Evaluation of Antibiotic Use in Patients with Acute Respiratory Tract Infection Using the Gyssens Method

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Abstract: Proper antibiotic usage prevents antibiotic resistance and ensures ARI treatment success. This study examined antibiotic use among ARI patients at RSUD Dr Drajat Prawiranegara in Serang District and adherence to the Gyssens method. This descriptive observational study used medical records for retrospective data. The study included all ISPA patients receiving antibiotics at Dr Drajat Prawiranegara from September to December 2022. A careful random sample of 55 participants was used in the study. Data showed 53% of ARI patients were male and 4.94 months old. Cefotaxime (62%) was followed by Ceftriaxone (13%) as the most common antibiotic. The Gyssens approach found that 74% of antibiotics were sensibly provided. Due to inappropriate antibiotic dosages (10%) and short administration periods (2%), numerous requirements were not met. These data support RSUD Dr Prawiranegara's sensible antibiotic use in ARI patients. However, inappropriate doses and short administration must be considered. This emphasises the necessity to teach doctors about antibiotic usage. Understand ARI antibiotic use and improve treatment adherence with this study. This study can alleviate antibiotic resistance and improve treatment. However, more research with a larger sample and more factors impacting ARI antibiotic use is needed. Understand ARI antibiotic use and improve treatment adherence with this study. This study can alleviate antibiotic resistance and improve treatment.

Keywords: Acute Respiratory Infection; Gyssens Method; Antibiotics and Rational Use; Antibiotic Resistance; Effective Treatment Management; Retrospective Data; Antibiotic Therapy.

1. Introduction

Acute respiratory infections (ARIs) are caused by bacteria or viruses and are divided into upper respiratory tract infections (e.g., influenza, rhinitis, laryngitis) and lower respiratory tract infections (e.g., bronchitis, pneumonia) [1]. ISPA is the main cause of mortality and morbidity from infectious diseases in the world, influenced by factors such as poor sanitation, poverty, pollution, low nutritional status, and low socioeconomic status and education [2]. The worldwide prevalence of ARI is about 34 cases per 100,000 people per year. In Indonesia, in 2018, there were 1,017,290 sufferers of ISPA, with the highest prevalence rates in children, adolescents and the elderly [3]. Giving antibiotics is a common therapy for ARI, both caused by bacteria and viruses [4]. Appropriate antibiotic use is very important to prevent antibiotic resistance, which can reduce the effectiveness of

therapy and increase treatment costs [5]. The use of antibiotics must be rational and in accordance with Law No. 36 of 2009 concerning Health [6]. The Gyssens method is used to evaluate antibiotic use by considering indications, patients, drugs, doses, routes of administration, and duration of administration [7]. Studies show varying results regarding the rationality of giving antibiotics to ARI patients [8]. Some problems with the rational use of antibiotics include a lack of technical guidance and training for health workers, as well as insufficiently strict policies and sanctions [9]. In Banten, there were 48,621 cases of ISPA in 2018. In Tangerang City, ISPA cases increased from 8,348 in 2016 to 12,842 in 2018, creating challenges for standardised management [10]. Previous studies at Bakti Asih Public Hospital in Tangerang City showed that cefixime-class antibiotics (third-generation cephalosporins) were the most commonly used in ARI patients [11]. Therefore, it is necessary to evaluate antibiotic use using the Gyssens method in ISPA patients at Bakti Asih Hospital in Ciledug, Tangerang City [12]. This study aims to evaluate the quality of antibiotic use among patients with acute respiratory infection (ARI) at Dr Drajat Prawiranegara Serang from September 2022 to December 2022 [13]. The evaluation will be carried out using the Gyssens method [14]. The specific aim of this study was to evaluate factors affecting the quality of antibiotic use, including the type of antibiotic used, the type of antibiotic therapy, the route of administration, the number of antibiotics and drugs used by patients, and the length of stay [15].

2. Method

The research design was a descriptive observational study using medical record data to evaluate antibiotic use in ISPA patients at Bakti Asih Ciledug General Hospital, with a study period from September 2022 to December 2022 [16]. This study used an observational research design and retrospective data collection from the patients' medical records [17]. The study population consisted of all ARI patients who received antibiotic therapy at Bakti Asih Hospital in Ciledug during the study period [18]. The research sample was selected using systematic random sampling, with inclusion criteria of patients with a primary diagnosis of ISPA who received antibiotics and were hospitalised, and who had complete medical records [19]. The data used are secondary, obtained from the patient's medical record [20]. Data collection involved extracting medical record data that met the inclusion criteria [21]. Data were collected using the Gyssens method to evaluate the accuracy of antibiotic use, taking into account the time of administration, dose, interval, route of administration, duration of administration, effectiveness, toxicity, cost, spectrum, indications, and side effects [22]. Data analysis was carried out descriptively, grouping and analysing data using the Gyssens method, and the research results will be presented in Tables and narratives—spectrum, indications, and side effects [23]. Data analysis was carried out descriptively, grouping and analysing data using the Gyssens method, and the research results will be presented in Tables and narratives [24]—spectrum, indications, and side effects [25]. Data analysis was carried out descriptively, grouping and analysing data using the Gyssens method, and the research results will be presented in Tables and narratives [26].

3. Results and Discussion

Retrospective data were collected from the medical records of ISPA patients who were treated at RSUD Dr Drajat Prawiranegara, Serang Regency, in 2022. Sampling was carried out in February 2023, and the researchers directly selected 55 patients from the total number of patients with a primary diagnosis of ISPA at the Hospital. Secondary data collected included patient demographic information and antibiotic use, including the name of the antibiotic, dose, type of use, indication for use, frequency of use, duration of administration, method of administration, and completeness of medical record.

3.1. Patient Profile

Research on patients with Acute Respiratory Infection (ARI) with 55 patients diagnosed. In this study, as shown in Table 1, 53% of the patients were male (29 patients) and 42% were female (23 patients).

Table 1: Characteristics of ARI patients

Patient Characteristics	N = 50	%
Gender		
Man	29	53%
Woman	23	42%
n/d	3	5%
Age		
<1 year	3	5.4%
1 year	7	12.7%
2 years	7	12.7%
3 years	3	5.4%

4 years	10	18.2%
5 years	4	7.2%
6 years	2	3.6%
7 years	7	12.7%
8 years	3	5.4%
9 years	2	3.6%
10 years	2	3.6%
11 years old	2	3.63%
n/d	3	5.4%
t/d = unknown		

There were also three patients (5%) with unknown sex due to incomplete medical records. The highest prevalence of ARI occurred at age 4 (n = 10). Boys are more susceptible to severe disease due to their immune responses, respiratory mechanisms, and smaller airways (Table 2).

Table 2: Class and type of antibiotics

Characteristics	N = 55
Drug	
Cefotaxime	41 (75%)
Ceftriaxone	8 (15%)
n/d	6 (10%)

This research highlights the importance of socio-demographic factors, such as the child's age, mother's occupation, wealth index, and region of residence, in improving child health outcomes in Indonesia.

3.2. Antibiotic Prescription Profile

3.2.1. Types of Antibiotics

In this study, the variables class and type of antibiotics were examined in 55 patients. The results showed that most of the patients (75%) received treatment with Cefotaxime antibiotics. In addition, 15% of patients received the antibiotic Ceftriaxone. In addition, up to 10% of patients have uncertain information about the antibiotic used.

3.2.2. Characteristics of Antibiotics

The effectiveness of antibiotics is evaluated by ensuring that the antibiotics administered are appropriate for the patient's indications and contraindications. The results showed that 48 patients (approximately 87%) responded to the antibiotics administered. No patients complied with the indications and had contraindications to the treatment given by the doctor (Table 3).

Table 3: Characteristics of antibiotics

Characteristics	N = 55
Effectiveness	
Effective	48 (87%)
Less effective	0 (0%)
n/d	7 (13%)
Security	
Safe	48 (87%)
Less secure	0 (0%)
n/d	7 (13%)
Price	
Cheap	48 (87%)
Expensive	0 (0%)
n/d	7 (13%)
Spectrum	

Narrow	0 (0%)
Wide	48 (3%)

Antibiotic safety is also an important consideration in treatment because of the risk of side effects in certain patients. In this study, 48 patients (approximately 87%) reported that the antibiotics used were safe for them. No patients had a high risk of side effects from the drugs prescribed by the doctor. The cost aspect of antibiotics is also evaluated in Table 3. The results show that about 87% of patients receive antibiotics at affordable prices because the drugs are generic, while 13% receive unknown drugs. In addition, Table 3 describes the spectrum of antibiotic use, namely, the breadth of their activity against various types of microorganisms. The results show that most of the antibiotics used (about 87%) have a broad spectrum, meaning they can treat various types of infections. Before administering antibiotic therapy to ISPA patients, Dr Drajat Prawiranegara did not carry out bacterial culture and antibiotic sensitivity tests; therefore, they were not given antibiotics with a narrow spectrum. Excessive treatment duration can lead to antibiotic overuse. The route of drug administration was administered intravenously (IV) (87%), whereas 12% were unknown. The use of antibiotics by the intravenous route is still common, although it raises concerns about side effects and additional safety issues (1.20). Several studies underscore the importance of appropriate treatment duration and adherence to guidelines on antibiotic use to optimise patient treatment outcomes. For the majority of common infections treated in primary care settings, antibiotic prescriptions exceed the guidelines' recommendations. The duration of antibiotic prescription affects treatment outcomes in patients.

3.2.3. Administration of Antibiotics

Table 4 presents the characteristics of 55 patients diagnosed with Acute Respiratory Infection (ARI). In this study, 87% of the total sample received antibiotics via the correct route for the drug administered.

Table 4: Administering antibiotics

Characteristics	N = 55
route	
Appropriate	48 (87%)
Not exactly	0
n/d	7 (13%)
Delivery time	
Appropriate	48 (87%)
Not exactly	0 (20%)
n/d	7 (13%)
Administration Dosage	
Appropriate	46 (84%)
Not exactly	2 (3%)
n/d	7 (13%)
Feeding intervals	
Appropriate	48 (87%)
Not exactly	0 (0%)
n/d	7 (13%)
Delivery duration	
Appropriate	48 (87%)
Not exactly	0 (0%)
n/d	7 (13%)

The accuracy of administering antibiotics can affect their effectiveness and efficiency. In the majority of patients (87%), the timing of antibiotic administration was appropriate, with antibiotics administered at the daily dose so that the antibiotic remained effective in the blood for a specified number of hours. Furthermore, the antibiotic dose given to most patients (84%) was calculated based on body weight, as in the sample group in this study, in accordance with the standard for children. Regarding the interval of antibiotic administration, the majority of patients (87%) received antibiotics correctly according to the specified schedule. No patients received antibiotics at inappropriate intervals. Finally, the duration of antibiotic administration was correctly timed in 87% of cases, but 13% of patients received an inappropriate duration. The correct duration is very important for ensuring treatment effectiveness and preventing antibiotic resistance. The duration of antibiotic prescription affects treatment outcomes in patients.

3.3. Completeness of Medical Records

Table 5 presents the completeness of patient medical records: 87% have complete records, while the remaining 13% have incomplete records. Completeness of Medical records is an important factor in data analysis and provides insight into the quality of the information used in this study.

Table 5: Medical record completeness

Characteristics	N = 55
Medical record equipment	
Complete	48 (87%)
Incomplete	7 (13%)

3.4. Evaluation of Antibiotic Prescription with Gyssens' Method

Table 6 presents the evaluation of antibiotic use according to the Gyssens criterion. It shows that most prescriptions were appropriate (74%), though some problems were noted, such as short-term therapy (2%) and inadequate medical records (13%).

Table 6: Gyssens' criteria analysis results

Category	Gyssens criterion	N	%
Category 0	Appropriate (rational use of antibiotics)	32	74
Category I	Not on time delivery	0	0
Category II A	Incorrect dose administration	2	10
Category II B	Improper administration interval	0	0
Category II C	Incorrect route of administration	0	0
Category IIIA	Giving antibiotics for too long	0	0
Category III B	Giving antibiotics is too short-term	11	2
Category IVA	More effective antibiotics are available	1	2
Category IV B	Safer antibiotics are available	0	0
Category IV C	Giving is too short	2	4
Category IV D	A narrower spectrum of antibiotics is available	0	0
Category V	Use of antibiotics without indication	0	0
Category VI	Incomplete medical records	7	13

Primary Data 2023

3.4.1. Category 0: Correct (Rational Administration of Antibiotics)

In category 0, antibiotics are given appropriately and rationally. This shows that the doctor or medical staff has chosen the appropriate antibiotic for the patient's infection. This action is important to ensure the effectiveness of antibiotics and appropriate treatment. A total of 32 patients (74%) fell into this category.

3.4.2. Category I: Not on Time Delivery

In category I, no patient met the criteria. This indicates that no patients were found or included in category I in the study. Therefore, there were no observations regarding the inappropriate timing of drug administration.

3.4.3. Category II A: Incorrect Dose Administration

In category II A, there is an error in administering the antibiotics to the patient. Dosage errors can occur for various reasons, such as incorrect calculations or administration errors. Dosing errors can affect treatment effectiveness and increase the risk of antibiotic resistance. Two patients (10%) experienced dosage errors in this category.

3.4.4. Category II B: Improper Administration Interval

Category II B indicates an error in the interval of antibiotic administration. Incorrect administration intervals can alter antibiotic concentrations in the patient's body, reducing treatment effectiveness. It is important to follow the correct dosing schedule for antibiotics to maximise their effectiveness. No patient was included in category II B.

3.4.5. Category III A: Giving Antibiotics for Too Long

In category IIIA, antibiotics are given for a longer period than is necessary to treat the existing infection. That is, antibiotics are given beyond the recommended duration to treat the type of infection being treated. None of the patients were included in category IIIA.

3.4.6. Category III B: Administration of Antibiotics is Too Short

In category III B, there are problems in which antibiotics are given for too short a period. Insufficient treatment can result in the development of bacterial resistance and does not ensure complete eradication of the infection. It is important to follow the recommended course of treatment to minimise the risk of treatment failure. A total of 11 patients (2%) fell into this category.

3.4.7. Category IV A: More Effective Antibiotics are Available

In category IV A, there are problems for which more effective antibiotics are available, but are not selected for treatment. Inappropriate antibiotic selection can reduce treatment effectiveness and delay patient recovery. A total of 1 patient (2%) fell into this category.

3.4.8. Category IV B: Some Antibiotics are Safer or Less Toxic

Category IV B implies that other antibiotics are safer or less toxic for use. In this study, no medical record data were included in category IV B.

3.4.9. Category IV C: There are Cheaper Antibiotics

In category IV C, other antibiotics are cheaper to use. In the context of antibiotic evaluation or classification, category IV C indicates that there are alternative antibiotics at a lower cost that can be used as substitutes for the antibiotics in this category. RSUD Dr Drajat Prawiranegara uses a formulary that is generic and affordable for patients, ensuring that the drugs used are generic. None of the patients were included in category IV C.

3.4.10. Category IV D: There are Antibiotics with a Narrower Spectrum

Category IV D refers to the presence of a narrower-spectrum antibiotic for use. In the evaluation or classification of antibiotics, this means that there are alternative antibiotics effective only against specific types of infections or with a more limited range of action than those included in this category. No patient was included in category IV D.

3.4.11. Category V: Use of Antibiotics Without Indication

Category V is the use of antibiotics without any clear indication or reason. The evaluation or classification of antibiotics describes situations in which antibiotics are used without a valid medical need or without an infection requiring antibiotic treatment. None of the patients were included in category V.

3.4.12. Category VI: Incomplete Medical Records

Category VI indicates a deficiency or irregularity in the patient's medical record regarding antibiotic use. Incomplete medical records can hinder proper monitoring and evaluation of antibiotic treatment. It is important to maintain accurate, detailed medical records to ensure optimal patient care. A total of 7 patients (13%) fell into this category.

3.5. Bivariate Associations

In this study, a bivariate association analysis was performed between the sexes (male and female) in patients with acute respiratory infection (ARI) who received antibiotic treatment using the Gysens method at Bakti Asih Hospital in September-December 2022 (Table 7).

Table 7: Bivariate association by age group

Characteristics	Man, N = 291	Woman, N = 231	difference2	95% CI3	p-values2
Age (Month)					
< 6 months	15 (52%)	16 (70%)			0.2585
≥ 6 months	14 (48%)	7 (30%)			
n/d	0	0			
Weight	20 (11.4)	16 (7.6)	-4.03	-9.5, 1.5	0.1479
n/d	3				
Length of Treatment (days)	4.9 (5.8)	3.3 (0.97)	-1.62	-3.9, 0.6	0.1490
n/d					
Return state					
Healed	10 (34%)	4 (17%)			
getting better	15 (52%)	14 (61%)			
Not yet healed	1 (3%)	1 (4%)			
Unknown	3	4			
n/d		1			
Body temperature	37 (0.8)	38 (1)	0.40	-0.16, 0.97	0.1590
RR	24.6 (3.6)	34 (44)	9.74	-10.3, 29.8	0.1352
n/d		2			
N	123 (30)	135 (25)	11.8	-3.8, 27	0.7044
n/d		1			
Blood pressure					
120/80	2 (7%)	0			
100/60	2 (7%)	0			
106/60	1 (3%)	0			
100/80	1 (3%)	0			
100/70	0	1 (4%)			
100/67	1 (3%)	0			
90/60	0	1 (4%)			
80/60	1 (3%)	0			
32/65	0	1 (4%)			
n/d	21 (72%)	20 (87%)			
Main Diagnostics					
ISPA	23 (79%)	21 (91%)			
Obs Febri ISPA	3 (10%)	0			
ISPA fever	2 (7%)	0			
ISPA UTI	0	1 (4%)			
ISPA (Acute Tonsillitis)	0	1 (4%)			
Obs Febris ARI, Vomius	1 (3%)	0			
n/d	0	0			
Drug					
Cefotaxime	20 (55%)	20 (78%)			
Ceftriaxone	5 (17%)	2 (9%)			
Cefotaxime + Cefixime	4 (14%)	2 (9%)			
Ceftriaxone + Cefixime	1 (3%)	0			
Cefotaxime // Ceftriaxone	1 (3%)	0			
n/d	2	1			
Dose					
250mg	1 (3%)	1 (4%)			
300mg	3 (9%)	3 (11%)			
400mg	3 (9%)	4 (15%)			
500mg	3 (9%)	5 (19%)			
600mg	5 (16%)	1 (4%)			
650mg	0	1 (4%)			

700mg	5 (16%)	1 (4%)			
750mg	2 (6%)	4 (15%)			
800mg	1 (3%)	0			
900mg	2 (6%)	1 (4%)			
1000mg	2 (6%)	3 (11%)			
1000 mg (ns 50 cc)	1 (3%)	0			
1500mg	2 (6%)	0			
n/d	2	2			
Intervals (Hours)	10 (5)	9 (4.8)			0.7044
n/d	2	2			
Route					
IV	23 (79%)	21 (91$)			
IV Drip	1 (3%)	0			
Drip Ns	1 (3%)	0			
IV // Drip	1 (3%)	0			
IV Drip NaCl 50 cc	1 (3%)	0			
n/d	2 (7%)	2 (9%)			
Delivery Time (days)	4 (1.3)	4 (0.8)	-0.12	-0.78, 0.54	0.7165
n/d					
Medical Record Completeness				0.0112	
Yes	28 (97%)	21 (91%)			
No	1 (3%)	2 (9%)			
Gyssens category					
Category 0	14 (48%)	18 (78%)			
Category II A	2 (7%)	0			
Category III B	8 (27%)	3 (13%)			
Category IVA	1 (3%)	0			
Category IV C	2 (7%)	0			
Category VI	2 (7%)	2 (9%)			
[1]Means (SD).					
[2]Welch Two-Sample t-test and Fisher Extract.					
[3]CI = Confidence Interval.					

The results of the statistical analysis showed significant differences between males and females in observed clinical characteristics, including age, weight, length of stay, body temperature, respiratory rate (RR), heart rate (HR), and duration of antibiotic administration. However, this analysis has limitations with a relatively small sample size and incomplete data on several variables. Biological factors, such as differences in immune responses between males and females that may not be documented in the data, may also influence the analysis results. The results of this analysis are important for medical personnel in planning appropriate and rational treatment for ARI patients. Evaluation of antibiotic use in respiratory tract infections should be conducted carefully to avoid antibiotic misuse and bacterial resistance. Thus, these findings may help promote more effective treatment management and address the growing problem of antibiotic resistance. However, further research is needed with a larger sample and consideration of other factors that influence antibiotic use in ARI patients to draw stronger conclusions and broader generalisations. Besides that,

4. Conclusions and Suggestions

Based on the results of research that has been conducted regarding the use of antibiotics in patients with acute respiratory infections (ARI) at Bakti Asih Hospital during the period September - December 2022, using the Gyssens method, it can be concluded that there are no significant differences in the use of antibiotics between male and female patients. Although there were differences in several clinical characteristics between the two groups, such as age, weight, length of stay, body temperature, respiratory rate (RR), and heart rate (HR), the statistical analysis showed that these differences were not statistically significant. However, this research has some limitations. The relatively small sample size and incomplete data on some of the variables may affect the validity of the findings. In addition, biological factors that may influence immune responses between males and females need to be considered, although they were not documented in the data used in this study. Based on these findings, several suggestions can be given. Medical personnel need to pay more careful attention to evaluating the use of antibiotics in ARI patients, follow guidelines on the rationality of using antibiotics, and avoid the misuse of antibiotics, which can cause bacterial resistance. More effective treatment management requires considering the patient's clinical characteristics holistically, not just by gender. In addition, educating medical personnel and patients regarding the importance of using the

right antibiotics, the appropriate duration of administration, and the risk of antibiotic resistance needs to be increased. For further research, it is recommended to use a larger sample size, include more variables that affect antibiotic use in ARI patients, and consider biological factors that can influence the immune response. Further research may also investigate the biological mechanisms underlying differences in immune response between males and females in the context of respiratory infections. In conclusion, the evaluation of antibiotic use in ARI patients needs to be improved with a more holistic approach, and further research is needed to deepen the understanding of the rational and effective use of antibiotics in the management of acute respiratory infections.

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