collected purposively.

Inclusion and Exclusion Criteria

Patients aged ≥ 18 years, hospitalized for at least 48 hours with clinical signs of infection (e.g., sepsis, pneumonia, wound infection, UTI), and who provided informed consent. Patients < 18 years, those with community-acquired infections (< 48 hours hospitalization), or those unwilling to participate or had incomplete clinical records.

Ethical Considerations

Ethical approval was obtained from the Kano State Ministry of Health Research Ethics Committee (Approval No.: NHREC/17/03/2018, dated 17/09/2024). An informed consent was obtained from all participants.

Samples Collection and Transportation

A total of 200 clinical specimens were aseptically collected following standard protocols (Cheesbrough, 2010), including 50 urine, 50 catheter-associated urine, 46 wound swabs, 39 sputum, and 15 blood samples, from the Medical, Surgical, Orthopedic, Accident and Emergency, and Eclampsia wards. All samples were transported within one hour and processed at the Postgraduate Research Laboratory, Department of Microbiology, Bayero University, Kano, while sputum samples were immediately processed at the MMSH Microbiology Laboratory. Sociodemographic data, including age, sex, marital status, and occupation, were obtained using structured questionnaires.

Isolation and Identification of *Acinetobacter* spp.

Clinical specimens were first inoculated onto MacConkey agar (HiMedia M081) following standard microbiological procedures described by Cheesbrough (2010), and incubated aerobically at 37 °C for 18–24 h. Non-lactose fermenting colonies, typically pale to colourless, smooth, convex, and mucoid, were subjected to Gram staining. Gram-negative coccobacillary isolates were further screened by standard biochemical tests following Cheesbrough (2010), including oxidase, catalase, motility, citrate utilization, urease, and triple sugar iron (TSI) tests. Colonies that were oxidase-negative, catalase-positive, non-motile, citrate-positive, and demonstrated an alkaline/alkaline (K/K) TSI reaction without gas or H₂S production were presumptively identified as *Acinetobacter* spp. (Muhammad et al., 2018; Yusuf et al., 2023). Presumptive isolates were subcultured onto CHROMagar™ *Acinetobacter* (CHROMagar, France) and incubated at 37 °C for 18–24 h. The appearance of distinct salmon-red colonies was considered confirmatory for *Acinetobacter* spp. (Yusuf et al., 2023).

Speciation of *Acinetobacter* spp.

Species-level identification was performed according to the phenotypic classification scheme of Bouvet and Grimont (1987), which remains a reference standard for differentiating *Acinetobacter* species. The tests employed included assessment of growth at 37 °C and 44 °C, hemolysis on blood agar, gelatin liquefaction, oxidative–fermentative (O/F) glucose utilization, and arginine hydrolysis. Quality control was maintained using *A. baumannii* ATCC 19606 as the reference strain.

Antibiotics Susceptibility Testing

The antimicrobial susceptibility profile of the isolates was determined using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar (HiMedia, India; M173) in accordance with CLSI guidelines (CLSI, 2023). A 0.5 McFarland standard was used to adjust bacterial inoculum. Antibiotics tested included ampicillin (10 µg), ceftazidime (30 µg), cefotaxime (30 µg),

ceftriaxone (30 µg), cefepime (30 µg), piperacillin–tazobactam (100/10 µg), ciprofloxacin (5 µg), meropenem (10 µg), imipenem (10 µg), gentamicin (10 µg), amikacin (30 µg), tetracycline (30 µg), and trimethoprim–sulfamethoxazole (1.25/23.75 µg). *Escherichia coli* ATCC 25922 and *Pseudomonas aeruginosa* ATCC 27853 were used for quality control. Results were interpreted using CLSI breakpoints for *Acinetobacter* spp. MDR was defined according to Magiorakos et al. (2012) criteria.

Data Analysis

Data were analysed using SPSS version 31. Descriptive statistics were applied, Chi-square and Fisher's exact test were used to compare proportions. Significance level was set at $p \leq 0.05$.

RESULTS

Table 1 shows the overall prevalence of *Acinetobacter* species recovered from 200 clinical samples. A total of 13 (6.5%) samples were positive for *Acinetobacter* species. *A. baumannii* was the most frequently isolated species (10/13; 76.9%), followed by *A. lwoffii* (2/13; 15.4%). Table 2 shows the distribution of *Acinetobacter* isolates according to ward, sample type, gender, and age group. The majority of isolates were recovered from the medical ward (38.5%), catheterized urine samples (30.7%), male patients (61.5%), and individuals aged 30–49 years (38.5%).

Table 3 presents the antibiotic resistance profiles of the 13 *Acinetobacter* isolates. Complete resistance (100%) was observed to ampicillin, cefotaxime, and trimethoprim–sulfamethoxazole (100% each), and high resistance for ceftazidime (92.3%), ceftriaxone (84.6%), cefepime (76.9%), and imipenem (76.9%). Meropenem resistance was 61.5%, while piperacillin–tazobactam showed 69.2% resistance. By contrast, ciprofloxacin retained the highest activity with 84.6% susceptibility, followed by gentamicin (69.2%) and amikacin (53.8%), whereas tetracycline demonstrated moderate susceptibility (53.8%).



Table 1: Prevalence of *Acinetobacter* species among clinical samples (n=200)

Category	Number (n)	Frequency (%)
Total samples collected	200	100
Positive for <i>Acinetobacter</i> spp.	13	6.5
Species distribution		
<i>A. baumannii</i>	10	76.9
<i>A. Iwoffii</i>	2	15.4
<i>A. calcoaceticus</i>	1	7.7
Total	13	100

Table 2: Frequency of *Acinetobacter* Isolates Recovered (n =13)

Category	No. Screened (%)	No. of <i>Acinetobacter</i> Isolates Recovered (%)	p-value
Wards			1.000*
Medical (Male & Female)	66 (33.0)	5 (38.5)	
Surgical (Male & Female)	59 (29.5)	4 (30.8)	
Orthopaedic (Male & Female)	42 (21.0)	3 (23.0)	
Accident & Emergency	17 (8.5)	1 (7.7)	
ICU	4 (2.0)	0 (0.0)	
Eclampsia Ward	12 (6.0)	0 (0.0)	
Total	200 (100)	13 (100)	
Sample Type			.991*
Urine	50 (25.0)	3 (23.1)	
Catheter Urine	50 (25.0)	4 (30.7)	
Wound Swab	46 (23.0)	3 (23.1)	
Sputum	39 (19.5)	2 (15.4)	
Blood	15 (7.5)	1 (7.7)	
Total	200 (100)	13 (100)	
Gender			.732*
Male	114 (57.0)	8 (61.5)	
Female	86 (43.0)	5 (38.5)	
Total	200 (100)	13 (100)	
Age Group (Years)			.588*
18–29	60 (30.0)	2 (15.4)	
30–49	55 (27.5)	5 (38.5)	
50–64	50 (25.0)	4 (30.7)	
65–above	35 (17.5)	2 (15.4)	
Total	200 (100)	13 (100)	

Key: * = No significant difference

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Table 3: Antibiotic Susceptibility of *Acinetobacter* Isolates (n=13)

Antibiotic (Disc Conc.)	Resistant n (%)	Sensitive n (%)	Intermediate n (%)
Ampicillin (10 µg)	13 (100.0)	0 (0.0)	0 (0.0)
Ceftazidime (30 µg)	12 (92.3)	1 (7.7)	0 (0.0)
Ceftriaxone (30 µg)	11 (84.6)	2 (15.4)	0 (0.0)
Cefepime (30 µg)	10 (76.9)	3 (23.1)	0 (0.0)
Cefotaxime (30 µg)	13 (100.0)	0 (0.0)	0 (0.0)
Piperacillin-Tazobactam (100/10 µg)	9 (69.2)	4 (30.8)	0 (0.0)
Tetracycline (30 µg)	4 (30.8)	7 (53.8)	2 (15.4)
Trimethoprim-Sulfamethoxazole (1.25/23.75 µg)	13 (100.0)	0 (0.0)	0 (0.0)
Ciprofloxacin (5 µg)	2 (15.4)	11 (84.6)	0 (0.0)
Imipenem (10 µg)	10 (76.9)	3 (23.1)	0 (0.0)
Meropenem (10 µg)	8 (61.5)	5 (38.5)	0 (0.0)
Gentamicin (10 µg)	4 (30.8)	9 (69.2)	0 (0.0)
Amikacin (30 µg)	5 (38.5)	7 (53.8)	1 (7.7)

DISCUSSION OF FINDINGS

The prevalence of *Acinetobacter* spp. in this study was 6.5%. This finding is in agreement with reports from other Nigerian tertiary hospitals, where prevalence rates of 5–8% have been documented. For example, Ogbonna *et al.* (2023) reported a prevalence of 7% in Ebonyi State and Odewale *et al.* (2016) documented 8.5% in Osogbo. Bashir *et al.* (2019) reported 10.1% among patients with prolonged hospital stays across three tertiary hospitals in Kano Metropolis, and the higher prevalence could be attributed to seasonal variations and the differences in study design. The predominance of *A. baumannii*, which accounted for 76.9% of isolates, is consistent with both Nigerian and global reports (Ajoseh *et al.*, 2025; Li *et al.*, 2025). *A. Iwoffii* (15.4%) and *A. calcoaceticus* (7.7%), although less prevalent and traditionally considered less virulent, are increasingly recognized as opportunistic pathogens.

These species can cause infections in immunocompromised patients or those with prolonged hospital stays and may serve as reservoirs for antimicrobial resistance genes (Mindlin *et al.*, 2020). Of the 13 *Acinetobacter*

isolates, 8 (61.5%) were recovered from male patients and 5 (38.5%) from female patients, with no statistically significant difference observed. The higher isolation rate among males may reflect increased exposure to trauma, invasive procedures, and occupational risks, and is consistent with reports from Nigeria and other sub-Saharan African settings (Ogbonna *et al.*, 2023; Silago *et al.*, 2022). However, contrasting reports exist, such as Nwadike *et al.* (2014), who observed higher prevalence among females, suggesting that gender-related risk factors may vary across settings. Age-specific analysis revealed that middle-aged adults (30–49 years) were the most affected, a pattern consistent with the finding from Nigeria (Ajoseh *et al.*, 2025). This age group often experiences prolonged hospital stays due to chronic illnesses and surgical interventions, increasing their susceptibility to opportunistic infections.

The highest proportion of *Acinetobacter* isolates was recovered from the medical ward (38.5%), followed by the surgical ward (30.8%), with no isolates detected in the ICU and eclampsia wards. The predominance of isolates in the medical and surgical wards may be attributed to

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the frequent use of invasive procedures, broad-spectrum antibiotics, and prolonged patient stays. This observation is supported by Yusuf *et al.* (2025), who recovered multidrug-resistant *Acinetobacter* from clinical and environmental samples collected from these wards within the same hospital, underscoring the role of environmental contamination and patient to environment interactions in intra-ward transmission.

Similarly, Bashir *et al.* (2019) in Kano identified prolonged hospitalization, frequent surgical interventions, and high antibiotic use as major risk factors for colonization and infection by multidrug-resistant *Acinetobacter* species. Orthopedic wards, which accounted for 23.0% of isolates, also represent high-risk settings due to the frequent use of prosthetic implants and exposure of open wounds. The absence of isolates from ICU samples is unexpected, as intensive care units are commonly reported as hotspots for *A. baumannii* outbreaks worldwide (Castanheira *et al.*, 2023).

This finding may reflect the small proportion of ICU samples analyzed (2%) and potentially stricter infection prevention and control measures in the ICU relative to other wards. In contrast, Nwadike *et al.* (2014) reported a 14.0% prevalence among ICU patients, suggesting that the lower detection in this study likely reflects limited sampling rather than a true absence of *Acinetobacter* spp. Catheter-associated urine accounted for the largest proportion of isolates (30.7%), consistent with previous studies linking *Acinetobacter* spp. to catheter-associated urinary tract infections (CAUTIs) (Odihi *et al.*, 2023; Ajoseh *et al.*, 2025). The isolation of *A. baumannii* from non-catheterized urine (23.1%) suggests its ability to cause community-onset urinary infections in vulnerable hosts, as reported by Mohammed *et al.* (2018).

The antibiotic resistance profile of isolates in this study is of particular concern. Nearly all the isolates (92.3%) met the criteria for multidrug resistance (MDR) when classified using isolate-level susceptibility results. Complete resistance was observed to ampicillin, cefotaxime, and trimethoprim-sulfamethoxazole (100% each),

while cephalosporins performed poorly, with resistance rates of 92.3% for ceftazidime, 84.6% for ceftriaxone, and 76.9% for cefepime. Carbapenems, traditionally regarded as last-resort agents, were also compromised with imipenem resistance at 76.9%, and meropenem 61.5%. Piperacillin-tazobactam showed resistance in 69.2% of isolates.

By contrast, ciprofloxacin retained the highest activity, with 84.6% of isolates susceptible, while gentamicin (69.2% susceptible) and amikacin (53.8% susceptible) exhibited moderate activity. Tetracycline showed mixed results, with 53.8% susceptibility, 30.8% resistance, and 15.4% intermediate susceptibility. These findings are consistent with the alarming global trend of multidrug resistance (MDR) among *Acinetobacter* spp. (WHO, 2017; Li *et al.*, 2025). Ampicillin (100%) resistance is consistent with the intrinsic resistance of *Acinetobacter* species to this antibiotic class. For cephalosporins, a study by Bashir *et al.* (2019), in Kano reported *Acinetobacter* spp. resistance rates of 71.4% to ceftazidime and 85.7% to ceftriaxone. Similarly, Garba *et al.* (2023) reported resistance to ceftriaxone, ceftazidime and cefepime in 80%, 65.0% and 75% of isolates respectively in Gombe, whereas Ogbonna *et al.* (2023) in Ebonyi State similarly reported cephalosporin resistance rates above 80%. This highlights a widespread failure of cephalosporin antibiotics in clinical settings.

In Kano, Bashir *et al.* (2019) similarly reported high carbapenems resistance (85.7%), aligning with the present findings, whereas Garba *et al.* (2023) in Gombe also documented high carbapenems resistance, though their resistance rate (55%) were somewhat lower than those recorded in this study, a difference possibly attributable to variations in prescribing practices and stewardship implementation across hospitals. High carbapenems resistance suggests the possible circulation of carbapenemase-producing strains, commonly mediated by the expression of oxacillinases (*bla*_{OXA-23}, *bla*_{OXA-24/40}) and metallo- β -lactamases such as *bla*_{NDM}, which have been increasingly detected in *A. baumannii* across Nigerian healthcare facilities as reported by Yusuf *et al.* (2025). However, molecular



confirmation was not performed in this study and is needed to identify specific resistance determinants. Gentamicin and amikacin demonstrated moderate activity, with 69.2% and 53.8% of isolates susceptible, respectively, in line with findings from Bashir *et al.* (2019).

Ciprofloxacin retained the highest activity and demonstrated the lowest resistance rate of 15.4%, with 84.6% of isolates susceptible. This finding aligns with Bashir *et al.* (2019), who reported a comparable resistance rate of 14.3%. In contrast, Odewale *et al.* (2016) documented complete resistance to ciprofloxacin (100%). The high frequency of multidrug resistance highlights the clinical challenge posed by these pathogens. The high resistance rates observed here also have implications for laboratory practice. Our results, which demonstrated limited activity of cephalosporins and carbapenems, are consistent with and lend support to the existing laboratory decision at MMSH to restrict or discontinue routine testing of these agents. Nonetheless, given the small number of isolates and the single-center scope of this study, such decisions should be regularly reviewed and validated against broader surveillance data to ensure patient safety.

CONCLUSION

This study established a prevalence of 6.5% for *Acinetobacter* species among patients in a tertiary hospital in Kano, with *A. baumannii* identified as the predominant isolate. The majority of isolates originated from medical and surgical wards, and mostly recovered from catheter-associated urine. Demographic analysis indicated a higher occurrence among male patients and middle-aged adults. Although the prevalence was low, high levels of multidrug resistance, including resistance to carbapenems, were observed. Ciprofloxacin remained the most active agent, and aminoglycosides demonstrated moderate activity, but their overuse could rapidly compromise their effectiveness.

RECOMMENDATIONS

The findings highlight the urgent need for coordinated infection prevention strategies, strengthened antimicrobial stewardship, and

hospital-specific empirical treatment guidelines, to mitigate the continued spread of multidrug-resistant pathogen. Continuous surveillance and future molecular epidemiological studies are further recommended to track resistance trends and inform targeted interventions.

LIMITATIONS

This study was limited by reliance on phenotypic methods for species identification, as molecular characterization of the isolates and resistance genes was not performed. The relatively small sample size, especially from intensive care units and the single center design further restricts generalizability of findings.

Conflict of Interest:

The authors declare that there are no conflicts of interest with this work.

Acknowledgement and Funding:

The authors acknowledge the management and staff of MMSH, Kano, for their support and cooperation during this study. No funding was received.

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