ORIGINAL ARTICLE

Intisari Sains Medis 2023, Volume 14, Number 3: 1023-1027
P-ISSN: 2503-3638, E-ISSN: 2089-9084

Intisari Sains Medis

Published by Intisari Sains Medis

Antibiogram of *Acinetobacter baumannii* isolated from Intensive Care Unit at Prof. dr. I.G.N.G. Ngoerah Hospital in 2020-2022

Indramawan Setyojatmiko[1], Ni Nengah Dwi Fatmawati[2*], Ni Made Adi Tarini[2]

[1]Clinical Microbiology Specialist Study Program, Faculty of Medicine, Udayana University, Bali, Indonesia;
[2]Department of Clinical Microbiology, Faculty of Medicine, Udayana University/ Prof. dr. I.GN.G. Ngoerah Hospital, Bali, Indonesia.

*Corresponding author:
Ni Nengah Dwi Fatmawati;
Department of Clinical Microbiology, Faculty of Medicine, Udayana University/ Prof. dr. I.GN.G. Ngoerah Hospital, Bali, Indonesia;
nnd.fatmawati@unud.ac.id

Received: 2023-06-29
Accepted: 2023-09-22
Published: 2023-10-31

ABSTRACT

Background: *Acinetobacter baumannii* infection is a severe problem since it tends to be multi-resistant to many antibiotics. This study aimed to determine the prevalence of *A. baumannii* isolated from blood, urine, and sputum cultures and their antibiotic resistance patterns.

Methods: Data of *A. baumanii* isolated from clinical specimens of Intensive Care Unit (ICU) wards patients were collected retrospectively from laboratory records in the Clinical Microbiology Department of Prof. Dr. I. G. N. G. Ngoerah General Hospital during 2020-2022. Identification and antimicrobial susceptibility tests were conducted using the Vitek-2 Compact system (bioMérieux, France). Isolates resistant to ≥ 3 antibiotic classes were categorized as multidrug-resistant (MDR) *A. baumanii*.

Results: *A. baumanii* collected from sputum, blood, and urine in Intensive Care Unit (ICU) wards were 63%, 13%, and 7.5% from 2020 until 2022. Most *A. baumanii* isolates in 2020, 2021, and 2022 were susceptible to Amikacin, which was 75%, 78%, and 76%, respectively. Furthermore, the isolates that were susceptible to Trimethoprim/Sulfamethoxazole were 66%, 81%, and 72%, followed by Tigecycline, 80%, 61%, and 56% respectively. *A. baumanii*, however, showed low sensitivity to Meropenem even though susceptibility is getting higher each year. Almost all the isolates were resistant to ceftriaxone.

Conclusions: *Acinetobacter baumannii* isolates isolated during 2020-2022 showed high resistance to penicillin, cephalosporin and fluoroquinolones. Although *A. baumanii* was resistant to carbapenem, its susceptibility tends to increase throughout the 3 years of this study. These data could be considered for empirical therapy of *A. baumanii* infections.

Keywords: *Acinetobacter baumanii,* Antimicrobial Susceptibility, Multidrug Resistance (MDR).
Cite This Article: Setyojatmiko, I., Fatmawati, N.N.D., Tarini, N.M.A. 2023. Antibiogram of *Acinetobacter baumannii* isolated from Intensive Care Unit at Prof. dr. I.G.N.G. Ngoerah Hospital in 2020-2022. *Intisari Sains Medis* 14(3): 1023-1027. DOI: 10.15562/ism.v14i3.1831

INTRODUCTION

Gram-negative bacilli constituted the most prevalent group of nosocomial pathogens in the ICUs. The most common single pathogens causing ICU-acquired infection in low – middle-income countries were *Acinetobacter baumannii* (24%), *Pseudomonas aeruginosa* (16%), *Klebsiella pneumoniae* (15%), these caused the majority of infections. In 2015, at Siloam Tangerang General Hospital, *A. baumanii* were mostly isolated from ICUs (46.6%).[1] While In 2022, unpublished data from Prof. Dr. I.G.N.G. Ngoerah General Hospital, Bali Intensive Care Unit recorded that the most common pathogen causing an infection are *Klebsiella pneumoniae* (20.5%), *Acinetobacter baumanii* (17%), *Pseudomonas aeruginosa* (13.6%), and *Escherichia coli* (12.3%).

Acinetobacter spp. are non-fermenting, largely opportunistic Gram-negative bacteria ubiquitous in the environment. *Acinetobacter baumannii* complex (*Acinetobacter nosocomialis, Acinetobacter pitti* and *Acinetobacter baumannii*) is the most clinically significant out of the over 20 species in the *Acinetobacter* genus.[2] *Acinetobacter baumannii* is one of the most prevalent opportunistic pathogens causing severe and persistent infection in immunocompromised patients; this *bacteria* can form biofilms, is significantly associated with multi-drug resistance (MDR) and can transfer mobile genetic elements to other clinically relevant pathogens.[3] Worldwide, *A. baumannii* infection has been implicated in several hospital outbreaks of diseases like pneumonia, bloodstream, wound and urinary tract infections, especially among patients with severe morbidities, more likely ICU patients.[4] The pathogen can survive adverse environmental conditions, fostering its persistence and spread in the hospital environment.[5] The mortality rate of infection cases, particularly hospital-acquired infection, is high and increases due to multidrug–resistant strain infection.[6] Morrocan Teaching Hospital reported a crude mortality rate of 74.1% and a median hospitalization of 10 days in patients with *A. baumannii* infection.[7] Multi-drug resistant (MDR) strains emerged due to selective pressure antibiotics mostly used in intensive care wards. There have been few reports on the

tendency change of *A. baumanii* sensitivity to antibiotics in Indonesia.[8]

Infections from *A. baumannii*, particularly carbapenem-resistant *A. baumannii* (CRAb), are of significant public health importance worldwide because of their association with mortality, morbidity, and high-cost treatment.[9,10] At present, the article on CRAb prevalence in Indonesia is limited. A study in Sanglah General Hospital Bali reported that of all *A. baumannii* isolates, almost 40% were multidrug-resistant, and three produced carbapenemase.[11] The World Health Organization (WHO) has ranked carbapenem-resistant *A. baumannii* as a critical pathogen on its global list of antibiotic-resistant bacteria to guide drug research and development.[12,13] Treating carbapenem-resistant *A. baumannii* infections is challenging since they are naturally antibiotic-resistant in the WHO "Access" and "Watch" lists. They are, therefore, associated with poor clinical outcomes across many healthcare settings. Morrocan Teaching Hospital reported a crude mortality rate of 74.1% and a median hospitalization of 10 days in patients with *A. baumannii* infection.[12] Multiple studies have been conducted worldwide to analyze the burden of healthcare-associated infections caused by *A. baumannii*. The incidence or prevalence estimates of (carbapenem-resistant) *A. baumannii* vary significantly between the studies. Even though representative data are scarce, there is evidence of increasing incidence of *A. baumannii* in ICUs across Sub-Saharan Africa and Eastern Mediterranean countries, both of which have diverse populations.[14] Carbapenem resistance accounts for 65% of *A. baumannii* pneumonia in the USA and Europe. A recent study showed that >60% of *A. baumannii* isolates causing hospital-acquired pneumonia in Asian countries were PDR and carbapenem-resistant. Moreover, the epidemiological situation has worsened in Europe as it has become further exacerbated in only two years, from 2013 to 2015, with some areas experiencing cross-border transmission.[15,16] An antibiogram is an essential resource to track changes in antimicrobial resistance and guide empirical antimicrobial therapy.[17]

Based on those mentioned above, this study aims to investigate antibiotic susceptibility in the ICU at Prof. Dr. I. G. N. G. Ngoerah General Hospital from 2020 to 2022.

METHODS

This cross-sectional, retrospective, descriptive study was conducted in Prof. Dr. I. G. N. G. Ngoerah Hospital. This study has already been deemed eligible for ethical clearance from the ethics commission of Medical Faculty Udayana University, Prof. Dr. I. G. N. G. Ngoerah General Hospital, with number 1881/UN14.2.2.VII.14/LT/2023. Data on *Acinetobacter baumannii* and its antimicrobial sensitivity test were gathered retrospectively from clinical specimens of patients in 3 years from 2020 to 2022. The *A. baumanii* was isolated from blood, urine, and sputum specimens. Specimen management for bacteriology culture based on the standard operating procedure of the Department of Microbiology of Prof. Dr. I. G. N. G. Ngoerah General Hospital. Microorganism and antimicrobial sensitivity tests were identified using the Vitek-2 Compact system (bioMérieux, France). The interpretation of breakpoints was defined by the Clinical and Laboratory Standard Institute (CLSI) guidelines.[18–20] Every MICs that have results above breakpoints defined by CLSI guidelines are deemed resistant. Inclusion criteria were all positive cultures for *A. baumannii* from Intensive care unit ward patients. The exclusion criteria were all samples originating from Prof. Ngoerah General Hospital. Data was collected and analyzed using Microsoft Excel 365 software descriptively. Calculations were presented in chart diagrams.

RESULTS

During this study, from 2020 to 2022, as many as 239 samples identified with *Acinetobacter baumanii* were collected from ICUs. Most of the samples *of A. baumanii* isolates were collected from sputum specimens with 151 (75%) samples, followed by blood 32 (16%), and urine with 18 (9%).

All *Acinetobacter baumannii* isolates (239) in 2020, 2021, and 2022 were mostly sensitive to Amikacin Trimethoprim/Sulfamethoxazole and Tigecycline. In detail, the antibiotic susceptibility pattern of the isolates to Amikacin showed 75%, 78%, and 76%, respectively, while to Trimethoprim/Sulfamethoxazole were 66%, 81%, 72%, and to Tigecycline were 80%, 61%, 56% respectively, as shown in Figure 2. In addition, the susceptibility of *A. baumannii* isolated to Meropenem showed low sensitivity, which was 24%, 42%, and 58%, respectively. The isolates showed the lowest sensitivity to Ceftriaxone, which were 1%, 7%, 5%.

CRAb isolates in 2020, 2021, and

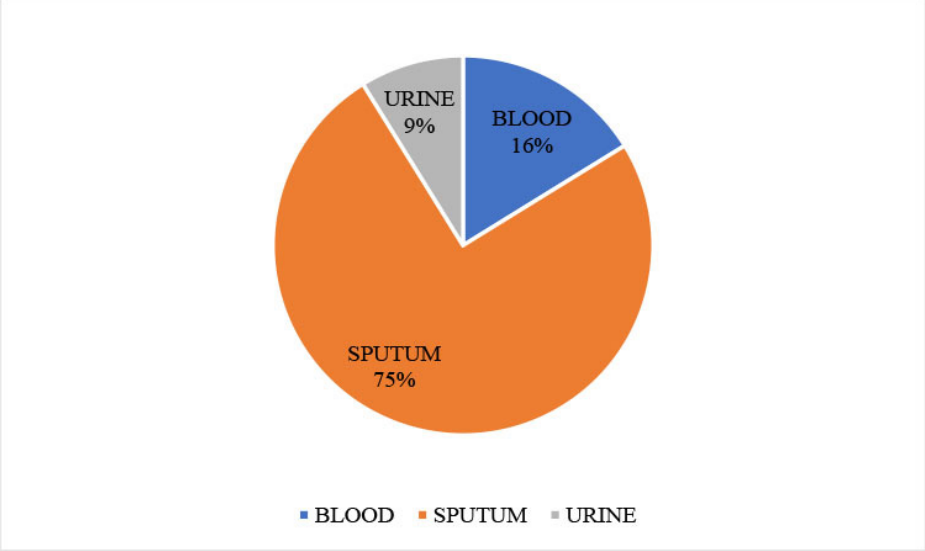

Figure 1. Distribution of *Acinetobacter baumannii* isolates based on Specimen Type in ICU at Prof. Dr. I. G. N. G. Ngoerah General Hospital.

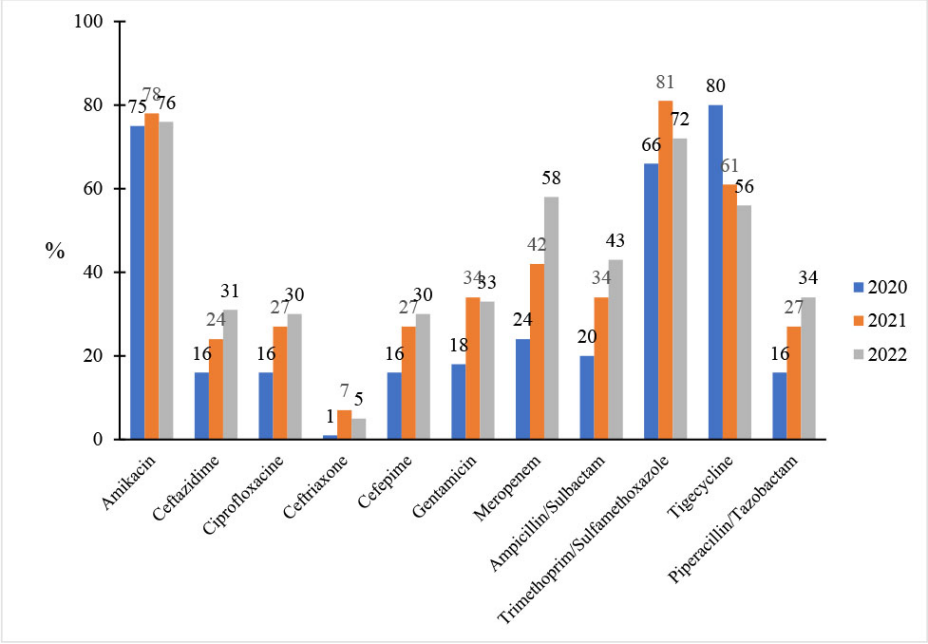

Figure 2. Antibiogram of *Acinetobacter baumannii* isolates in 2020, 2021 and 2022 at ICU wards at Prof. Dr. I. G. N. G. Ngoerah General Hospital.

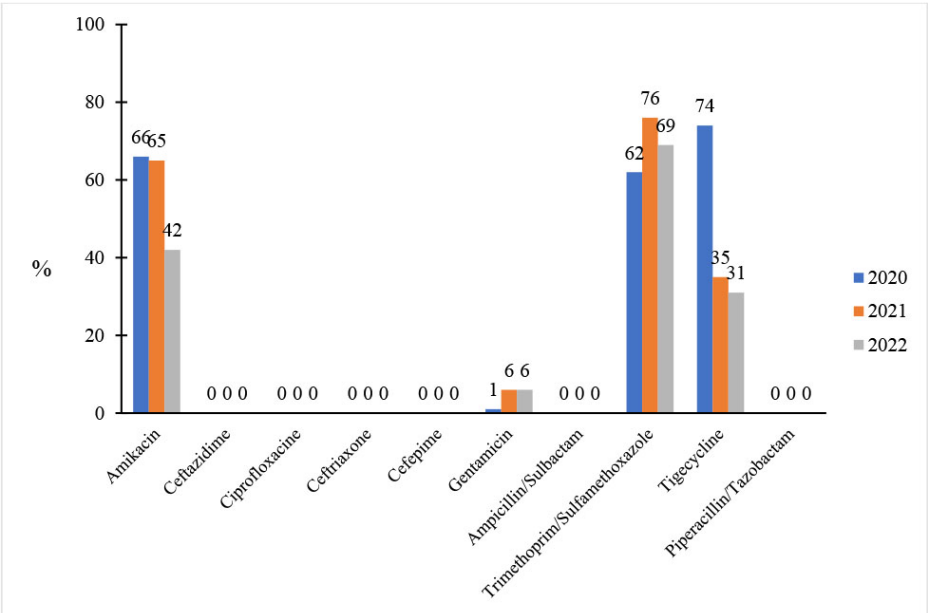

Figure 3. Antibiogram of Carbapenem-resistant *Acinetobacter baumannii* (CRAb) isolates in ICU at Prof. Dr. I. G. N. G. Ngoerah Hospital.

2022 showed the lowest sensitivity to gentamicin, with 1%, 6%, and 6%, respectively. The isolates showed lower sensitivity to Amikacin, which were 66%, 65%, and 42%. In contrast, most *A. baumannni* isolates showed better susceptibility to trimethoprim/sulfamethoxazole, which showed 66%, 81%, and 72%. The susceptibility of *A. baumannii* to amikacin and Tigecycline both showed decreasing sensitivity rates each year. The isolates were susceptible to amikacin, which were 66%, 65%, and 42%, respectively and for Tigecycline, 74%, 35%, and 31%, respectively (Figure 3).

DISCUSSION

MDR *A. baumanii* is one of the most common pathogens that can cause serious hospital infections and has a high mortality rate. In this study, sputum was the specimen that *A. baumanii* isolated from the ICU. This finding is similar to a study that was conducted by Sileem AE et al. in Al-Adwani General Hospital, with 79.5 % isolate from respiratory tract infections patients.[21] Blood specimens showed the second most frequent of *A. baumanii* isolated from ICU, which can be one of the major threat of bacteremia and mortality cases in ICU.[22] Amikacin showed stable susceptibility with 75%, 78% and 76%, respectively, which is similar to a study in Tangerang Hospital with 80% in both 2013 and 2014.[8] Alotaibi T et al also reported that 58% of isolates from ICU were susceptible to amikacin in which has a lower percentage.[6] Furthermore, most of the referred patients have used those kinds of antibiotics before hospital admission. While susceptibility to penicillin, cephalosporin, and fluoroquinolones showed a slight increase throughout 2020 – 2022, respectively. The availability and adherence to antibiotic guidelines, such as a list of Access, Watch and Reserve (AWaRe) antibiotics in the hospital, will affect the susceptibilities of bacteria to certain antibiotics.[6] In a recent study, the susceptibility to trimethoprim/sulfamethoxazole was moderate and showed the highest susceptibility in 2021 (81%), similar to another study.[23-25] Trimethoprim/sulfamethoxazole is not considered as first–line treatment option against *A. baumannii*, and increasing sensitivity caused by limited use of cotrimoxazole in referral hospitals is because Cotrimoxazole is only available in oral preparation in Indonesia.[8] In this study, CRAb isolates showed decreasing susceptibilities to many classes of antibiotics like Tigecycline and amikacin, especially Tigecycline in 2022, which were possibly due to overuse of antibiotics either as empirical or definitive therapy for amikacin and Tigecycline are the mostly used antibiotics to treat Carbapenem–resistant.[26-28] Generally, Carbapenem-resistant *Acinetobacter baumannii* is also resistant to two or more other antibiotics, especially beta-lactam antibiotics and the researchers also found a similar phenomenon in this study.[29,30] The surveillance of antimicrobial susceptibility patterns will help to determine empirical treatment in *A. baumannii* infections.

Susceptibility to aminoglycoside and Tigecycline in this study showed a decrease in CRAb isolates, which can challenge antibiotic therapy options, where these antibiotics are the appropriate definitive therapy against CRAb infection.

There are some limitations in this study. This study used secondary data; while specimens used in this study have collecting standards, the author did not confirm the quality, so they might not represent real *A. baumanni* characteristics in ICUs. For further study, prospective study will represent more valid data and fewer potential biases.

CONCLUSIONS

We found *A. baumanii* isolated from ICU wards, mostly from sputum specimens. CRAb isolates tend to increase throughout the 3 years of this study. Moreover, the decreased susceptibility *of A. baumanii* to amikacin and Tigecycline in CRAb isolates that showed in this study should be a warning for clinicians of antibiotics usage in ICU wards. Further study that shows proper data on antibiotics' usage is needed. The antibiogram presented in this study may help clinicians select appropriate empirical antimicrobial therapy for *A. baumanii* infection.

CONFLICT OF INTEREST

The authors report no conflict of interest.

ETHICAL CONSIDERATIONS

This research was conducted based on the ethical conduct of research from the Ethics Committee of the Medical Faculty, Universitas Udayana, Prof I.G.N.G Ngoerah Hospital Denpasar and have received permission from the Research and Development Unit (R & D) of Universitas Udayana, Prof I.G.N.G Ngoerah Hospital Denpasar.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

AUTHOR CONTRIBUTIONS

All authors participated in the study design, analysis of data, writing of the manuscript and data collection. All authors read and approved the final manuscript.

ACKNOWLEDGMENT

The authors would like to acknowledge all technicians of the Clinical Microbiology Laboratory, Prof. dr. I.G.N.G. Ngoerah Hospital, for the technical support, dr. I Nengah Tony Rustawan, SpMK, as chief of the Clinical Microbiology Laboratory Prof. dr. I.G.N.G. Ngoerah Hospital, for research permit.

REFERENCES

1. Saharman YR, Karuniawati A, Severin JA, Verbrugh HA. Infections and antimicrobial resistance in intensive care units in lower-middle-income countries: a scoping review. Antimicrob Resist Infect Control. 2021;10(1):1–19.
2. Raut S, Rijal KR, Khatiwada S, Karna S, Khanal R, Adhikari J, et al. Trend and characteristics of acinetobacter baumannii infections in patients attending Universal College of Medical Sciences, Bhairahawa, Western Nepal: A longitudinal study of 2018. Infect Drug Resist. 2020;13:1631–41.
3. Fahy S, O'Connor JA, Lucey B, Sleator RD. Hospital Reservoirs of Multidrug Resistant Acinetobacter Species—The Elephant in the Room! Br J Biomed Sci. 2023;80(March):1–7.
4. Higgins PG, Dammhayn C, Hackel M, Seifert H. Global spread of carbapenem-resistant Acinetobacter baumannii. Journal of Antimicrobial Chemotherapy. 2009;65(2):233–8.
5. Kohlenberg A, Brümmer S, Higgins PG, Sohr D, Piening BC, De Grahl C, et al. Outbreak of carbapenem-resistant Acinetobacter baumannii carrying the carbapenemase OXA-23 in a German university medical centre. J Med Microbiol. 2009;58(11):1499–1507.
6. Alotaibi T, Abuhaimed A, Alshahrani M, Albdelhady A, Almubarak Y, Almasari O. Prevalence of multidrug-resistant Acinetobacter baumannii in a critical care setting: A tertiary teaching hospital experience. SAGE Open Med. 2021;9(1):20503121211001144.
7. Uwingabiye J, Lemnouer A, Baidoo S, Frikh M, Kasouati J, Maleb A, et al. Intensive care unit-acquired Acinetobacter baumannii infections in a Moroccan teaching hospital: Epidemiology, risk factors and outcome. Germs. 2017;7(4):193–205.
8. Cucunawangsih, Wiwing V, Lugito NPH. Antimicrobial Susceptibility of in a Teaching Hospital : A Two-Year Observation. Open J Med Microbiol. 2015;5(June):85–89.
9. Chang D, Sharma L, Dela Cruz CS, Zhang D. Clinical Epidemiology, Risk Factors, and Control Strategies of Klebsiella pneumoniae Infection. Front Microbiol. 2021;12(December):1–9.
10. Choi J, Ki M, Kwon HJ, Park B, Bae S, Oh CM, et al. Health indicators related to disease, death, and reproduction [Internet]. Journal of Preventive Medicine and Public Health. 2019;52(1):14–20.
11. Darwinata AE, Tarini NMA HL. Detection of carbapenemase by Modified Hodge test, distribution, resistence pattern of MDR A. baumannii in Sanglah General Hospital. In: 8th Nat Congress Indonesian Society Clin Microbiol. 2012.
12. Organisation Mondiale de la Santé. WHO Publishes List of Bacteria for Which New Antibiotics Are Urgently Needed. Saudi Med J. 2017;38(1):444–445.
13. Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet DL, et al. Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infect Dis. 2018;18(3):318–327.
14. Ayobami O, Willrich N, Harder T, Okeke IN, Eckmanns T, Markwart R. The incidence and prevalence of hospital-acquired (carbapenem-resistant) Acinetobacter baumannii in Europe, Eastern Mediterranean and Africa: a systematic review and meta-analysis. Emerg Microbes Infect. 2019;8(1):1747–1759.
15. Kim UJ, Kim HK, An JH, Cho SK, Park KH, Jang HC. Update on the Epidemiology, Treatment, and Outcomes of Carbapenem-resistant Acinetobacter infections. Chonnam Med J. 2014;50(2):37.
16. European Centre for Disease Prevention and Control. Rapid Risk Assessment: Carbapenem-resistance Acinetobacter baumannii in healthcare settings. Rapid Risk Assessment. 2016;2015. [Available from: https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/8-Dec-2016-RRA-Acinetobacter baumannii-Europe.pdf] [Accessed on: 4th September 2023].
17. Truong WR, Hidayat L, Bolaris MA, Nguyen L, Yamaki J. The antibiogram: Key considerations for its development and utilization. JAC Antimicrob Resist. 2021;3(2):1–6.
18. CLSI. CLSI M100-ED29: 2021 Performance Standards for Antimicrobial Susceptibility Testing, 30th Edition. Vol. 40, CLSI. 2020;1(1):50–51.
19. Clinical and laboratory standards institute. Clinical and Laboratory Standards Institute. CLSI Document. Performance standards for antimicrobial. M100-S22. 2022.
20. CLSI. M100 Performance Standards for Antimicrobiafile. 2021. [Available at: https://clsi.org/standards/products/microbiology/documents/m100/] [Accessed on: 1st September 2023].
21. Sileem AE, Said AM, Meleha MS. Acinetobacter baumannii in ICU patients: A prospective study highlighting their incidence, antibiotic sensitivity pattern and impact on ICU stay and mortality. Egyptian Journal of Chest Diseases and Tuberculosis. 2017;66(4):693–698.
22. Ballouz T, Aridi J, Afif C, Irani J, Lakis C, Nasreddine R, et al. Risk factors, clinical presentation, and outcome of Acinetobacter baumannii bacteremia. Front Cell Infect Microbiol. 2017;7:1–8.

23. Gustawan IW, Satari HI, Amir I, Astrawinata DA. Gambaran Infeksi Acinetobacter baumannii dan Pola Sensitifitasnya terhadap Antibiotik. Sari Pediatri. 2016;16(1):35-40.
24. Dharma BDA, Mulyantari NK, Prabawa IPY. Analisis korelasi kadar serum prokalsitonin dengan jumlah leukosit pada penderita dengan kecurigaan sepsis di RSUP Sanglah, Bali, Indonesia. Intisari Sains Medis. 2020;11(1):179-182.
25. Syaiful I, Mertaniasih NM, Alimsardjono L, Endraswari PD, Utariani A, Utomo B. Critical priority Multidrug-Resistant Organisms (MDROs) secondary infection among COVID-19 patients: hidden threat during a pandemic? A retrospective study. Bali Medical Journal. 2023;12(1):416–422.
26. Reid GE, Grim SA, Aldeza CA, Janda WM, Clark NM. Rapid development of Acinetobacter baumannii resistance to Tigecycline. Pharmacotherapy. 2007;27(8):1198–1201.
27. Syaiful I, Widodo ADW, Endraswari PD, Alimsardjono L, Utomo B, Arfijanto MV. The association between biofilm formation ability and antibiotic resistance phenotype in clinical isolates of gram-negative bacteria: a cross-sectional study. Bali Medical Journal. 2023;12(1):1014–1020.
28. Baran A, Atelik M, Arslan Y, Demirk H. Evaluation of risk factors in patients with ventilator-associated pneumonia caused by Acinetobacter baumannii. Bali Medical Journal. 2020;9(1):253–258.
29. Bialvaei AZ, Kouhsari E, Salehi-Abargouei A, Amirmozafari N, Ramazanzadeh R, Ghadimi-Daresajini A, et al. Epidemiology of multidrug-resistant Acinetobacter baumannii strains in Iran: a systematic review and meta-analysis. Journal of Chemotherapy. 2017;29(6):327–337.
30. Primaningtyas W, Pamungkasari EP. Factors Causing Acinetobacter Baumannii Resistance to Carbapenem Antibiotics in Patients with Healthcare Associated Infection (HCAI) at Dr. Moewardi Hospital, Surakarta. Indonesian Journal of Medicine. 2017;02(02):125–138.