iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

HEALTHCARE-ASSOCIATED INFECTIONS CAUSED BY *ACINETOBACTER BAUMANNII*: A SYSTEMATIC REVIEW OF CLINICAL MANIFESTATIONS, ANTIMICROBIAL RESISTANCE, AND TREATMENT OUTCOMES

Lee Archedel C. Deluta
Glecell M. Duyanan
Melliz Cecilia Ecija
Raynald G. Escota
Zyrene Vienn L. Sune
Gecelene C. Estorico
Civil and Allied Department; Environmental Science and Chemical Technology Department
Technological University of the Philippines – Taguig, Metro Manila, 1630, Philippines
De La Salle University – Dasmariñas, Cavite, DBB-B, 4115 West Ave., Dasmariñas

ABSTRACT
Multidrug-resistant *Acinetobacter baumannii* is a major healthcare acquired pathogen causing serious infections. They have developed multi drug resistance which makes it difficult to diagnose and treat. This systematic review aimed to gather evidence from literature to understand more about healthcare acquired infections caused by *A. baumannii*. This included understanding the clinical manifestations, demographics, antimicrobial resistance, risk factors, treatment and effectiveness of treatment given. Relevant research articles and case reports on healthcare acquired infections caused by *A. baumannii* were searched. Data was collected relating to patient demographics, country of origin, main infection, manifestation, antimicrobial resistance, treatment received, effectiveness of treatment, outcomes and risk factors. Patients of varying ages and from various countries were included in the studies. Both genders were infected with pneumonia, meningitis, ventriculitis, bloodstream infections, wound infections and sepsis. Many of the cases involved critically ill patients, admission to intensive care, invasive procedures, ventilation, trauma and co-morbidities. There was a high level of antimicrobial resistance as many of the infections were carbapenem resistant, multi drug resistant and pan drug resistant. Treatments varied depending on the infection and antimicrobial resistance. This included polymyxin B, colistin, cefiderocol, Tigecycline, Eravacycline and combination treatments. In several cases intraventricular/intrathecal colistin had clinical benefit for resistant central nervous system infections. The effectiveness of treatment varied. Some patients had good clinical improvement and negative cultures, but one patient failed treatment and died due to severe bloodstream infection and sepsis. A successful infection control strategy was used to contain an outbreak of carbapenem resistant *A. baumannii* in ICU. This included isolating patients, good hand hygiene, PPE, cleaning of environment, staff education and monitoring. Overall healthcare acquired infections caused by *A. baumannii* can be a serious issue. This is due to the variety of presentations and high levels of antimicrobial resistance. Early and accurate diagnosis, treatment based on antimicrobial susceptibilities and appropriate combination treatment if needed is important. Improving monitoring and early intervention may reduce the spread of infection, treatment failure and negative outcomes.

Keywords:
Healthcare-associated infections, *Acinetobacter baumannii*, drug-resistant bacteria

INTRODUCTION

Healthcare-associated infections (HAIs) remain a concern in hospital settings, particularly among patients who require intensive care, invasive medical procedures, or prolonged hospitalization. One of the bacterial pathogens associated with these infections is *A. baumannii*, an organism known for its ability to develop resistance to multiple antimicrobial agents. The studies included in this review describe infections involving different parts of the body, including the respiratory tract, bloodstream, and central nervous system. These infections can be difficult to manage when the isolated strains are resistant to commonly used antibiotics, limiting the available treatment options and complicating patient care.

The clinical manifestations reported in the reviewed studies varied according to the infection site and the patient's underlying condition. Respiratory infections were prominent among the selected reports. Wang et al. (2021)

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

described a 23-year-old woman with severe pneumonia in whom carbapenem-resistant *A. baumannii* was subsequently identified as the main pathogen. The patient received polymyxin B and recovered. Similarly, Wu et al. (2016) reported that *A. baumannii* was identified in 21 of the 31 critically ill patients included in their retrospective investigation of hospital-acquired pneumonia caused by carbapenem-resistant Gram-negative bacteria. Other studies documented infections involving the central nervous system. Cheyne et al. (2024) reported ventriculitis following ventriculoperitoneal shunt placement, while Dimovska Gavrilovska et al. (2024) described meningitis and ventriculitis in a child following neurosurgery. D'Isanto et al. (2025) also documented a bloodstream infection caused by a colistin-resistant, multidrug-resistant strain. These findings illustrate the range of clinical presentations associated with *A. baumannii* and the potential severity of infections among hospitalized patients.

Antimicrobial resistance was a recurring concern across the selected studies. Several reports involved carbapenem-resistant, multidrug-resistant, extensively drug-resistant, or pan-drug-resistant *A. baumannii*. These resistance patterns complicate treatment because the selection of appropriate antibiotics depends on the susceptibility of the isolated strain. Shi et al. (2024) investigated 559 patients with extensively drug-resistant *A. baumannii* infections and identified several associated risk factors, including prolonged intensive care unit (ICU) stay, urinary catheterization, mechanical ventilation, diabetes, and carbapenem use. Duan et al. (2024) examined 634 bacterial isolates collected from seven ICUs and reported substantial levels of multidrug resistance and extensive drug resistance, together with evidence of transmission among hospital units. Similarly, Dagher et al. (2025) investigated an outbreak involving an NDM-2-producing *A. baumannii* strain in an ICU in Lebanon. These findings highlight the importance of examining antimicrobial resistance alongside patient-related factors and the transmission of resistant bacteria within healthcare facilities.

The treatment outcomes described in the selected case reports further demonstrate the difficulties of managing infections caused by resistant *A. baumannii*. Rei et al. (2023) reported a patient with multidrug-resistant *A. baumannii* pneumonia and subsequent ventriculitis, alongside a separate ventriculitis infection caused by vancomycin-resistant Enterococcus faecium. Different combination therapies were used to manage the infections. Cheyne et al. (2024) documented clinical improvement after intraventricular colistin was added to treatment when intravenous colistin alone had not produced significant improvement. Dimovska Gavrilovska et al. (2024) likewise reported clinical improvement and negative cultures following treatment that included intraventricular colistin in a patient with pan-drug-resistant *A. baumannii* meningitis and ventriculitis. Meanwhile, Melchio et al. (2026) reported a favorable outcome in a patient with difficult-to-treat *A. baumannii* bacteremia following eravacycline treatment. Although these reports provide useful information about the management of difficult infections, their findings represent individual clinical experiences and cannot establish that the same treatments will produce similar outcomes in other patients.

The reviewed studies provide complementary perspectives on healthcare-associated *A. baumannii* infections. Individual case reports describe specific clinical presentations, diagnostic findings, and treatment experiences, whereas observational and genomic epidemiological investigations provide broader information on infection-associated factors, resistance patterns, and possible transmission within hospitals. Despite these contributions, the studies differ in research design, patient characteristics, infection sites, and reported outcomes. These differences must be considered when interpreting the findings, particularly when comparing individual treatment experiences with results obtained from larger hospital-based investigations. Examining these studies together allows recurring patterns to be identified while recognizing the limitations of the available evidence.

OBJECTIVE

The main objective is to conduct a systematic review of existing literature and research papers on healthcare-associated infections caused by *A. baumannii* to assess and synthesize their clinical manifestations, antimicrobial resistance patterns, associated risk factors, and treatment outcomes among hospitalized patients. Additionally, the review aims to identify common findings, highlight gaps in existing research, and provide insights that may guide future clinical management and inform healthcare professionals regarding the prevention, diagnosis, and treatment of these infections.

METHODOLOGY

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which provides a framework for conducting and reporting systematic reviews. Through this framework, the methods employed in the review aim to be reproducible, efficient, and transparent. The methodology section discusses the search strategy, inclusion and exclusion criteria, study selection process, data sources, and data extraction procedures. The following search string was used as the primary search strategy:

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

("*Acinetobacter baumannii*") AND ("hospital-acquired infection" OR "healthcare-associated infection" OR "nosocomial infection") AND ("case report" OR "case study" OR "clinical study"). The publication period was restricted to January 1, 2015, through September 2026 to ensure that the review focused on literature published within the predetermined ten-year period.

Search Strategy

Google Scholar and ScienceDirect were utilized as the primary sources of literature for this systematic review to obtain relevant case studies on healthcare-associated infections caused by A. baumannii. To maintain consistency and relevance, a structured search strategy employing Boolean operators was developed and applied to identify studies aligned with the objectives of the review.

Inclusion/Exclusion Criteria

To identify articles relevant to the review, the following inclusion criteria were established: (1) the studies must have been published between 2015 and 2026; (2) must involve A. baumannii infections acquired in hospital or healthcare settings; (3) must be scientific articles, case reports, case studies, or relevant observational studies; (4) must provide information on the clinical manifestations, patient characteristics, antimicrobial resistance, risk factors, or treatment outcomes associated with the infections; and (5) must be written in English.

Articles that did not meet these requirements were excluded to maintain the focus of the review. Specifically, studies were excluded if they (1) were not scientific publications; (2) did not focus on healthcare-associated infections involving A. baumannii; or (3) were published outside the specified period of January 1, 2015, to September 2026.

Study Selection Process

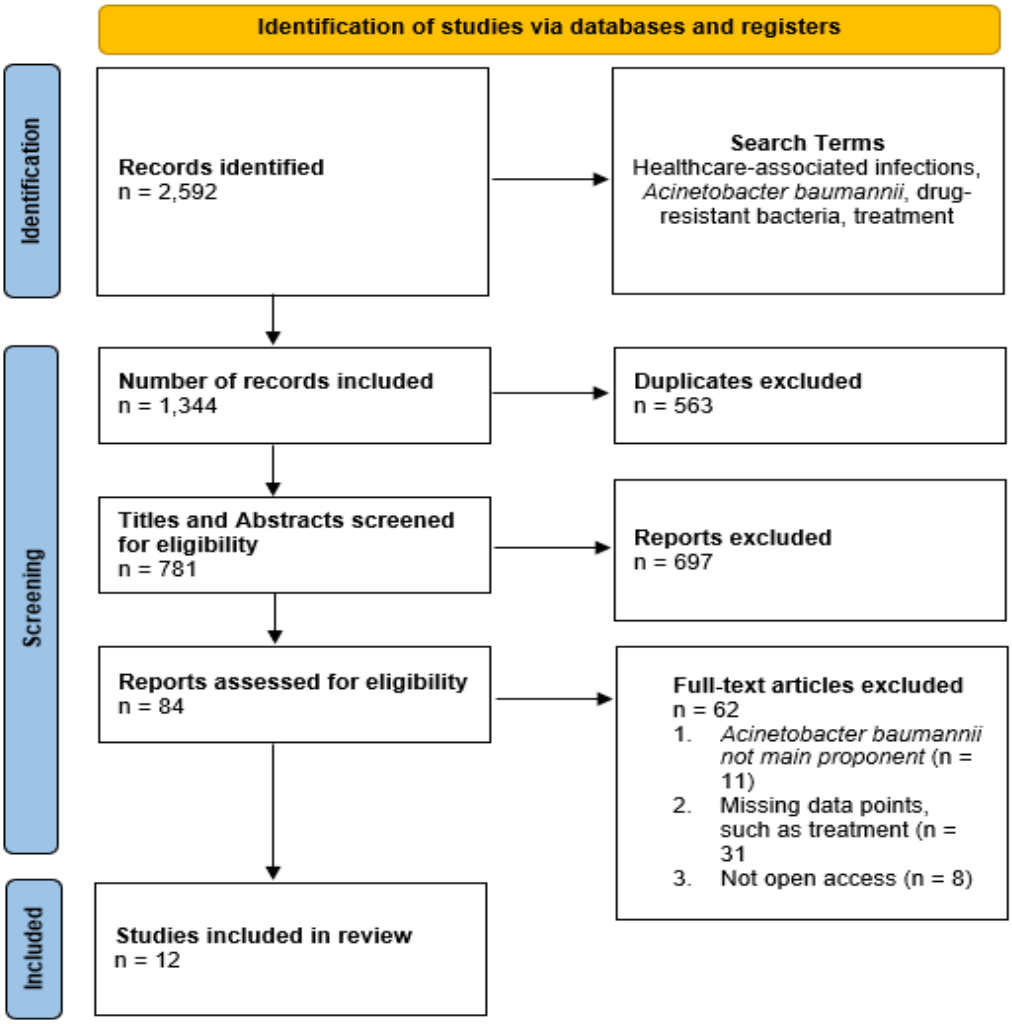


Figure 1. PRISMA Diagram of the Study Selection Process

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

Data Items and Extraction

Specific information was collected from the selected studies to facilitate the systematic comparison and synthesis of their findings. The data items included (1) the clinical manifestations, (2) agen and sex of the patient/s, (3) the country of origin, (4) the primary affliction or the reason of initial admittance, (5) the synergistic effect between the original affliction and *A. baumannii*, (6) the administered treatment/s, (7) their efficacy, (8) the findings and insights from the study) and (7) the authors and year of publication. These data were reviewed by each researcher and organized in a shared Google Document to promote accuracy, consistency, and completeness during data extraction.

RESULTS AND DISCUSSION

Table 1. Summary of Case Studies of the Systematic Review

Clinical Manifestations	Age & Sex	Country	Primary Affliction	Synergistic Effect	Administered Treatment	Efficacy	Findings	Author(s) (Year)
The patient exhibited various symptoms such as high fever, hypotension, dyspnoea and low white blood cell count.	23-year-old female	China	*Tropheryma whipplei* infection	Treatment was complicated due to the antimicrobial resistance of *Acinetobacter* worsening her pneumonia	The patient was treated with polymyxin B as added to her existing treatment plan as the final solution, for the previous plans were insufficient	After almost two weeks of admission, the patient's respiratory function had improved, and she was weaned from the ventilator and extubated. All antibiotics were discontinued on the 15th day after admission, and the patient was able to get out of bed and perform simple activities 16 days after admission. She was discharged 18 days after admission	Using next generation sequencing (NGS), infection with *Tropheryma whipplei* was ruled out after bacterial culture of the patient's bronchoalveolar lavage fluid showed carbapenem-resistant *A. baumannii* as the main pathogen.	Wang, S., Xia, D., Wu, J., Jia, D., Li, L., & Xu, S. (2021)
The patient already has a history of trigeminal neuralgia and was brought to a rehabilitation facility due to intermittent fevers that had persisted for three weeks, along with known pneumonia and a	59-year-old male	United States of America	Pneumonia and pseudomenin gocele in the left suboccipital region without a work-up being completed at the rehabilitation facility.	The patient presented with CSF catheter-associated VRE faecium ventriculitis and MDR-A. baumannii pneumonia who subsequentl y developed a	MDR-*A. baumannii* ventriculitis was treated with combination therapy including cefiderocol, ampicillin/sulbactam, and intrathecal colistin.	Although the MDR A. baumannii pneumonia was not cured with cefiderocol monotherapy, the MDR A. baumannii ventriculitis was successfully treated with combination therapy.	The presence of two drug-resistant pathogens was a challenge, however it was both treated successfully with combination antibiotic therapy. VRE	Rei, K. M., Reddy, V., Andraos, C., Brazdzionis, J., & Siddiqi, J. (2023)

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

pseudomening ocele in the left suboccipital region.				nosocomial MDR-A. baumannii ventriculitis.			faecium ventriculitis was cured with linezolid and intrathecal daptomycin.	
Mild headache, diplopia (double vision), deterioration in activity level, severe neck stiffness, and later a myoclonic seizure. The patient also developed neurological deterioration associated with hydrocephalus and experienced fever reaching 39.9°C during treatment.	22-year-old male	Poland	Head trauma, subdural hematoma, and hydrocephalus	The patient developed a neuroinfection, becoming tachycardic (124 BPM), increase in body temperature at 37.3°C degrees and a further increase in CRP, WBC count, and procalcitonin.	Intraventricular (IVT) or intrathecal administration of colistin	The addition of IVT colistin significantly improved the patient's neurological condition and reduced inflammatory markers. The patient experienced one myoclonic seizure during IVT colistin treatment, managed with antiepileptics. After multiple unrelated nosocomial complications, the patient was discharged in good condition to rehabilitation.	The patient developed a nosocomial A. baumannii ventriculitis following ventriculoperitoneal shunt placement. The isolate was susceptible only to colistin. Intravenous colistin alone showed no significant improvement, while the addition of intraventricular colistin improved the patient's neurological condition and reduced inflammatory markers.	Ithamar Cheyne, Kamelia Hassan, Tjard Dunkel, Marcin Sota, Łukasz Wróblewski, & Małgorzata Mikaszewska-Sokolewicz (2024)
Signs of meningism, development of hydrocephalus, fever with temperatures reaching 38.5°C, and clinical manifestations consistent with meningitis/ventriculitis. CSF findings also showed cloudy fluid, elevated lactate and albumin, and numerous polymorphonuclear leukocytes	6-year-old female	North Macedonia	Embryonal tumor of the central nervous system	The patient developed a healthcare-associated CNS infection after craniotomy and external ventricular drainage.	Intravenous meropenem and vancomycin combined with IVT colistin	Treatment resulted in significant clinical improvement and negative cultures after two weeks.	CSF cultures confirmed pan-drug-resistant A. baumannii. IVT colistin remains to be an effective antimicrobial treatment against the resistant *A. baumannii*.	Aleksandra Dimovska Gavrilovska, Hristijan Veljanovski, & Radomir Jovchevski (2024)

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

consistent with acute purulent meningitis.								
Fever, haemodynamic deterioration, bilateral consolidative pneumonia, respiratory failure, and bacteraemia. The patient initially presented with haemorrhagic shock.	40-year-old male	Italy	Admitted critically ill in the intensive care unit with diabetes and cirrhosis associated with metabolic dysfunction-associated steatohepatitis	He then developed new-onset fever and haemodynamic deterioration, which blood cultures testing confirmed *A. baumannii*	Eravacycline monotherapy at 1 mg/kg every 12 hours for 7 days	Symptoms alleviated within 24 hours and the patient remained in good health after 6 months.	Eravacycline is a next-generation tetracycline characterized by a favourable pharmacokinetic and pharmacodynamic profile. Although in vitro studies suggest activity against *A. baumannii*.	Melchio, M., Portunato, F., Vena, A., Porcile, E., Centanaro, M., & Bassetti, M. (2025, September 23)
Patients experienced fever, abnormal leukocyte counts, cough, dyspnea, tachypnea, hypoxemia, altered sputum, respiratory failure, and pulmonary infiltrates.	31 critically ill adults with a mean age of 74.6 ± 9.4 years; 22 being male, 9 being female	China	Pneumonia	Carbapenem-resistant Gram-negative pneumonia, frequently involving A. baumannii, was associated with treatment challenges and high mortality	Tigecycline; high-dose and standard-dose regimens were compared	48.4%; microbiological eradication: 61.3%; ICU mortality: 45.2%. High-dose treatment was associated with greater clinical success and lower mortality.	*A. baumannii* is observed to be a prevalent pathogen, occurring in 21 out of 31 patients in the report.	Wu, X., Zhu, Y., Chen, Q., Gong, L, Lin, J., Lv, D., & Feng, J. (2016, November 14)
Recurrent high fever, bacteremia, sepsis, jaundice, septic shock, and rapid deterioration leading to cardiac arrest and death.	66-year-old male	Italy	Carcinomatosis of the biliary tract and peritoneum, and hepatic metastases secondary to colon cancer.	Bloodstream infection and sepsis caused by pan-drug-resistant *A. baumannii* complicating treatment	Initially received meropenem, piperacillin/tazobactam, and tigecycline for 5 days, followed by colistin for 3 days. After resistance was identified, treatment was changed to cefiderocol, fosfomycin, and tigecycline for 15 days.	Temporary clinical stabilization, followed by fatal treatment failure. The patient was discharged in stable condition after approximately one month but was readmitted in critical condition one month later. The patient died from cardiac	The authors suggested that delayed effective treatment, immunocompromise, and extensive antimicrobial resistance may have prevented eradication, resulting in the patient's death.	D'Isanto, M., Battista, F., Cipollaro, M., Balestrieri, A., Proroga, Y. T. R., Paradiso, R., Fusco, G., Borriello, G., & Maddaluno, S. (2025).

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

						arrest 48 hours after readmission due to irreversible clinical deterioration .		
Nosocomial infections present across clinical specimen types, including respiratory tract infections (bronchoalveolar lavage and sputum), bloodstream infections (blood), urinary tract infections (urine), wound infections, and bedsores.	32 non-duplicate *A. baumannii* isolates were collected from ICU patients, an unspecified amount.	Lebanon	Original diagnoses were not reported.	The study documented carbapenem-resistant A. baumannii (CRAB), predominantly involving an NDM-2-producing ST103 clone following an outbreak	Patient isolation, staff training, hand hygiene, personal protective equipment, environmental screening, hydrogen peroxide disinfection, hydrogen peroxide vapor decontamination, and ongoing surveillance. No patient-specific antibiotic treatment was reported.	The outbreak was successfully contained, and the microbe responsible was completely eradicated. There were no observed spreads to other hospital units, and there were only a few minor cases of the microbe.	The study identified an outbreak of carbapenem-resistant A. baumannii in an ICU in Lebanon. Among 32 isolates collected, 17 isolates from March–May 2019 were mostly positive for the blaNDM-2 gene and belonged to the same ST103 clone, suggesting that the resistant strain was spreading within the ICU. This was the first report of blaNDM-2-producing A. baumannii in Lebanon. Infection-control measures were successfully implemented and stopped the outbreak.	Dagher, T. N., Hadjadj, L., Bittar, F., Fenianos, F., Abdo, E., Rolain, J.-M., & Al-Bayssari, C. (2025).
The patient had major pelvic and abdominal lesions, with hypertension and hypercholesterolemia	72-year-old male	Unspecified	A car accident caused intertrochanteric neck of femur fracture on the patient	High fever, highly elevated inflammatory markers: C-Reactive Protein, white blood cell count, and erythrocyte sedimentatio	A regimen of rifampicin, tigecycline, and vancomycin in their maximum doses, at 600 mg QD, 100 mg, and 1000 mg	Inflammatory markers greatly improved, and the patient was discharged on day 26 post-injury after being afebrile.	The maximum doses for rifampicin, tigecycline, and vancomycin is appropriate if the patient is in critical condition.	Balfousias, T., Apostolopoulos, A., Angelis, S., Filippou, D., & Maris. S. (2019)

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

				n rate.	BID respectively.			
Computed tomography scan showed possible soft-tissue infection of the craniotomy wound with purulent secretion, erythema, and swelling.	74-year-old, unspecified gender	Germany	Patient experienced non-traumatic acute subdural hematoma on the right hemisphere and underwent emergency cranial trepanation	The patient had high fever, pneumonia, and developed septic shock	A colistin-based combination therapy was given to the patient, with 0..25 MIU via EVD every 12 hours. This was steadily adjusted; the colistin dose was reduced to 2 MIU eerie 12 hours. For pneumonia, cleared tracheal aspirates and normothermia was used for de-escalation.	The TDM showed decreasing levels of colistin and therapy was continued with 0.25 MIU once daily (days 21–25) resulting in unexpected high levels of colistin.	n after 3.5 days. Most commonly, patients received once daily local colistin with doses of 0.125 MIU–0.5 MIU/day. 15 Imberti also report a non-linear relationship for CMS (prodrug) hydrolysis to active colistin in CSF with a terminal half-life time of about 7.8 h in CSF. Based on these findings, the most important factors contributing to drug clearance in CSF are liquor drainage or resorption.	Tafelski, S, Wagner, L, Angermair, S., & Deja, M. (2017)

RESULTS AND DISCUSSION

The reviewed studies demonstrate that healthcare-associated infections caused by *A. baumannii* present significant challenges in clinical management because of the different infection sites, patient conditions, and antimicrobial resistance patterns reported. The patients included children, adults, and older individuals, indicating that these infections were documented across various age groups and both sexes. The studies also originated from several countries, including China, the United States, Poland, North Macedonia, Italy, Germany, and Lebanon, although the country of origin was not specified in every report.

The clinical manifestations described in the reviewed studies included pneumonia, bloodstream infections, meningitis, ventriculitis, and possible wound infections. Several cases involved patients who were critically ill or had undergone invasive medical procedures, such as neurosurgery and shunt placement. The additional studies by Balfousias et al. (2019) and Tafelski et al. (2017) provided further information about patients with traumatic injuries, surgical complications, and complex clinical conditions. However, not all conditions reported in the table could be directly attributed to *A. baumannii.*

Antimicrobial resistance was a recurring concern throughout the reviewed literature. The studies documented carbapenem-resistant, multidrug-resistant (MDR), extensively drug-resistant (XDR), and pan-drug-resistant

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

(PDR) strains, as well as an outbreak involving an NDM-2-producing strain. These findings highlight the difficulties of selecting appropriate antibiotics and controlling the spread of resistant bacteria in healthcare facilities. The treatments reported included polymyxin B, colistin, tigecycline, eravacycline, and combination antibiotic therapies, with some cases requiring adjustments in dosage or administration methods.

The reported treatment outcomes varied among patients. Several studies documented clinical improvement, negative culture results, or hospital discharge, while others described complex clinical courses requiring close monitoring and treatment adjustments. The findings from Balfousias et al. (2019) and Tafelski et al. (2017) also highlighted the importance of monitoring patient condition, inflammatory markers, and antibiotic concentrations during treatment. Nevertheless, the different study designs and individual patient circumstances prevent direct conclusions about which treatment is most effective.

A. Age and Sex of Patients

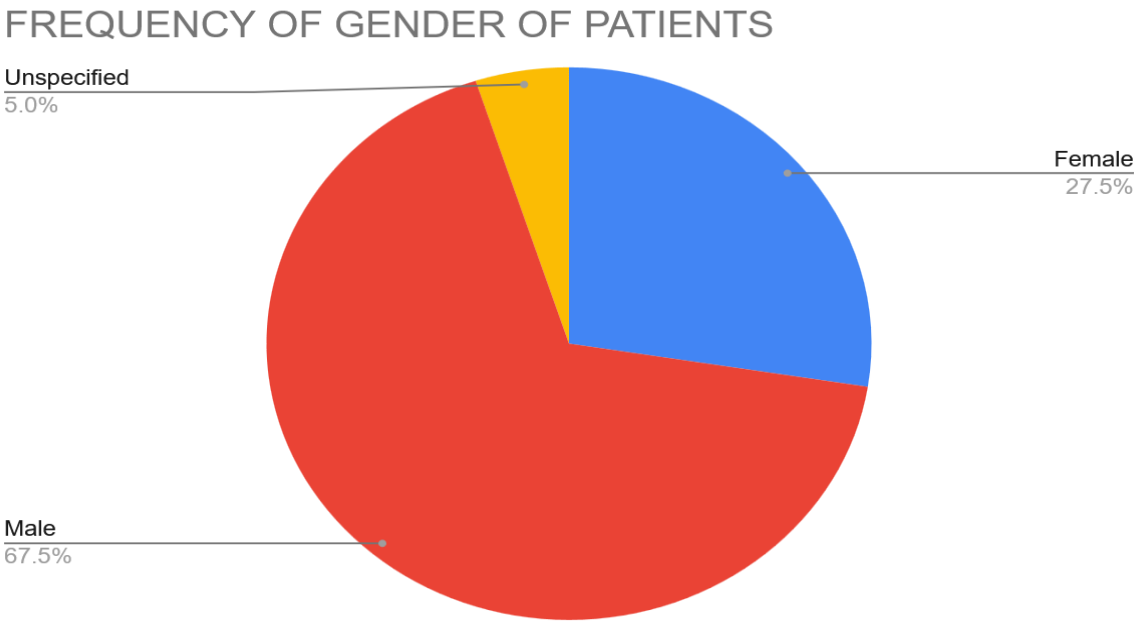


Figure 2. Frequency of Genders of Patients across the Case Reports

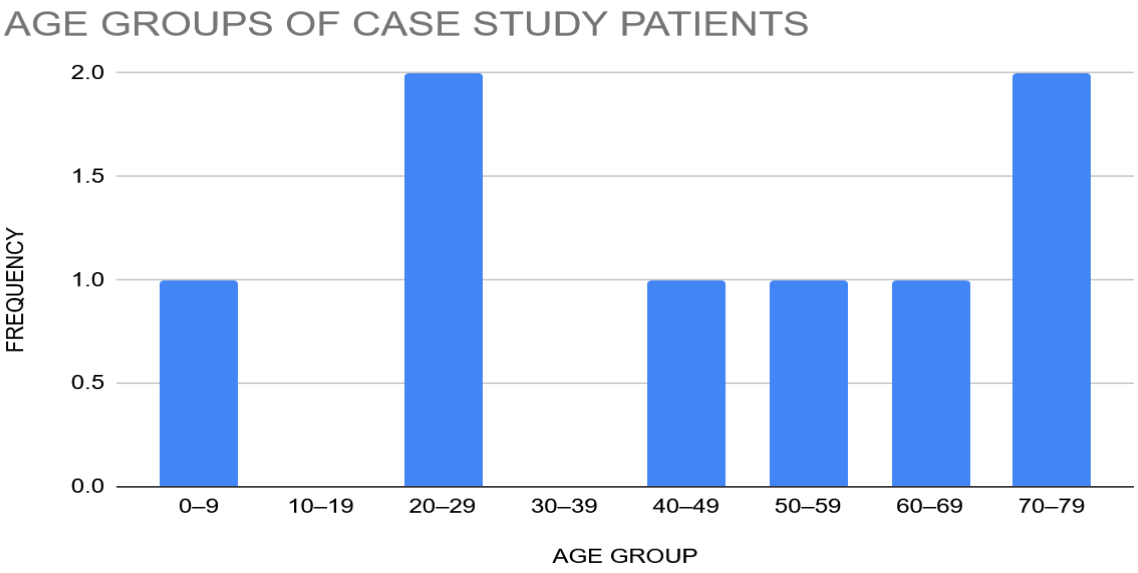


Figure 3. Age Groups of Patients in Included Case Reports

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

The demographic characteristics of the patients in the reviewed studies showed that males were more frequently represented than females, while the age groups of 20–29 and 70–79 years appeared most frequently in the collected data. These patterns may be related to differences in hospital exposure, clinical conditions, and the characteristics of the patients included in the studies. The higher representation of males may be partly supported by Linz et al. (2025), who studied 220 adult patients with *A. baumannii* pneumonia.

Their findings showed that male patients (67.5%) were more likely than female patients (27.5%) to have hospital-acquired infections and had longer hospital stays. This suggests that differences in hospital-acquired infection patterns and patient outcomes may contribute to the greater representation of males in some clinical studies. Nevertheless, the researchers noted that the reasons behind these sex-related differences require further investigation. Therefore, male sex should not be considered the sole cause of infection.

Meanwhile, the representation of patients aged 70–79 years may be related to age-associated health conditions and greater exposure to hospital care. Older patients may have chronic illnesses, require surgery or intensive care, and undergo invasive procedures such as mechanical ventilation or the use of medical devices. These circumstances can increase opportunities for healthcare-associated infections. Supporting the relevance of older age, Said et al. (2021) reported a median age of 69 years among the clinical isolates included in their study, showing that older adults were substantially represented in their dataset. However, this study focused on carbapenem resistance rather than proving that people aged 70–79 have the highest overall risk of infection.

B. Country of Origin

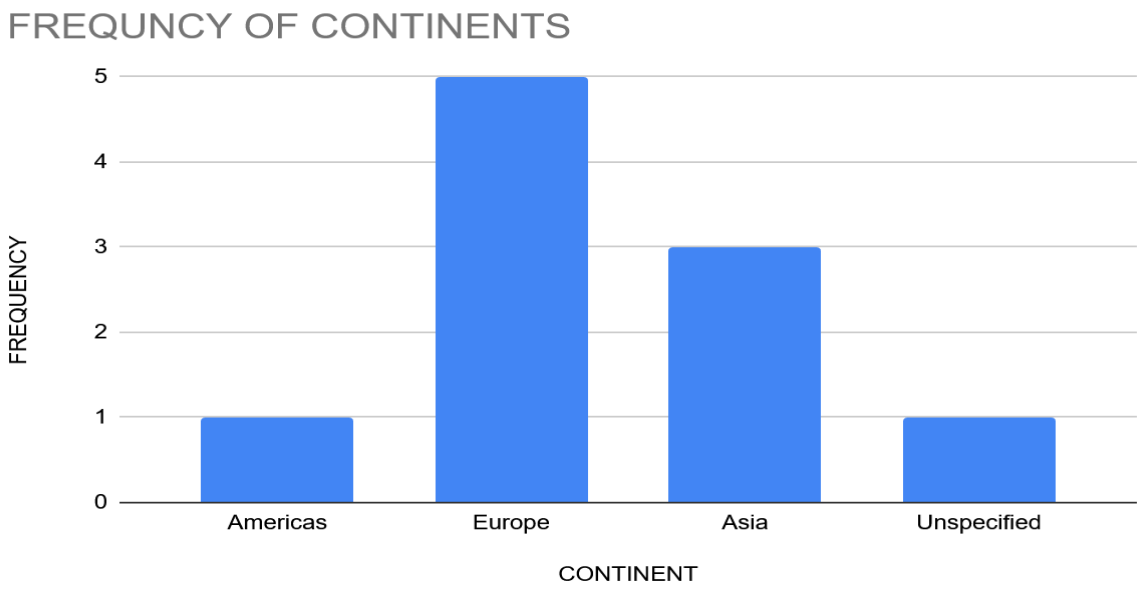


Figure 4. Frequency of Continents of Origin of the Case Reports.

The selected studies originated from several countries, demonstrating the geographical diversity of the literature on healthcare-associated *A. baumannii* infections. Wang et al. (2021) and Wu et al. (2016) represented studies conducted in China. Other studies came from the United States (Rei et al., 2023), Poland (Cheyne et al., 2024), North Macedonia (Dimovska Gavrilovska et al., 2024), Italy (Melchio et al., 2025), and Lebanon (Dagher et al., 2024). Tafelski et al. (2017) reported a case from Germany.

The studies also differed in their research approaches. Some focused on individual patients, while others examined groups of patients or investigated outbreaks within healthcare facilities. For example, Dagher et al. (2024) investigated an outbreak involving 32 non-duplicate *A. baumannii* isolates in an intensive care unit in Lebanon. In comparison, Tafelski et al. (2017) described the clinical management of an older patient with a suspected soft-tissue infection involving a craniotomy wound.

C. Primary Afflictions and Reasons for Hospital Admission

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

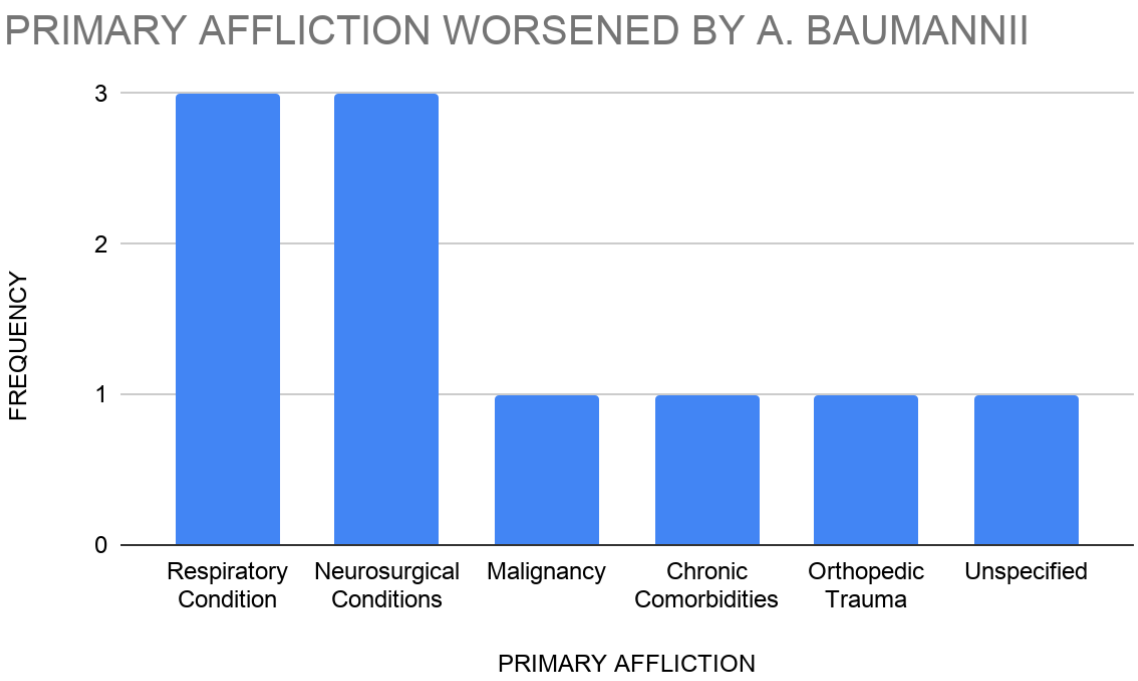


Figure 5. Reasons for Initial Hospital Admission

Neurological conditions were also reported. Rei et al. (2023) described a patient with pneumonia and pseudomeningocele who subsequently developed ventriculitis. Cheyne et al. (2024) reported ventriculitis following ventriculoperitoneal shunt placement, while Dimovska Gavrilovska et al. (2024) documented meningitis and ventriculitis following neurosurgery. Tafelski et al. (2017) described a patient with a non-traumatic acute subdural hematoma who underwent emergency cranial trepanation. A computed tomography scan subsequently showed a possible soft-tissue infection involving the craniotomy wound, accompanied by purulent secretion, erythema, and swelling. The patient also experienced fever, pneumonia, and septic shock.

Traumatic injuries and underlying health conditions were described in another report. Balfousias et al. (2019) documented a 72-year-old male who sustained major pelvic and abdominal lesions following a car accident. The patient also had hypertension and hypercholesterolemia. Meanwhile, Melchio et al. (2025) reported bacteremia in a patient with diabetes and cirrhosis who had been admitted to the intensive care unit.

D. Clinical Manifestations

The clinical manifestations reported in the selected studies varied according to the infection site and the patient's condition. Respiratory infections were documented by Wang et al. (2021), who described a patient with severe pneumonia, and Wu et al. (2016), who investigated critically ill adults with hospital-acquired pneumonia. These reports demonstrate the involvement of the respiratory system in the reviewed cases of healthcare-associated *A. baumannii* infection.

Neurological infections were also reported. Rei et al. (2023) described a patient who developed ventriculitis involving multidrug-resistant *A. baumannii*. Cheyne et al. (2024) reported ventriculitis following ventriculoperitoneal shunt placement, while Dimovska Gavrilovska et al. (2024) documented meningitis and ventriculitis following neurosurgery. These cases illustrate the occurrence of serious central nervous system infections among patients with neurological complications or previous medical procedures.

Other clinical manifestations involved wound infections and bloodstream infections. Tafelski et al. (2017) described a patient with a possible soft-tissue infection involving a craniotomy wound, accompanied by purulent secretion, erythema, and swelling. The patient also experienced fever, pneumonia, and septic shock. Meanwhile, Melchio et al. (2025) reported bacteremia in a patient with underlying diabetes and cirrhosis. Balfousias et al. (2019) described a patient with major pelvic and abdominal injuries following a car accident, although the table does not clearly establish the specific clinical manifestations attributable to *A. baumannii* in this case..

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

E. Synergistic Effect of A. baumannii

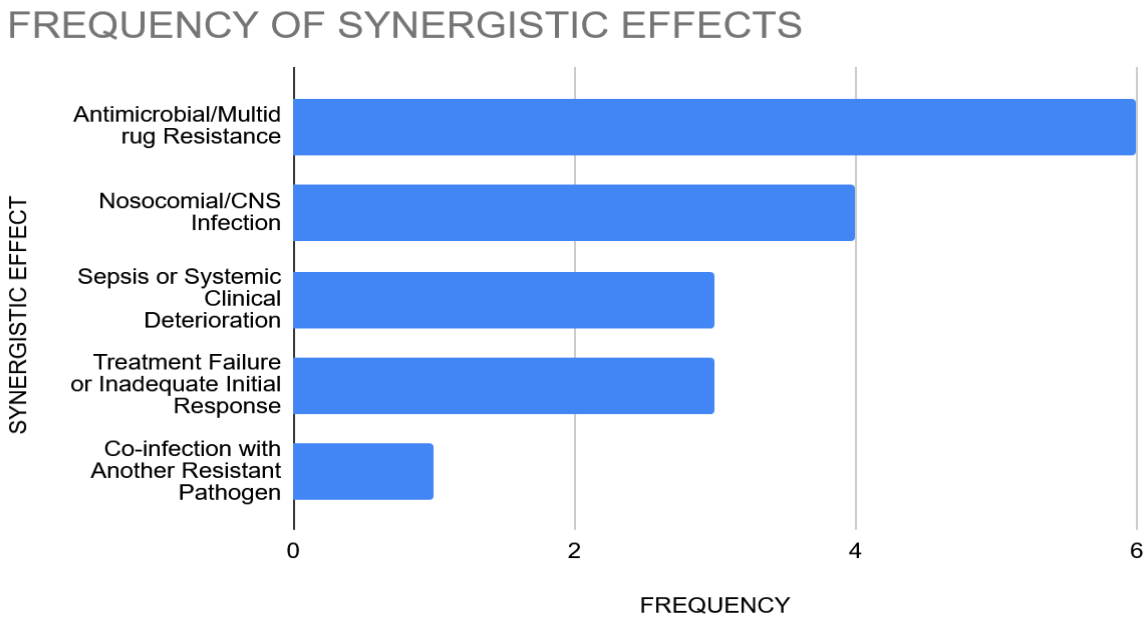


Figure 6. Frequency of Synergistic Effects

Antimicrobial resistance was an important finding in the selected studies, with reported *A. baumannii* strains demonstrating different levels of resistance to antibiotics. Wang et al. (2021) reported carbapenem-resistant *A. baumannii* in a patient with severe pneumonia. Rei et al. (2023) described a multidrug-resistant (MDR) strain associated with pneumonia and subsequent ventriculitis. These cases illustrate the presence of resistant strains in infections involving different body systems.

More extensive resistance was reported by Dimovska Gavrilovska et al. (2024), who described a pan-drug-resistant (PDR) *A. baumannii* strain in a patient with meningitis and ventriculitis. Wu et al. (2016) investigated hospital-acquired pneumonia involving carbapenem-resistant Gram-negative bacteria and reported the identification of *A. baumannii* in 21 of the 31 critically ill patients included in the study.

Resistance associated with outbreaks was also documented. Dagher et al. (2024) investigated an outbreak involving an NDM-2-producing *A. baumannii* strain in an intensive care unit in Lebanon. This finding highlights the importance of monitoring resistant strains in hospital environments, where transmission may complicate infection control.

F. Treatments Administered

The treatments reported in the selected studies varied according to the infection, the patient's clinical condition, and the available treatment options. Wang et al. (2021) described the administration of polymyxin B to a patient with severe pneumonia involving carbapenem-resistant *A. baumannii*. The antibiotic was added to the existing treatment plan after previous treatment had been insufficient, and the patient's respiratory condition subsequently improved.

Combination therapy was reported in other cases. Rei et al. (2023) described the use of cefiderocol, ampicillin/sulbactam, and intrathecal colistin to manage multidrug-resistant *A. baumannii* infection involving the central nervous system. The study also reported separate treatment for ventriculitis caused by vancomycin-resistant Enterococcus faecium. Cheyne et al. (2024) documented the addition of intraventricular colistin after intravenous colistin alone had not produced significant improvement. Dimovska Gavrilovska et al. (2024) also reported treatment that included intraventricular colistin for a patient with PDR *A. baumannii* meningitis and ventriculitis.

Other studies examined different antibiotic approaches. Wu et al. (2016) compared high-dose tigecycline with standard-dose tigecycline among critically ill adults with pneumonia. Melchio et al. (2025) reported the use of eravacycline to treat difficult-to-treat *A. baumannii* bacteremia. These reports demonstrate that treatment approaches differed according to the infection and clinical circumstances. Wu et al. (2016) compared high-dose tigecycline with standard-dose tigecycline among critically ill adults with pneumonia. Melchio et al. (2025)

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

reported the use of eravacycline to treat difficult-to-treat *A. baumannii* bacteremia. These reports demonstrate that treatment approaches differed according to the infection and clinical circumstances.

G. Treatment Efficacy and Patient Outcomes

The treatment outcomes reported in the selected studies varied, with several patients showing clinical improvement while others required adjustments to their treatment. Wang et al. (2021) reported that a patient with severe pneumonia improved following treatment that included polymyxin B. The patient's respiratory condition improved, and she was eventually weaned from the ventilator and extubated. Similarly, Cheyne et al. (2024) documented improvement after intraventricular colistin was added to the treatment of ventriculitis when intravenous colistin alone had not produced significant improvement.

Favorable outcomes were also reported in other cases. Dimovska Gavrilovska et al. (2024) described clinical improvement and negative culture results following treatment that included intraventricular colistin for a patient with pan-drug-resistant *A. baumannii* meningitis and ventriculitis. Melchio et al. (2025) reported a favorable outcome in a patient with difficult-to-treat *A. baumannii* bacteremia following eravacycline treatment. These cases suggest that improvement was possible with treatment approaches selected according to the infection and the patient's condition.

Balfousias et al. (2019) reported that the patient's inflammatory markers improved and the patient was discharged on the 26th day after the injury, following treatment and recovery from an afebrile condition. Tafelski et al. (2017) described decreasing colistin concentrations during treatment, with therapeutic drug monitoring used to guide dosage adjustments. The report also discussed factors affecting colistin clearance in cerebrospinal fluid (CSF), particularly fluid drainage and reabsorption.

H. Risk Factors and Infection Transmission

Several patient-related and healthcare-related circumstances were described in the selected studies involving healthcare-associated *A. baumannii* infections. These included critical illness, invasive medical procedures, underlying health conditions, and treatment within intensive care settings. For example, Rei et al. (2023) described a patient with pneumonia and pseudomeningocele who subsequently developed ventriculitis. Cheyne et al. (2024) reported ventriculitis following ventriculoperitoneal shunt placement, while Dimovska Gavrilovska et al. (2024) described meningitis and ventriculitis following neurosurgery. These cases illustrate the clinical circumstances in which serious infections were reported, although individual case reports cannot establish that the procedures directly caused the infections.

Underlying conditions and traumatic injuries were also present in some reports. Balfousias et al. (2019) described a patient with major pelvic and abdominal injuries following a car accident, alongside hypertension and hypercholesterolemia. Tafelski et al. (2017) reported a patient who underwent emergency cranial trepanation after developing an acute subdural hematoma and subsequently presented with a possible craniotomy-wound infection, fever, pneumonia, and septic shock. These cases highlight the complexity of treating seriously ill patients with multiple clinical complications, but the table does not establish that every condition was an independent risk factor for *A. baumannii* infection. Balfousias et al. (2019) reported that the patient's inflammatory markers improved and the patient was discharged on the 26th day after the injury, following treatment and recovery from an afebrile condition. Tafelski et al. (2017) described decreasing colistin concentrations during treatment, with therapeutic drug monitoring used to guide dosage adjustments. The report also discussed factors affecting colistin clearance in cerebrospinal fluid (CSF), particularly fluid drainage and reabsorption.

CONCLUSION

The collected available information concerning health issues associated with *A. baumannii*, a bacteria acquired in healthcare facilities, particularly in intensive care units (ICUs) illustrate the challenges to identify it due to its drug-resistant nature. Based on the reviewed literature, the exceptional ability of *A. baumannii* to survive in prolonged periods in the harsh environment of hospital units cause nosocomial outbreaks. For instance, a case report by Wang et al. (2021) presents a young woman contracting Tropheryma whipplei infection that resulted in severe pneumonia and was admitted to hospital. However, during her stay and treatment of prior infection, examination results and further testing has ruled out Tropheryma whipplei and established carbapenem-resistant *A. baumannii* as the main pathogen, which was resistant to all tested antibiotics. In the end, the patient was treated with polymyxin B and was released after her condition improved. More cases wherein prolonged hospitalization and other factors such as urinary catheterization, mechanical ventilation, diabetes, and carbapenem use put patients at risk in contracting *A. baumannii* infection (Shi, J. et al., 2024). Additionally, history of severe illness compromises the exposure to *A. baumannii* infection. A case of a 59 year-old man with a history of trigeminal neuralgia and known pneumonia and a pseudomeningocele in the left suboccipital region was exposed to the same infection. Pneumonia was treated using combination therapy, given that *A. baumannii* ventriculitis is multidrug-

 © Author(s) | CC BY 4.0 International License.

iJETRM
INTERNATIONAL JOURNAL OF ENGINEERING TECHNOLOGY RESEARCH & MANAGEMENT (IJETRM)
https://ijetrm.com/

resistent cefiderocol, ampicillin/sulbactam, and intrathecal colistin were administered. Meanwhile, VRE faecium ventriculitis was cured the same with combination antibiotic therapy, namely linezolid and intrathecal daptomycin (Rei, K. M. et al., 2023). These findings highlight the importance of early diagnosis of the said bacteria, the selection of appropriate antibiotics, and the considerations of other factors influencing the emergence of hospital-acquired infections such as the multidrug-resistent *A. baumannii*.

RECOMMENDATIONS

After reviewing the research studies conducted, the following recommendations is proposed:

1) There is a need for early diagnosis and susceptibility testing in the hospital to ensure that the most appropriate antibiotic is administered since the infection site and strain determine the right treatment.
2) The study found that the use of carbapenem resulted in extensive drug resistance, and thus stewardship programs should discourage the overuse of these medications.
3) Infection control measures should be reinforced with intensive care units to reduce the spread of infection within the facility. Such preventive measures may help reduce the length of hospital stays, mechanical ventilation, and urinary catheterization.
4) Clinicians should exercise caution when using treatment findings since most of these studies were case reports. Colistin combined with polymyxin B or cefiderocol, Eravacycline, and high-dose Tigecycline should be used as secondary treatments in the future clinical settings since they were only case reports.
5) Further studies analyzing the most appropriate antibiotic treatment for patients with carbapenem-resistant *A. baumannii* infections should be conducted. Further research studies should use a larger sample size and identical research design to analyze the effectiveness of each antibiotic.

ACKNOWLEDGEMENT

This systematic review, “Healthcare-Associated Infections Caused by *A. baumannii*: A Systematic Review of Clinical Manifestations, Antimicrobial Resistance, and Treatment Outcomes” is a product of diligence and dedication of all the authors that have contributed until its completion. The authors would like to extend their sincerest appreciation and gratitude to Professor Gecelene C. Estorico for her unwavering guidance, support, and mentorship that has motivated us to accomplish the study with integrity. Furthermore, we give recognition to the researchers for their foundational study on healthcare-induced infections caused by *A. baumannii* and its appropriate treatment that has helped frame our systematic review.

REFERENCES

1) Wang, S., Xia, D., Wu, J., Jia, D., Li, L., & Xu, S. (2021). Severe Pneumonia Caused by Infection With Tropheryma whipplei Complicated With Acinetobacter baumannii Infection: A Case Report Involving a Young Woman. Frontiers in Public Health, 9, 729595. https://doi.org/10.3389/fpubh.2021.729595
2) Rei, K. M., Reddy, V., Andraos, C., Brazdzionis, J., & Siddiqi, J. (2023). Catheter-Associated Vancomycin-Resistant Enterococcus faecium Ventriculitis and Multidrug-Resistant Acinetobacter baumannii Pneumonia With Subsequent Acinetobacter Ventriculitis: A Case Report. Cureus, 15(11), e49058. https://doi.org/10.7759/cureus.49058
3) Dagher, T. N., Hadjadj, L., Bittar, F., Fenianos, F., Abdo, E., Rolain, J., & Al-Bayssari, C. (2024). Clonal dissemination of an NDM-2-producing Acinetobacter baumannii ST103 clone resulting in an outbreak in an intensive care unit of a Lebanese tertiary care hospital. Journal of Global Antimicrobial Resistance, 40, 66–71. https://doi.org/10.1016/j.jgar.2024.11.016
4) D'Isanto, M., Battista, F., Cipollaro, M., Balestrieri, A., Proroga, Y. T. R., Paradiso, R., Fusco, G., Borriello, G., & Maddaluno, S. (2025). Human bloodstream infection caused by a Colistin multidrug-resistant Acinetobacter baumannii strain: a case report. The new microbiologica, 48(1), 22–26. https://www.researchgate.net/publication/391401584_Human_bloodstream_infection_caused_by_a_Colistin_multidrug-resistant_Acinetobacter_baumannii_strain_a_case_report/citations
5) Cheyne, I., Hassan, K., Dunkel, T., Sota, M., Wróblewski, Ł., & Mikaszewska-Sokolewicz, M. (2024). Effective Treatment of Acinetobacter baumannii Ventriculitis With Interventricular Colistin: A Case Report. Cureus, 16(6), e62169. https://doi.org/10.7759/cureus.62169
6) Dimovska Gavrilovska, A., Veljanovski, H., & Jovchevski, R. (2024). Successful treatment of pan-drug resistant Acinetobacter baumannii meningitis/ventriculitis following craniotomy and external ventricular drainage: a case report. Journal of Surgical Case Reports, 2024(9), rjae603. https://doi.org/10.1093/jscr/rjae603

 © Author(s) | CC BY 4.0 International License.