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Original Article

Evaluation of Rational Antibiotic Use (RAU) in Cerebrovascular Accident (CVA) Patients in the ICU Using the Gyssens Criteria

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Abstract

Cerebrovascular accident (CVA) is a major cause of morbidity and mortality, often requiring intensive care unit (ICU) treatment. Patients with CVA are at high risk for secondary infections, which commonly lead to the use of antibiotics. This study aimed to evaluate the patterns and rationality of antibiotic use in CVA patients treated in the ICU of a regional hospital using the Gyssens method. A retrospective observational study was conducted involving 30 CVA patients who received antibiotics during their ICU stay. Data collected included patient demographics, comorbidities, types of antibiotics used, route of administration, combination patterns, and evaluation of prescription rationality based on the Gyssens criteria. The most frequently used antibiotic class was third-generation cephalosporins (60%), with ceftriaxone being the most prescribed (46.7%). All antibiotics were administered intravenously. Combination therapy was used in 20% of cases. Based on Gyssens categorization, only 33.3% of prescriptions were considered rational (category 0). The remaining 66.7% were irrational, including delayed initiation or discontinuation (13.3%), incorrect dosing (16.7%), unnecessarily broad-spectrum (10%), and no indication (6.7%). The study highlights a substantial proportion of irrational antibiotic use in ICU CVA patients, mainly due to suboptimal timing, dosing errors, and unnecessary broad-spectrum antibiotics. These findings underline the importance of antimicrobial stewardship and routine rationality assessments to ensure optimal antibiotic use and patient outcomes.

Keywords: Antibiotics, Gyssens Evaluation, Intensive Care Unit, Medication Rationality, Stroke.

1. Introduction

The prevalence of Cerebrovascular Accident (CVA) in Indonesia positions this condition as one of the leading causes of death and permanent disability at various levels of healthcare services. As the population ages and non-communicable risk factors such as hypertension, diabetes mellitus, dyslipidemia, and unhealthy lifestyles increase, the occurrence of cerebrovascular accidents (CVA) is becoming more widespread, particularly in regional referral hospitals like RSUD Gambiran (Chen et al., 2025). In the Intensive Care Unit (ICU), patients with CVA have a high risk of hospital-acquired infections, such as aspiration pneumonia, urinary tract infections, and sepsis, which leads to the initiation of empirical antibiotic treatment or definitive therapy (Azeem-ur-Rehman et al., 2022). The presence of infections in critically ill patients not only increases morbidity and mortality but also extends the duration of hospitalization and imposes a significant financial burden on the national

healthcare system. Choosing antibiotics for ICU patients requires a careful strategy to ensure the correct dosage, duration, indication, and spectrum. This approach aims to prevent resistance, toxicity, and inefficient use of resources (Carval et al., 2022)

The growth in the use of antibiotics in hospitals (Suminar, 2022), particularly in ICUs, raises global concerns about the increasing rates of bacterial resistance. This situation necessitates a systematic evaluation of the rationality of antibiotic use, one of which can be conducted using the Gyssens method (Molly et al., 2023). The Gyssens method has long been utilized as an auditing tool to evaluate essential aspects of antibiotic administration, including indications, timing of administration, dosage, spectrum, and duration, thereby enabling the identification of rationality categories ranging from level 0 (entirely rational) to level VI (insufficient data) (Masyrifah, et al, 2022). At RSUD Gambiran, there has not been a local study examining the extent to which the rational use of antibiotics in CVA patients in the ICU has been considered, despite the fact that clinical decisions are often made quickly with limited microbiological data. Furthermore, human resources in the fields of clinical pharmacy and microbiology at referral hospitals must collaborate effectively to ensure that antibiotic usage protocols adhere to national and international guidelines such as those set forth by the WHO and IDSA, as well as the antimicrobial stewardship program (ASP) committee (Limbong et al., 2023).

Current research aims to provide a comprehensive overview of the characteristics of stroke patients in the ICU of RSUD Gambiran, the patterns of antibiotic usage (including categories, types, formulations, and combination patterns), as well as the evaluation results of the rationality of antibiotic use based on the Gyssens criteria. Consequently, the findings of this research are anticipated to offer both scientific and practical contributions in the form of intervention recommendations, ranging from training for healthcare personnel, enhancement of electronic recording systems, regular audits of medication usage, to the comprehensive implementation of ASP (Nelwan et al., 2021).

This research is crucial due to several factors: first, there is still a lack of local studies in Indonesia, particularly in the ICU for stroke patients, that comprehensively evaluate the use of antibiotics using the Gyssens method. Secondly, in RSUD Gambiran, the practice of antibiotic use is often considered empirical, lacking adequate culture evidence or official guidelines, which may lead to potential clinical errors. Thirdly, the limitations in resources, such as the timely availability of cultured results, often lead the medical team to make decisions that are either too broad or too narrow in scope. Fourth, the impact of irrational antibiotic use not only leads to microbial resistance but also poses significant risks of side effects for patients, such as nephrotoxicity associated with aminoglycosides and neurotoxicity related to cephalosporins. Fifth, the development of local evidence is essential to ensure that evidence-based hospital policies can be justified, particularly for accreditation and audits at both national and international levels. Experienced writers in clinical pharmacy recognize that pharmacy clinics in the ICU have a golden opportunity to conduct daily evaluations of treatments for critical patients (Nasidi, 2024). This can only be effectively implemented if supported by an electronic medical record system, an interdisciplinary team, and a commitment to carrying out Gyssens audits. This awareness motivated this research to be conducted as an effort to translate the institutional theory of ASP into real clinical practice (Rohmah et al., 2023).

This study is designed to collect retrospective data on ICU patients with CVA who received antibiotic therapy, analyze antibiotic usage patterns, and subsequently assess each case using the Gyssens method. The results of this research are expected to produce quantitative data on the percentage of rationality in therapy, along with in-depth qualitative

insights regarding areas for improvement, including issues related to dosage, duration, spectrum, timing indicators, and the reasons for administration (Putri & Oktavilantika, 2023).

Study will also compare the findings with national standards and recommendations from the World Health Organization, as well as similar literature from Southeast Asian countries. In addition, the study will address the challenges of implementing antibiotic usage audits in regional hospitals such as the need for microbiology training, updates to local guidelines, and efficient feedback systems. This background section serves as a basis for the reader to understand the urgency of the research, its clinical and academic relevance, and the scope of clinical pharmacy interventions anticipated in the future (Årdal et al., 2024).

Through this research, it is anticipated that synergy will develop among clinical pharmacology, microbiology, and ICU clinical practice in addressing the challenges of rational antibiotic use in the era of global bacterial resistance. The scope of the research, which concentrates on ICU patients with CVA, also creates opportunities for similar audits to be conducted on other critically ill patients, such as those with septicemia, severe trauma, or post-major surgery patients. Ultimately, this study is expected to serve as a foundation for the development of hospital policies based on Data Quality Improvement (DQI) related to antibiotic use and to act as a reference for other healthcare centers facing challenges in antibiotic usage in critical care units.

2. Literature Review

2.1. Cerebrovascular Accident (CVA)

A Cerebrovascular Accident (CVA), commonly known as a stroke, is a sudden impairment of brain function caused by an interruption in blood flow to the brain, which can be due to a blockage (ischemic) or bleeding (hemorrhagic). According to the World Health Organization, stroke is the third leading cause of death worldwide and the primary cause of long-term disability. Patients with cerebrovascular accidents (CVA) frequently encounter decreased consciousness, immobilization, and various complications, with one of them being nosocomial infections that often require empirical or definitive antibiotic therapy (Alotaibi et al., 2023).

2.2. Infection Risk in CVA Patients in the ICU

Patients with cerebrovascular accidents (CVA) who are treated in the Intensive Care Unit (ICU) are highly susceptible to secondary infections (Su, X., et al., 2024), such as ventilator-associated pneumonia (VAP), urinary tract infections (UTI), and sepsis (Zhu, H., et al., 2024). The use of catheters, ventilators, and extended hospital stays increases the risk of hospital-acquired infections. This infection is often treated with broad-spectrum antibiotics, which, if not properly managed, can lead to antibiotic resistance, side effects, and higher treatment costs (Anggraini et al., 2023).

2.3. The Use of Antibiotics in the Intensive Care Unit

The intensive care unit is one of the departments with the highest antibiotic use in hospitals. According to the research conducted by Vincent et al. In 2009, over 70% of ICU patients were given at least one type of antibiotic during their treatment. Ineffective antibiotic therapy, characterized by inappropriate selection of the drug type, incorrect dosage, inadequate duration, or unclear indications, can lead to an increase in resistance, superinfections, and treatment failure. Therefore, it is crucial to conduct an evaluation of the rational use of antibiotics in the ICU (Kollef & Micek, 2014).

2.4. The Rational Use of Antibiotics

The concept of rational drug use as defined by the WHO includes administering medications that are appropriate for the indication, at the correct dosage, for the right duration, for the right patient, and based on strong scientific evidence. In the context of antibiotics, it is essential to apply rationality to prevent bacterial resistance, unwanted side effects, and the wastage of resources. The use of empirical antibiotics without adjustments based on culture results often represents a form of irregularity in clinical practice, particularly in the ICU setting (Mettler et al., 2007).

2.5. Gyssens Evaluation Method

The Gyssen method is a systematic qualitative evaluation technique used to assess the appropriateness of antibiotic use. This method classifies the use of antibiotics into seven categories (categories 0–VI) based on rational criteria, which include the choice of medication, dosage, frequency, duration, and indications for use (Fadrian et al., 2024). This method has been widely employed in numerous antibiotic audit studies in hospitals across various countries and has become a standard in clinical pharmacy training and resistance control (Limbong et al., 2023).

2.6. Related Studies

Several previous studies have employed the Gyssens method to assess the use of antibiotics. The research conducted by Wibowo et al. (2020) discovered that only 53% of antibiotic use is rational (category 0). Another study conducted by Rumende et al. (2019) at Cipto Mangunkusumo General Hospital, Budhi Asih Hospital, and Gatot Subroto Hospital also indicated that categories II – V (74,8%) represent the most frequent errors, particularly concerning therapy duration and dosage. Similar studies in RSUP Dr. M. Djamil Padang indicate a comparable trend, highlighting the significance of clinical pharmacy interventions in overseeing and educating physicians regarding antibiotic use (Putri, 2024).

2.7. Research Gaps and Study Justification

Although numerous studies have assessed the rational use of antibiotics in the ICU, there is currently no specific data examining the antibiotic use in stroke patients in the ICU of RSUD Gambiran utilizing the Gyssens method. Indeed, RSUD Gambiran serves as the primary referral hospital in the Kediri area and its surroundings, facing a significantly high patient load for stroke cases. Therefore, this study is essential for identifying patterns in antibiotic use, detecting potential inaccuracies in therapy, and providing a foundation for clinical pharmacy interventions and the development of more rational antibiotic usage protocols.

3. Methods

The study was conducted in the Intensive Care Unit (ICU) of RSUD Gambiran in Kediri City during May 2025. This location was chosen because it serves as a referral center with a high prevalence of Cerebrovascular Accident (CVA) cases and intensive antibiotic use, making it relevant for evaluating the rationality of treatment.

3.1. Research Design

This study is an observational research with a descriptive evaluative approach, aimed at assessing the use of antibiotics in patients diagnosed with Cerebrovascular Accident (CVA) in the Intensive Care Unit (ICU) of RSUD Gambiran in Kediri City. The evaluation of the rational use of antibiotics is conducted using the Gyssens method, a qualitative approach based on a widely validated algorithm in clinical pharmacy research. The research was conducted in May

2025, reflecting the current state of medication practices and antibiotic therapy management for critically ill inpatients during that time period.

3.2. Research Location and Time

The research was conducted in the ICU of Gambiran Regional Public Hospital (RSUD) in Kediri City, which is a type B referral hospital and possesses adequate intensive care facilities. The ICU area was selected because it is a service unit characterized by high complexity and a significant tendency for the empirical use of broad-spectrum antibiotics, along with the potential for therapeutic irrationality. The research was conducted in May 2025, with data collection carried out retrospectively from the medical records of patients who had completed treatment in the ICU.

3.3. Population and Sample

The population in this study consists of all patients who were treated in the ICU of RSUD Gambiran with the primary diagnosis of Cerebrovascular Accident (CVA) during May 2025. The sampling method utilized was total sampling, meaning all CVA patients who met the inclusion and exclusion criteria were included in the study. The inclusion criteria are as follows: (1) patients diagnosed primarily with a stroke (CVA), (2) patients receiving antibiotic therapy during their ICU stay, and (3) those with complete medical records concerning medication use and patient identity. The exclusion criteria include: (1) patients who are referred out before the complete administration of antibiotics, (2) patients who pass away within the first 24 hours prior to the commencement of antibiotic therapy, and (3) patients with incomplete medical record data.

3.4. Types and Sources of Data

The data utilized in this research consists of secondary data obtained from patient medical records, the hospital's medication usage list (formularium), and records of antibiotic use by the ICU nursing and doctor teams. The collected data includes patient identification details (gender, age, occupation, education, residence), clinical data (primary diagnosis, comorbidities, duration of treatment, type of medical procedures), and pharmacotherapy data (type of antibiotics, dosage, frequency, administration route, duration of administration, as well as the start and end times of antibiotic usage).

3.5. Research Instruments and Evaluation Procedures

The main tool used in this research is the Gyssens evaluation form, which has been developed based on the Gyssens algorithm to assess the rational use of antibiotics. Evaluation is conducted in several stages:

1. Assess whether antibiotics are utilized for the appropriate indication.
2. Assess the appropriateness of antibiotic selection based on clinical diagnosis and microbiological cultures (if available).
3. Evaluate the dosage, frequency, route, and duration of antibiotic administration.
4. Determine the Gyssens category ranging from 0 (rational) to VI (not evaluable).

The evaluation is conducted independently by two clinical pharmacists and verified by one specialist in internal medicine to ensure the validity of the assessment.

3.6. Operational Definition

1. Rationale for Antibiotic Use: The appropriate use of antibiotics involves adhering to guidelines regarding indications, types of medications, dosages, administration routes, intervals, and durations, based on therapeutic protocols and evaluations by Gyssens.

2. Gyssen's Category: A classification system for evaluating antibiotic use, which includes Category 0 (rational), Categories I–V (irrational for various reasons), and Category VI (data not available).
3. Antibiotics: Antimicrobial medications used for treating bacterial infections, whether they target a narrow spectrum or a wide range of bacteria.

3.7. Data Analysis Techniques

The data collected is analyzed using quantitative descriptive methods, presenting the frequency distribution and percentage for each category of Gyssens. The analysis was conducted using the latest versions of Microsoft Excel. The results of the rationality evaluation will be presented in the form of a table and bar graph that illustrate the proportion of each Gyssens category. Additionally, the analysis will explore the connections between these categories and the characteristics of the patients, as well as the types of antibiotics used.

3.8. Research Ethics

This study has received ethical approval from the Health Research Ethics Committee of University of Kadiri and has been endorsed by the hospital management. All patient data is kept confidential and is used solely for research purposes. Patient identities are not included in the publication. This study also adheres to the principles of Good Clinical Practice (GCP) and the ethical guidelines for health research.

3.9. Mind Maps

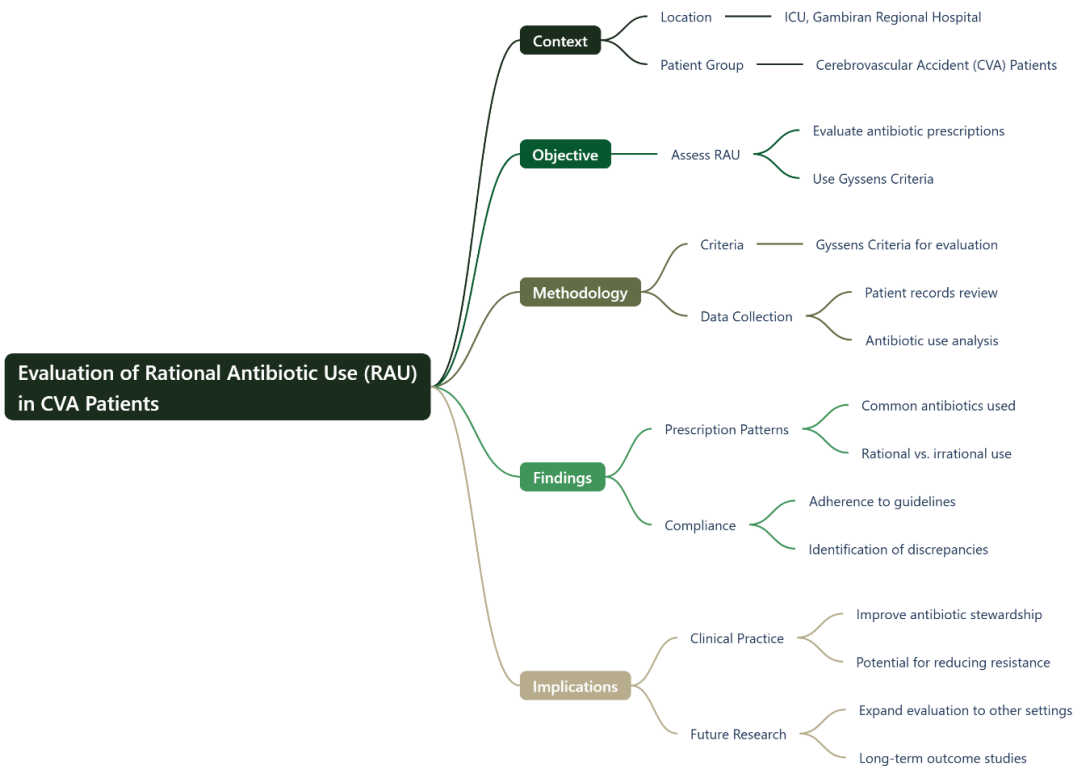

Figure 1. Mind Maps

The figure 1 above represents a research mind map that illustrates the systematic flow from the background, problem formulation, objectives, methodology, to the evaluation of antibiotic use based on Gyssens criteria for CVA patients in the ICU at RSUD Gambiran, thereby facilitating a comprehensive understanding of the overall structure of the study.

This study evaluated the rational use of antibiotics (RAU) in Cerebrovascular Accident (CVA) patients in the ICU of RSUD Gambiran. The aim was to assess antibiotic prescribing using the Gyssens Criteria. The methodology used included medical record review and analysis of antibiotic use. The results identified prescribing patterns, the level of compliance with guidelines, and the presence of discrepancies. Implications include improving antibiotic stewardship and potentially reducing resistance in clinical practice, as well as suggestions for broader future research and long-term outcome studies.

4. Results and Discussion

This study includes 30 patients diagnosed primarily with Cerebrovascular Accident (CVA) who are receiving treatment in the Intensive Care Unit (ICU) of RSUD Gambiran, as well as undergoing antibiotic therapy during their treatment period. Patient characteristics are assessed to provide an overview of the studied population, while also serving as a foundation for analyzing the rational use of antibiotics.

4.1. Patient Characteristics

This section presents the demographic and clinical characteristics of patients diagnosed with cerebrovascular accident (CVA) admitted to the ICU, including gender, age, education, occupation, and diagnosis profile.

Table 1. Gender Distribution of Patients

Gender	Frequency (n)	Percentage (%)
Male	18	60
Female	12	40
Total	30	100

Table 1 depict the total of 30 patients, 18 (60%) were male and 12 (40%) were female. The prevalence of male patients was higher than female, aligning with existing literature stating that men are at greater risk of experiencing cerebrovascular accidents (CVA). This increased risk is commonly associated with contributing factors such as hypertension, smoking, and dyslipidemia, which tend to be more prevalent among men, particularly in the productive age group to the elderly. These findings support the notion that gender-related behavioral and physiological factors influence the incidence of CVA.

Table 2. Age Distribution of Patients

Age Range (Years)	Number of Patients	Percentage (%)
40–49	3	10
50–59	7	23.3
60–69	12	40
≥70	8	26.7
Total	**30**	**100**

Table 2 shows that the majority of patients were aged 60 years and above, with the highest proportion in the 60–69 year range (40%). Advanced age is a well-established risk factor for cerebrovascular accidents (CVA), primarily due to vascular degeneration, reduced elasticity of blood vessels, and the higher prevalence of comorbidities like diabetes mellitus and hypertension. These physiological and pathological changes associated with aging significantly increase the likelihood of stroke, underscoring the need for targeted prevention strategies in elderly populations.

Table 3. Educational Level Distribution of Patients

Last Education Level	Number of Patients	Percentage (%)
No Formal Education	2	6.7
Primary–Junior High School	11	36.7
Senior High School or Equivalent	10	33.3
Higher Education (Diploma–Bachelor)	7	23.3
Total	30	100

Table 3 shows that 36.7% of patients had primary to secondary education. This lower educational level may contribute to limited awareness of cerebrovascular accident (CVA) risk factors, inadequate management of chronic diseases, and delayed healthcare-seeking behavior, which can worsen patient outcomes and increase complication risks.

Table 4. Occupation Distribution of Patients

Occupation Type	Number of Patients	Percentage (%)
Unemployed (retired/housewife)	14	46.7
Farmers/Laborers	7	23.3
Employees (civil/private)	5	16.7
Entrepreneurs	4	13.3
Total	**30**	**100**

Table 4 shows that the majority of patients (46.7%) were unemployed or retired, which aligns with the age distribution indicating most patients are elderly. Furthermore, a notable proportion of patients were farmers, highlighting the local demographic profile of Kediri City and its surrounding rural areas. This occupational trend may influence health access, lifestyle factors, and disease awareness, which are important considerations in managing cerebrovascular conditions among this population group.

Table 5. Domicile Distribution of Patients

Domicile	Number of Patients	Percentage (%)
Kediri City	11	36.7
Kediri Regency	15	50
Outside Kediri (Nganjuk, Tulungagung, Blitar)	4	13.3
Total	30	100

Table 5 shows that the majority of patients came from Kediri Regency (50%), followed by Kediri City residents (36.7%). This suggests that RSUD Gambiran functions as a key regional referral hospital for cerebrovascular accident (CVA) cases, not only within the city but also across the Greater Kediri area and nearby regions. The hospital's role as a central referral center reflects its accessibility, available medical services, and trust within the surrounding communities for stroke management and care.

Table 6. Clinical Classification of CVA in Patients

CVA Classification	Number of Patients	Percentage (%)
Ischemic Stroke	21	70
Hemorrhagic Stroke	9	30
Total	30	100

Table 6 shows that most patients (70%) were diagnosed with ischemic stroke, aligning with global trends where ischemic strokes occur more frequently than hemorrhagic strokes.

This pattern is likely associated with common risk factors such as hypertension, diabetes mellitus, and dyslipidemia, particularly in elderly populations. These conditions contribute to atherosclerosis and vascular obstruction, which are the main causes of ischemic stroke. The findings highlight the importance of early detection and management of chronic diseases to prevent stroke occurrence and reduce related complications in high-risk groups.

Table 7. Comorbid Diagnoses

Comorbidity	Number of Patients	Percentage (%)
Hypertension	21	70%
Diabetes Mellitus	10	33.3%
Dyslipidemia	8	26.7%
Respiratory Tract Infection	6	20%
Chronic Kidney Disease	4	13.3%
No Comorbidities	2	6.7%
Total	30	100

Table 7 shows that most patients had comorbidities, with hypertension (70%) and diabetes mellitus (33.3%) being the most prevalent. This finding aligns with epidemiological data identifying hypertension as a primary risk factor for cerebrovascular accidents (CVA). Additionally, the presence of comorbidities often increases susceptibility to secondary infections, making antibiotic use more common in this population. These underlying conditions not only contribute to the onset of stroke but also complicate clinical management, highlighting the importance of comprehensive care and infection prevention in CVA patients with multiple comorbidities.

Table 8. Length of Stay (LOS) in ICU

Length of Stay (Days)	Number of Patients	Percentage (%)
≤ 5 Days	6	20%
6–10 Days	15	50%
> 10 Days	9	30%
Total	30	100

In Table 8, half of the patients (50%) had an ICU stay ranging from 6 to 10 days. Prolonged ICU stays were often linked to complications such as infections or decreased levels of consciousness. These findings emphasize the need for early clinical intervention and the implementation of rational antibiotic use. Optimizing these strategies may help prevent secondary complications, improve patient outcomes, and potentially shorten the duration of ICU hospitalization for patients with cerebrovascular accidents.

4.2. Antibiotic Drug Profile

Evaluation of antibiotic use in CVA patients in the ICU is important considering the high risk of nosocomial infections and the potential for irrational use of antibiotics in the intensive care unit. This study analyzes the antibiotic profile which includes drug class, antibiotic type, dosage form, route of administration, and frequency of use.

The antibiotics used in this study were categorized into several major classes based on their mechanism of action and spectrum of activity.

Table 9. Classes of Antibiotics

Antibiotic Class	Frequency of Use (n)	Percentage (%)
Third-Generation Cephalosporins	18	60
Carbapenems	6	20
Fluoroquinolones	4	13.3
Aminoglycosides	2	6.7
Total	30	100

Third-generation cephalosporins, particularly ceftriaxone, were the most frequently used antibiotics of 60%. This is consistent with their broad usage in treating severe systemic infections, including pneumonia, sepsis, or urinary tract infections, which are commonly associated with CVA patients in the ICU.

Table 10. Types of Antibiotics

Antibiotic	Number of Patients	Brand Name
Ceftriaxone	14	Rocephin®, Triaseton®
Meropenem	6	Meropen®, Meronem®
Levofloxacin	4	Levaquin®, Tavanic®
Gentamicin	2	Gentacimin®, Garamycin®
Cefotaxime	4	Claforan®, Taxime®
Total	**30**	**100**

Ceftriaxone was the primary antibiotic used in more than half of the patients. Antibiotic combinations were also observed in several cases, particularly in patients with suspected multi-organism infections or resistant pathogens

The table 10 displays data on the types of antibiotics administered to 30 patients. Ceftriaxone was the most frequently used antibiotic, prescribed to 14 patients. This was followed by Meropenem for 6 patients, while Levofloxacin and Cefotaxime were each used for 4 patients. The least common was Gentamicin, prescribed to only 2 patients. The brand names associated with each antibiotic are also listed, providing specific commercial examples for each generic drug.

All antibiotics used in this study were administered in injectable/intravenous (IV) form. This aligns with the condition of ICU patients, who generally cannot receive oral formulations due to impaired consciousness or other critical conditions.

Table 11. Dosage Form and Route of Administration

Dosage Form	Number of Administrations (n)	Percentage (%)
IV Injection	30	100
Oral	0	0
Total	**30**	**100**

The use of the parenteral route provides faster effects and high bioavailability, which are crucial in critical conditions such as CVA with infectious complications. As seen in table 11, that all drug administrations for the study's patients were performed via a single method. Out of a total of 30 administrations, every single one was an intravenous (IV) injection, accounting for 100% of the total. The table shows zero instances of oral administration, highlighting that the medication was exclusively delivered directly into the bloodstream. This data suggests a critical care or acute treatment setting where rapid and direct delivery of medication is required

4.3. Evaluation of the Rationality of Antibiotic Use with the Gyssens Method

Evaluation of the rationality of antibiotic use in this study was conducted using the Gyssens Method, which is one of the algorithm-based qualitative evaluation methods widely used in auditing antibiotic use in hospitals.

Table 12. Gyssens Category Evaluation

Gyssens Category	Number of Cases (n)	Percentage (%)	Description
0	10	33.3	Rational
I	4	13.3	Initiated too late or stopped too late
IIa	2	6.7	Dose too high
IIb	3	10	Dose too low
IIIa	2	6.7	Duration too long
IIIb	1	3.3	Duration too short
IVa	3	10	Spectrum too broad
IVb	1	3.3	Spectrum too narrow
V	2	6.7	No indication for antibiotic use
VI	2	6.7	Incomplete clinical data
Total	30	100	

The Gyssens classification assessment, merely 33. 3% (10 out of 30 cases) of antibiotic usage was classified as rational (Category 0). This suggests that, in these cases, the antibiotics were prescribed appropriately concerning the indication, dosage, route, and length of treatment. The other 66. 7% were classified as irrational to different extents. Category I (13. 3%) indicated a lack of proper timing, as antibiotics were either started too late or stopped too late, which could heighten the risk of treatment failure or encourage resistance. Category IIa (6. 7%) and IIb (10%) demonstrated problems with dosing, being either excessively high or insufficiently low, which can result in toxicity or ineffective treatment, respectively. Issues related to duration were noted in Categories IIIa (6. 7%) and IIIb (3. 3%), where antibiotics were administered either for an excessively long time or an insufficient duration.

This could reduce the effectiveness of treatment or promote the emergence of resistant organisms. Mismatches related to spectrum were observed in Category IVa (10%), where the selected antibiotics provided unnecessarily extensive coverage, and in Category IVb (3. 3%), where the coverage was insufficient to adequately target the suspected pathogens. 6. 7% of prescriptions (Category V) lacked a clear justification for the use of antibiotics, highlighting a substantial issue related to overprescribing. 6. 7% of instances (Category VI) could not be adequately assessed because of insufficient clinical information, underscoring the significance of precise record-keeping and comprehensive diagnostic evaluations in the promotion of responsible antimicrobial use.

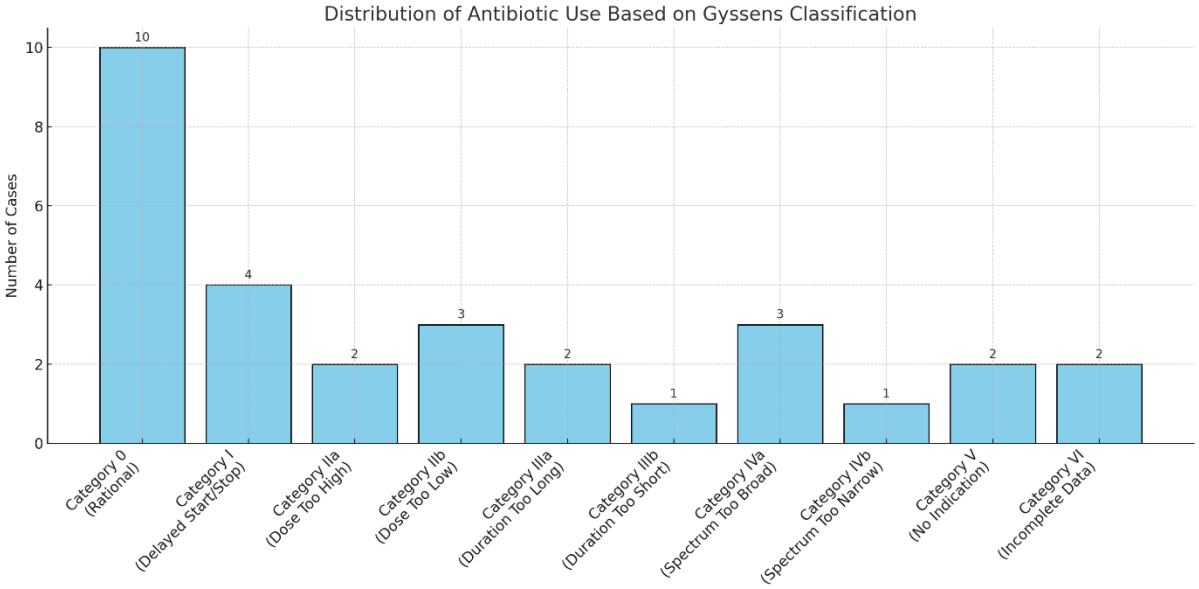

Figure 2. Distribution of Antibiotic Use Based on the Gyssens Classification

The Gyssens classification chart shows that merely 33. 3% of antibiotic use was considered rational (Category 0). The primary reasons for the irrational use of antibiotics are often a delay in starting or stopping treatment (Category I), incorrect dosages (Categories IIa and IIb), and the use of unnecessarily broad-spectrum antibiotics (Category IVa). These trends indicate that the decisions made regarding prescriptions were frequently based on experience rather than being adequately informed by microbiological information or clinical factors. This might be attributed to the serious condition of ICU patients or to a lack of available diagnostic tools.

5. Conclusion

The results of based on the Gyssens classification, the study revealed that only 33.3% of antibiotic prescriptions were considered rational (Category 0). The vast majority (66.7%) were found to be irrational, stemming from various issues. These included improper timing of administration (Category I), incorrect dosages (Categories IIa and IIb), and unsuitable duration of treatment (Categories IIIa and IIIb). Furthermore, a significant number of prescriptions used unnecessarily broad-spectrum antibiotics (Category IVa) or lacked clear justification (Category V). This highlights a critical need to improve antibiotic stewardship, particularly by focusing on the timing, dosage, and selection of antibiotics to combat the high rate of irrational use and the associated risk of antimicrobial resistance.

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