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Research Article

Acinetobacter baumannii in the Intensive Care Unit: Current Epidemiology and Antibiotic Resistance over a Six-Year Period (2017–2022)

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A B S T R A C T

Background: Acinetobacter baumannii is a non-fermenting, Gram-negative, ubiquitous and opportunistic pathogen and a leading cause of healthcare-associated infections in critically ill patients. As one of the ESKAPE organisms, it has evolved from a multi-susceptible commensal into a paradigm of multidrug resistance, and carbapenem-resistant A. baumannii (CRAB) was ranked by the WHO in 2018 as the top priority pathogen for new antibiotic development. We aimed to describe the current epidemiological profile and the antibiotic-resistance levels of A. baumannii isolated in the surgical intensive care unit (ICU) of Ibn Rochd University Hospital Centre (CHU Ibn Rochd), Casablanca, Morocco

Methods: Retrospective descriptive study of 169 non-duplicate A. baumannii isolates recovered from surgical ICU patients (≥18 years) at Ibn Rochd University Hospital Centre (CHU Ibn Rochd), Casablanca, between 1 January 2017 and 31 December 2022. Isolates were identified and tested for antimicrobial susceptibility according to standard methods following CA-SFM/EUCAST guidelines. Frequency, specimen type, sex distribution and resistance trends were analysed.

Results: Annual isolation rose from 21 isolates in 2017 to 41 in 2022, peaking in 2020 (n=43). There was a marked male predominance (75%; sex ratio 2.93). Most isolates originated from broncho-pulmonary specimens (74%), and the ICU was the principal source (74% of all hospital isolates). Resistance in the ICU exceeded 90% for ceftazidime (95%), cefepime (94%), ciprofloxacin (93%), cefotaxime (92%) and ticarcillin–clavulanate (90%); 87% of isolates were imipenem-resistant (carbapenem-resistant, CRAB). All isolates (100%) remained susceptible to colistin. Resistance increased steadily over the study period for carbapenems, aminoglycosides and fluoroquinolones, with a notable surge in 2020.

Conclusion: ICU A. baumannii at this institution shows an alarming, rising multidrug-resistance burden that severely restricts therapeutic options, with colistin remaining the last reliably active agent. Strict infection-control measures, antimicrobial stewardship and continuous epidemiological surveillance are urgently required.

Keywords: Acinetobacter baumannii; Intensive care unit; Nosocomial infection; Multidrug resistance; Carbapenem resistance; Colistin; Antimicrobial stewardship

Introduction

Acinetobacter baumannii is a ubiquitous, opportunistic, Gram-negative, non-fermenting coccobacillus responsible for healthcare-associated (nosocomial) infections, particularly in immunocompromised patients and those with significant comorbidities. Nosocomial infections-defined as infections acquired in a care facility that were neither present nor incubating at admission-represent a major public-health problem, with an overall incidence in intensive care units (ICUs) of 6.9–19.9% of admitted patients[1,2].

The genus Acinetobacter comprises about fifty species, of which A. baumannii, A. calcoaceticus and A. nosocomialis are opportunistic pathogens responsible for severe nosocomial infections, including pneumonia, bacteraemia, urinary-tract infections and wound superinfections. Over the past four decades A. baumannii has shifted from a microorganism considered of low virulence and broadly susceptible to a frontrunner of multidrug resistance, with a pronounced capacity to cause outbreaks in ICUs, where it affects the most debilitated patients.

The species is one of the ESKAPE organisms (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, A. baumannii, Pseudomonas aeruginosa and Enterobacter spp.) that constitute a global threat to human health. Its prevalence has risen steadily, and the recent emergence of carbapenemases threatens the current therapeutic arsenal[3,4]. In 2018 the World Health Organization classified carbapenem-resistant A. baumannii (CRAB) as the number-one priority for antibiotic research and development; carbapenem resistance was chosen as a marker of multidrug resistance because it is usually associated with co-resistance to a wide range of other antibiotic classes.

Infections caused by A. baumannii are associated with prolonged hospital stays, increased treatment costs and high morbidity and mortality. Knowledge of local epidemiology is essential to monitor resistance trends, to adapt empirical antibiotic protocols, and to evaluate control measures. The objective of this study was to determine, through a six-year descriptive study (2017-2022), the evolution of the epidemiological profile of A baumannii isolated in the surgical ICU of Ibn Rochd University Hospital Centre (CHU Ibn Rochd), Casablanca, and to assess its levels of resistance to the antibiotics tested[5,6].

Materials & Methods

Study design and setting

This was a retrospective descriptive study conducted at the Laboratory of Bacteriology and Virology of Ibn Rochd University Hospital Centre (CHU Ibn Rochd), Casablanca, Morocco. Data were collected from laboratory registers for 169 A. baumannii isolates obtained from patients hospitalised in the ICU over the six-year period from 1 January 2017 to 31 December 2022.

Specimens

Biological specimens collected by standard techniques and referred from the ICU were analysed. On receipt, container–request conformity was checked (container integrity, patient identifiers, requesting department, prescriber). Specimen types included broncho-pulmonary samples (bronchoalveolar lavage fluid, protected distal sampling, sputum/expectoration cytobacteriological examination, bronchial aspiration), blood cultures, pus, urine (urine cytobacteriological examination), catheter samples and biopsies.

Inclusion and exclusion criteria

All A. baumannii strains isolated for diagnostic purposes from ICU patients older than 18 years during the study period were included. Strains collected as part of an epidemiological screening survey and redundant (duplicate) isolates were excluded.

Susceptibility testing and analysis

Isolates were identified and antimicrobial susceptibility was determined using standard laboratory methods, with antibiotic selection, critical concentrations and inhibition-zone diameters interpreted according to the recommendations of the Antibiogram Committee of the French Society of Microbiology (CA-SFM/EUCAST, 2022). Resistance frequencies were computed overall and by hospital sector, and temporal trends in resistance to the principal agents were analysed across the study years.

Results

Frequency and temporal evolution

Over the six-year period, A. baumannii was isolated from 169 ICU patients. Annual isolation increased from 21 cases in 2017 to 41 in 2022, with the highest rate recorded in 2020 (n=43), reflecting a sustained upward trend across the study period.

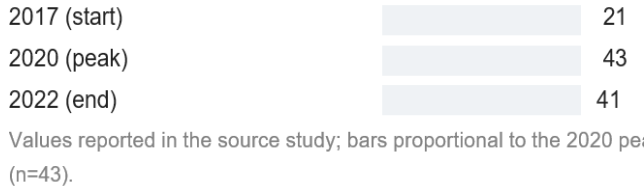

Figure 1: Number of A. baumannii isolates at reference time points, ICU, 2017–2022

Sex distribution

There was a clear male predominance: 126 isolates (75%) were recovered from male patients, giving a male-to-female sex ratio of 2.93.

Specimen distribution

Broncho-pulmonary specimens predominated, accounting for 74% of isolates (n=125), followed by blood cultures

(12%) and venous catheters (6%). The distribution of isolates by specimen type is shown in **(Table 1)**.

Table 1: Distribution of A. baumannii isolates by specimen type in the ICU (n=169)

Specimen type	No. (n)	%
Broncho-pulmonary	125	74%
Blood cultures	20	12%
Venous catheter	11	6%
Urine	6	4%
Pus	5	3%
Biopsy	2	1%

Distribution by hospital sector

Although A. baumannii was recovered across all hospital sectors, the ICU was by far the predominant source, accounting for 74% of all isolates, followed by the surgical departments (10%), medical departments (9%) and outpatients (7%).

Resistance profile in the ICU

Among the 169 ICU isolates, resistance exceeded 90% for ceftazidime (95%), cefepime (94%), ciprofloxacin (93%), cefotaxime (92%) and ticarcillin-clavulanate (90%). Imipenem resistance reached 87%, defining a high proportion of carbapenem-resistant A. baumannii (CRAB). By contrast, all isolates (100%) remained susceptible to colistin on standard antibiograms **(Table 2, Figure 2)**.

Table 2: Antibiotic resistance of A. baumannii isolates in the ICU (n=169).

Antibiotic	Susceptible n (%)	Resistant n (%)
Amikacin (AK)	22 (13%)	147 (87%)
Cefepime (FEP)	10 (6%)	159 (94%)
Cefotaxime (CTX)	14 (8%)	155 (92%)
Ceftazidime (CAZ)	9 (5%)	160 (95%)
Ciprofloxacin (CIP)	12 (7%)	157 (93%)
Tobramycin (TM)	28 (17%)	141 (83%)
Gentamicin (GM)	20 (12%)	149 (88%)
Imipenem (IMP)	22 (13%)	147 (87%)
Piperacillin–tazobactam (TZP)	30 (18%)	139 (82%)
Ticarcillin (TIC)	19 (11%)	150 (89%)
Ticarcillin–clavulanate (TCC)	16 (10%)	153 (90%)
Trimethoprim–sulfamethoxazole (SXT)	36 (21%)	133 (79%)
Colistin (CS)	169 (100%)	0 (0%)

Figure 2: Percentage resistance of ICU A. baumannii isolates (n=169)

Comparison between the ICU and other sectors

Across the 227 strains isolated hospital-wide (ICU, surgical, medical and outpatient sectors), resistance to cefepime, cefotaxime, ceftazidime and trimethoprim–sulfamethoxazole was more pronounced in the ICU than elsewhere, each exceeding 90%. Strains from other sectors were more susceptible to imipenem (susceptibility>34%) than ICU strains (13% susceptible), and amikacin susceptibility exceeded 40% outside the ICU. Colistin susceptibility was essentially universal: 100% in the ICU and surgical departments and 97% in medical/outpatient settings. The proportion of imipenem-resistant A. baumannii (CRAB) was higher in the ICU (87%) than in the medical/outpatient (69%) or surgical (65%) sectors **(Table 3)**.

Table 3: Resistance (%) by hospital sector for selected agents.

Antibiotic	ICU (n=169)	Surgical (n=23)	Medical/Outpt. (n=35)
Imipenem	87%	65%	69%
Amikacin	87%	56%	60%
Ciprofloxacin	93%	91%	77%
Ceftazidime	95%	74%	80%
Cefepime	94%	78%	69%
Ticarcillin–clav.	90%	83%	86%
Colistin	0%	0%	3%

Temporal evolution of resistance

Resistance to all tested antibiotics increased between 2017 and 2022. Imipenem resistance rose from 84% to 92.7%, amikacin from 80% to 97.5% (a marked surge in 2022, up 17.5 points from 80% in 2021), and ciprofloxacin from 84% to 95.1%. Colistin susceptibility remained at 100% throughout. The year 2020 was characterised by a conspicuous rise in resistance to amikacin, ciprofloxacin and imipenem **(Table 4)**.

Table 4: Evolution of resistance (%) to key antibiotics, ICU, 2017–2022.

Period	Amikacin	Ciprofloxacin	Imipenem	Colistin
2017–2018	80%	84%	84%	0%
2018–2019	82.4%	100%	88.2%	0%
2019–2020	81.8%	90.9%	86.4%	0%
2020–2021	90.7%	100%	97.7%	0%
2021–2022	80%	92%	96%	0%
2022–2023	97.6%	95.1%	92.7%	0%

Discussion

This six-year single-centre study confirms the growing burden of A. baumannii in critical care and its evolution into a near-pan-resistant nosocomial pathogen. The progressive rise in annual isolation, the male predominance and the overwhelming preponderance of broncho-pulmonary specimens is consistent with the epidemiology reported in other ICU series, where mechanically ventilated patients are at greatest risk of A. baumannii colonisation and ventilator-associated pneumonia[7,8]. The clustering of isolates within the ICU (74%) underscores the role of the critical-care environment-invasive devices, broad-spectrum antibiotic pressure and the organism's exceptional environmental persistence-in sustaining transmission.

The resistance profile is particularly concerning. With more than 90% of ICU isolates resistant to third- and fourth-generation cephalosporins, fluoroquinolones and β-lactam/β-lactamase-inhibitor combinations, and 87% resistant to imipenem, the population is dominated by carbapenem-resistant A. baumannii (CRAB)-the WHO's top-priority pathogen for new drug development. Because carbapenem resistance is typically accompanied by co-resistance across multiple classes, these data leave clinicians with very few empirical options. The higher resistance observed in the ICU compared with surgical and medical/outpatient sectors reflects the more intense selective pressure and the concentration of fragile hosts in critical care[9-11].

Colistin retained complete (100%) in-vitro activity throughout the study and remains the cornerstone of treatment for these multidrug-resistant strains in this setting. However, reliance on a single last-line agent is precarious: it heightens

the risk of emerging colistin resistance and of therapeutic dead-ends, and mandates judicious, guideline-driven use together with consideration of combination therapy where appropriate. The steady year-on-year increase in resistance-and the pronounced 2020 surge across aminoglycosides, fluoroquinolones and carbapenems-signals that the local situation is deteriorating rather than stabilising.

Several limitations should be acknowledged. This was a retrospective, single-centre, laboratory-based study; clinical outcomes, distinction between colonisation and true infection, and molecular characterisation of resistance determinants (e.g. OXA-type carbapenemases) were beyond its scope. Susceptibility to colistin was assessed by standard antibiogram rather than reference broth microdilution, which may underestimate emerging resistance. These aspects warrant dedicated prospective and molecular investigation.

Conclusion

A. baumannii occupies a prominent place in hospital pathology owing to its capacity to colonise and persist in the hospital environment, its rising frequency, its pathogenic potential and its continuous acquisition of resistance. This study describes a worrying epidemiological reality in the surgical ICU of Ibn Rochd University Hospital Centre (CHU Ibn Rochd), Casablanca, between January 2017 and December 2022: an increasing frequency of isolates and very high resistance levels-particularly to β-lactams, aminoglycosides and fluoroquinolones-in already fragile patients, with colistin remaining the only consistently active agent. Faced with this alarming situation, which severely restricts the therapeutic arsenal, it is imperative to rationalise antibiotic use, reinforce hygiene measures, and implement a prevention strategy built on epidemiological surveillance and the organisation of care.

A. baumannii remains the most feared agent of nosocomial infection, a difficult adversary to control and eradicate, and the optimal treatment of multidrug-resistant strains is yet to be established.

Declarations

Ethics approval

This study was based on anonymised, routinely collected microbiological laboratory data, with no intervention on patients. Given its retrospective design and the exclusive use of de-identified isolate data, formal ethics-committee approval was not required; the study was conducted in accordance with the Declaration of Helsinki, and all data were handled confidentially.

Consent to participate / for publication

Not applicable - the study used anonymised laboratory isolate data, with no identifiable patient information.

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Conflicts of interest

The authors declare that they have no competing interests.

Author contributions

All named authors contributed to the conceptualisation, data collection, analysis and interpretation, and to drafting and critically revising the manuscript. All authors read and approved the final version.

Data availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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