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## Evaluation of the Rationality of Antibiotic Drugs in Patients with ISPA (Acute Respiratory Tract Infection) at Dr. Moewardi Regional General Hospital (RSUD) Surakarta

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### Abstract

*Acute Respiratory Tract Infection (ARTI) remains a major infectious disease in Indonesia, significantly affected by inappropriate antibiotic utilization, potentially increasing bacterial resistance. This study aims to evaluate the rationality of antibiotic use among ARTI inpatients at Dr. Moewardi General Hospital, Surakarta. Utilizing a quantitative, retrospective descriptive design, all medical records of ARTI inpatients from 2023 to 2025 meeting the inclusion criteria were included as samples (total sampling). Data were collected using structured forms and processed using Microsoft Office and IBM SPSS Statistics 20; analysis was performed descriptively following Gyssens' criteria. The study found that although most patients received correct antibiotics with respect to indication (94.7%), drug type (94.7%), dose (100%), and timing (100%), only 34.2% received antibiotics for the appropriate duration. Rational antibiotic use by Gyssens' method was found in only 34.2% of cases. These findings highlight the high rate of duration errors and emphasize routine audits and educational interventions. It is concluded that, despite strengths in dosage and selection, duration of antibiotic use remains a challenge for rational therapy.*

**Keywords:** *Antibiotic Stewardship, Antimicrobial Resistance, Gyssens Criteria, Rational Drug Use, Respiratory Tract Infection.*

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## INTRODUCTION

Acute Respiratory Tract Infection (ARI) is one of the most common infectious diseases in Indonesia, especially among children and the elderly. The high incidence of ARI in Indonesia is influenced by environmental factors and the tropical climate, which favor the spread of various pathogens such as influenza, rhinovirus, parainfluenza, and respiratory syncytial virus (RSV) (Dewi et al., 2020; Putri et al., 2023). Based on 2018 RISKESDAS data, the prevalence of ARI in Central Java reached 4.6% according to health worker diagnoses, slightly higher than the national average, with the age group under 12 years being the most vulnerable (Hamzah, 2020; Runtu et al., 2020). This phenomenon confirms that ARI remains a significant public health problem and requires special attention, especially in terms of rational antibiotic therapy management (Fauziyah et al., 2023; Ovikariani, 2022).

The main problem in treating ARI is the high level of irrational antibiotic use, both in terms of indications, drug selection, dosage, and duration of administration. Previous studies have shown that between 30% and 80% of antibiotic use in hospitals is not based on correct indications, increasing the risk of bacterial resistance and endangering patient safety (Angin et al., 2021; Hadi, 2009). At Dr. Moewardi Hospital in Surakarta, recent research shows that the rationality of antibiotic use in ARI patients is still suboptimal, with varying accuracy in indications, dosages, and drug selection (Sari et al., 2023; Hafida, 2023). This condition is exacerbated by time constraints in establishing an etiological diagnosis of ARI, leading doctors to often prescribe antibiotics empirically without adequate laboratory confirmation (Fauziyah et al., 2023; Runtu et al., 2020).

Evaluating the rationality of antibiotic use in patients with acute respiratory infections (ARI) is crucial for reducing resistance rates and improving the quality of healthcare services. Previous research at various healthcare facilities in Indonesia, including community health centers (Puskesmas) and hospitals, has shown that inappropriate antibiotic use is still common, both in children and adults (Ovikariani, 2022; Astuti, 2021). Furthermore, evaluation methods such as the Gyssens method have been used to assess the rationality of antibiotic use, but the results still indicate a gap between clinical practice and expected standards of rationality (Sari et al., 2023; Hafida, 2023).

This study aims to analyze the demographic distribution of ARI patients receiving antibiotics at Dr. Moewardi Regional General Hospital, Surakarta, evaluate the appropriateness of antibiotic use based on five rationality criteria (correct indication, correct drug, correct dose, correct time, and correct duration of administration), and determine the level of rationality of antibiotic use using the Gyssens method. The urgency of this study lies in efforts to improve the quality of health services through periodic evaluation of antibiotic use, which is expected to become the basis for improving clinical policies and practices at major referral hospitals in Central Java. The novelty of this study lies in the wider scope of respondents, including children to the elderly, and the use of the latest empirical data from Dr. Moewardi Regional General Hospital, Surakarta, which has not been widely explored in previous studies (Sari et al., 2023; Fauziyah et al., 2023).

## RESEARCH METHODS

### Types and Methods of Research

This study is a quantitative study with a retrospective descriptive design, which aims to evaluate the rationality of antibiotic use in patients with acute respiratory infections (ARI) at Dr. Moewardi Regional General Hospital, Surakarta. The total sampling method was used in this study, in which all members of the population who met the inclusion criteria were included as the study sample. Total sampling was chosen because the population size was limited, allowing for a comprehensive analysis of all medical records of patients with acute respiratory infections (ARI) hospitalized between June and July 2025 (Sugiyono, 2021; Sudaryono, 2022; Lufiah et al., 2021).

### Data Analysis Instruments and Techniques

The main instrument in this study was a data collection sheet containing patient demographic information, drug dosage form, comorbidities, diagnosis, and type of antibiotic used. The collected data were then processed using Microsoft Office Word 2016, Microsoft Office Excel 2016, and IBM SPSS Statistics 20 software. Data analysis was performed descriptively by grouping data based on demographic variables and antibiotic rationality parameters according to Gyssens' criteria. The analysis process included editing, tabulation, data presentation, and cleaning to ensure data accuracy and completeness (Cresswell & Creswell, 2023; Emzir, 2022; Sari et al., 2023).

### Population and Sample

The population in this study was all medical records of patients diagnosed with ARI and hospitalized at Dr. Moewardi Surakarta Regional General Hospital between 2023 and 2025. The study sample was taken using a total sampling technique, namely, all ARI patients who met the inclusion and exclusion criteria. Inclusion criteria included patients diagnosed with ARI, of any age, receiving antibiotic treatment, and having complete medical records. Exclusion criteria were patients who did not have complete medical records, were discharged from the hospital before treatment was completed, or received treatment for less than 24 hours (Sugiyono, 2021; Hafida, 2023; Ovikariani, 2022).

### Research Procedures

The research procedure began with the collection of medical records of patients with acute respiratory infections (ARI) who met the inclusion and exclusion criteria. The collected data then underwent editing to check for completeness, tabulation to group and calculate data according to variables, data presentation to display the analysis results, and cleaning to ensure data accuracy. Analysis was performed by defining variables in SPSS, entering data, and conducting descriptive analysis based on the Gyssens classification to assess the rationality of antibiotic use. The results of the analysis are expected to provide a comprehensive picture of antibiotic use patterns and potential issues with rationality at Dr. Moewardi Regional Hospital, Surakarta (Sugiyono, 2021; Emzir, 2022; Sari et al., 2023; Fauziyah et al., 2023).

## RESULTS AND DISCUSSION

### Characteristics of ISPA Patients Based on Gender

Grouping by gender aims to determine how many ISPA patients are female and male, and to determine which gender experiences ISPA more in the Inpatient Installation of Dr. Moewardi Surakarta Regional Hospital from 2023 to 2025.

The following are the characteristics of ISPA patients in the Inpatient Installation of Dr. Moewardi Surakarta Regional Hospital from 2023 to 2025, based on gender, as seen in Table 1.

**Table 1. Patient Characteristics Based on Gender**

No	Gender	Number of Patients	Percentage (%)
1.	Man	17	44.70
2.	Woman	21	55.30
<b>Amount</b>		<b>38</b>	<b>100</b>

Based on Table 1, of the 38 patients hospitalized with a diagnosis of ARI and receiving antibiotic therapy at Dr. Moewardi Regional Hospital, Surakarta, from 2023 to 2025, 17 (44.70%) were male and 21 (55.30%) were female. This means there were more female patients than male patients.

According to Sukamawa in Nora et al. (2018) Gender does not affect the incidence of ARI, because this disease can occur in anyone regardless of ethnicity, race, religion, age, gender, or social status. According to the WHO, Nora et al. (2018) Generally, there is only a slight difference in the incidence of ISPA based on gender. Research by (Wardah and Indah Risnawati 2025) The results were consistent with this study, as the data showed that ARI was more common in women (60.1%) than in men (39.9%), although the difference was not significant. The cause of infection is a decline in immune system function, which can be caused by various factors. One triggering factor is stress. Women are more susceptible to stress than men. Stress can be physical, psychological, or emotional. This pressure triggers the body's response to cope.

### Characteristics of ISPA Patients Based on Age

The age grouping of ISPA patients who have received antibiotic therapy aims to determine the age range most affected by ISPA in the Inpatient Installation of Dr. Moewardi Surakarta Regional Hospital from 2023 to 2025. The following are the characteristics of ISPA patients based on age, see Table 2.

**Table 2. Characteristics of ISPA Patients Based on Age**

No	Age	Number of Patients	Percentage (%)
1.	0 – 14 years	8	21.10
2.	15 – 19 years	1	2.60
3.	20 – 34 years	11	28.90
4.	35 – 59 years old	10	26.30
5.	Over 60 years old	8	21.10
<b>Amount</b>		<b>38</b>	<b>100</b>

Table 2 shows the distribution of ARI at Dr. Moewardi Regional Hospital, Surakarta. In the 2023–2025 period, the age group most affected by ARI was 20–34 years old, with 11 cases, representing 28.90%. Meanwhile, only one case was recorded for the 15–19-year-old group, representing 2.60%. Table 6 shows that the 20–34-year-old group is the group most affected by ARI.

The age group of teenagers to adults has a higher risk of contracting ARI. This is caused by several factors, such as smoking habits, lack of good nutrition, inability to cough due to chronic diseases such as stroke, diabetes, or heart disease, use of sedative drugs and alcohol, respiratory tract infections, or decreased immunity due to HIV. (Mataputun and Serumena 2021). Adults tend to be outdoors more often in intense physical activity, making them vulnerable to the effects of air pollution (Wibowo et al. 2024). Unhealthy air can lead to excessive growth of microorganisms, resulting in symptoms and

health problems.

### Characteristics of ISPA Patients Based on Comorbidities

Comorbidities in patients with acute respiratory infections (ARI) are crucial for treatment. Patients with chronic illnesses or immune disorders are typically more susceptible to complications, so the presence of these comorbidities needs to be analyzed to determine their impact on antibiotic use. In this study, data on comorbidities were obtained from the medical records of patients with acute respiratory infections (ARI) hospitalized at Dr. Moewardi Regional Hospital, Surakarta, during the period 2023–2025, as shown in Table 7.

**Table 3. Characteristics of ISPA Patients Based on Comorbidities**

No	Comorbidities	Number of Patients	Percentage (%)
1	Other infections (DHF, viruses, GEA, gastroenteritis)	6	15.80
2	Cardiovascular disease (stroke, heart, ASD, etc.)	6	15.80
3	Lung cancer (Carcinoma/Adenocarcinoma)	4	10.50
4	Autoimmune diseases (SLE, ankylosing spondylitis)	4	10.50
5	Hematologic disorders (anemia, leukemia)	4	10.50
6	Nervous disorders (vertigo, polyneuropathy)	4	10.50
7	Metabolic disorders (hyperpyrexia, DM, lipid)	3	7.90
8	Other disorders (dyspepsia, cholecystitis, pregnancy)	3	7.90
9	No comorbidities	3	7.90
10	Liver disorders (hepatic cirrhosis, CHB)	1	2.60
11	HIV/AIDS	1	2.60
12	Kidney disorders (chronic kidney, ventricular failure)	1	2.60
<b>Amount</b>		<b>38</b>	<b>100</b>

Based on the results of a study of 38 patients with acute respiratory infections (ARI) at Dr. Moewardi Regional Hospital in Surakarta from 2023 to 2025, the majority of patients did not have comorbidities (7.90%). However, 92.10% of patients had comorbidities with a wide range of variations. The most common comorbidities were other infections (15.8%) and cardiovascular disease (15.8%), followed by lung cancer, autoimmune diseases, hematological disorders, and neurological disorders, each contributing 10.5%. Meanwhile, other comorbidities also encountered included kidney disorders, metabolic disorders, liver disorders, and other diseases related to pregnancy or the digestive system.

The presence of comorbidities plays a significant role in the clinical course of ARI. Patients with lung cancer are more susceptible to respiratory dysfunction, so respiratory infections can exacerbate existing clinical conditions. Cancer cells and the cytotoxic therapy patients undergo also reduce immunity, increasing susceptibility to secondary infections. This finding aligns with research from Sari (2023), who reported that the rationality of antibiotic use remains low, as antibiotics are often prescribed even when the indications do not fully align with guidelines. A similar finding was also found by Mustopa, which explains that broad-spectrum antibiotics are widely used even in cases that

could be managed with supportive therapy. These findings support the idea that patients with chronic diseases, including lung cancer, are more likely to receive antibiotics as a protective measure, even though this is not always in accordance with standard therapy.

In addition, patients with autoimmune diseases such as SLE (10.5%) were also found in this study. SLE patients undergoing immunosuppressive therapy are at high risk of developing opportunistic infections, including pneumonia and other respiratory tract infections. This was confirmed by Prasetyo (2019) In his research at Dr. Saiful Anwar Hospital in Malang, he reported that infection is one of the most common complications in SLE patients and contributes significantly to the increased mortality rate. This was also confirmed by Apriance et al. (2025) This explains that pulmonary manifestations in SLE are quite common, making respiratory involvement a major cause of morbidity. These findings suggest that patients with SLE are indeed a vulnerable group to infection, leading clinicians to prescribe antibiotics more frequently as a preventative measure, although not always in accordance with therapeutic guidelines.

Patients with cardiovascular disease (stroke, heart failure, hypertension, ASD, and heart valve disease) also have a high prevalence (15.8%). Patients with cardiovascular disease are often given antibiotics preventively, although not always in accordance with applicable guidelines. This is consistent with research. Lestari et al. (2018), which indicates that antibiotic use is still irrational due to the administration of drugs to patients with comorbidities, even though there is no clear indication. This condition indicates that the presence of comorbidities is often a reason for clinicians to prescribe antibiotics preventively, even though it does not always comply with standard therapy.

Another interesting finding is the discovery of patients with viral infections as comorbidities who still received antibiotic therapy. This situation clearly indicates inappropriate antibiotic indications, which, according to the Gyssens method, are classified as category V. This finding is consistent with research. Ismaya (2016), which also reported that there are still many cases of ISPA with viral etiology where antibiotics are given irrationally.

Therefore, it can be concluded that comorbidities play a significant role in determining the rational use of antibiotics in patients with ARI. The results of this study's evaluation indicate that inappropriate antibiotic use persists in patients with viral infections as comorbidities.

### **Characteristics of ISPA Patients Based on Dosage Form**

Distribution of antibiotic use by dosage form in patients with acute respiratory infections (ARI) hospitalized at Dr. Moewardi Regional Hospital, Surakarta, from 2023 to 2025. This data is important for understanding the most frequently used antibiotic dosage forms and helps determine the most common dosage forms used in the treatment of acute respiratory infection (ARI) patients at the hospital during that period. The following is the distribution of antibiotics by dosage form, as shown in Table 4.

**Table 4. Use of antibiotics based on the dosage form**

No	Dosage Form	Number of Patients	Presentaae (%)
1.	Injection	18	47.40
2.	Tablet	18	47.40
3.	Syrup	1	2.60
4.	Pulveres	1	2.60
<b>Amount</b>			100

The data show that injections and tablets were the primary dosage forms preferred by a total of 38 patients receiving antibiotic therapy. Injections and tablets each accounted for 47.40% of the total number of patients, while syrups and pulverizers were only used by one patient, accounting for 2.60%.

Tablets are a dosage form with many advantages, such as ease of consumption, lower production costs, and stability during storage. Tablets offer convenience and safety in administering active pharmaceutical ingredients (APIs) with good physicochemical stability and ensure accurate dosing compared to solution dosage forms. (Nurjanah et al. 2020).

Sterile injectables are liquid pharmaceutical preparations specifically designed to be administered directly into the body through injection using a sterile syringe or clean injection equipment. Because they are injected directly into body tissue or the bloodstream, sterile injectables are commonly used in various medical situations that require a rapid response of medication, such as emergencies, antibiotic therapy, parenteral nutrition, and the treatment of chronic diseases.(Nurjanah et al. 2020).

**Distribution of ISPA Patients Based on the Use of Single and Combination Antibiotics and Antibiotic Classes.**

The use of antibiotics in patients with ARI, both alone and in combination, needs to be differentiated to determine the effectiveness of each type of antibiotic in treatment. This is very important to know which antibiotics are most frequently used and effective in curing ARI patients in the Inpatient Installation of Dr. Moewardi Surakarta Hospital during 2023 to 2025. The following is a table showing the types of antibiotics and their groups used by ARI patients in the Inpatient Installation of Dr. Moewardi Surakarta Hospital from 2023 to 2025, which are differentiated based on the use of antibiotics alone or in combination, as in Table 9.

**Table 5. Distribution of Antibiotics Based on Single or Combination Use and Antibiotic Class**

Compositi on	Antibiotic Classes	Name Antibiotics	Numbe r of Patient s	Percenta ge (%)
Single	Penicillin	Ampicillin sulbactam	5	13.20
	Penicillin	Ampicillin	4	10.50
	Penicillin	Amoxicillin	2	5.30
	Macrolides	Azithromycin	6	15.80
	Cephalosporin 3	Cefixime	4	10.50
	Cephalosporin group 3	Ceftriaxone	3	7.90
	Quinolone	Ciprofloxacin	3	7.90
	Penicillin	Co-amoxiclav	1	2.60
	Quinolone	Levofloxacin	6	15.80
	Penicillin	Vicillin	1	2.60
Combinat ion	1. Penicillin+ Sulfonamides	Ampicillinsulbacta m+ Cotrimoxazole	1	2.60
	2. Aminopenicilli n+ Penicillin	Ampicillin+ Co-amoxyclav	1	2.60
	3. + Quinolone	Levofloxacin+ Ceftriaxone	1	2.60
	+ Cephalosp orin group 3			
Amount			38	100

From Table 5, it can be seen that the antibiotics most frequently used for the treatment of ARI in

the Inpatient Installation of Dr. Moewardi Surakarta Regional Hospital from 2023 to 2025 were azithromycin and levofloxacin, each with a percentage of 15.80%. Then for ampicillin sulbactam 13.20%; ampicillin 10.50%; amoxicillin 5.30%; cefixime 10.50%; ceftriaxone 7.90%; ciprofloxacin 7.90%; co-amoxycylav 2.60%; vicillin 2.60%, there are ampicillin sulbactam with co-trimoxazole 2.60%, ampicillin with co-amoxycylav 2.60%; levofloxacin with ceftriaxone 2.60%.

Azithromycin belongs to the macrolide class. This drug has stronger activity against gram-negative bacteria, a wider volume of distribution, and a longer half-life. Azithromycin can be used to treat acute respiratory infections (ARI) in both the upper and lower respiratory tracts.(Ismaya 2016)Macrolides affect bacterial protein synthesis by binding to the 50S subunit of the bacterial ribosome, thereby inhibiting the peptide translocation process.(Engko and Indrawaty 2011).

Levofloxacin is a type of antibiotic from the quinolone group. Its mechanism of action involves influencing nucleic acid synthesis or metabolism, and it has a broad spectrum of activity against gram-positive and gram-negative bacteria, as well as atypical bacteria that cause lower respiratory tract infections. This drug has high bioavailability and a long elimination half-life.(Yusuf et al. 2022)Quinolones are oral antimicrobials that have a significant impact on the treatment of infections. Levofloxacin has broad activity in treating infections that occur in the community and in hospitals. Furthermore, levofloxacin is also available in parenteral form, allowing for its widespread use, either alone or in combination with other agents. Its activity includes Enterobacteriaceae, Pseudomonasaeruginosa, staphylococci, enterococci, streptococci, and others. Levofloxacin is also safe for use in adult patients, with special attention to renal function, as its metabolism is limited, and it is excreted entirely in the urine.(Riska Aulia 2017).

### Rationality of Antibiotic Use

Antibiotics are drugs used to treat infections caused by bacteria. There are two types of antibiotics: bactericidal, which work by killing bacteria, and bacteriostatic, which prevent bacteria from multiplying.(Engko and Indrawaty 2011)If antibiotics are used inappropriately or irrationally, sensitive bacteria will die, while resistant bacteria will survive and multiply. Irrational antibiotic use can lead to the rapid rise of bacterial resistance, which can lead to increased health problems and deaths globally, as well as increasing annual medical costs.(Hanum et al. 2018).

Treatment is considered rational if it meets several criteria, such as correctly identifying the cause of the disease, selecting the correct antibiotic, administering the appropriate dosage, administering the medication for the correct duration, and administering the medication for the required duration. Correct and rational antibiotic selection and use will influence treatment success and prevent bacterial resistance. When choosing an antibiotic, three important factors must be considered: the cause of the disease, the patient's condition, and the antibiotic's properties.(Tuloli et al. 2024).

### Right Indication

The evaluation of appropriate antibiotic use aims to ensure whether the use of antibiotics in ISPA patients is appropriate to the condition of the disease being examined, especially in ISPA patients at Dr. Moewardi Surakarta Regional Hospital for the period 2023 to 2025, as seen in Table 6.

**Table 6. Data on the Accuracy of Indications for Antibiotic Use in ISPA Patients**

No	Evaluation	Number of Patients	Percentage (%)
1.	Right Indication	36	94.70
2.	Incorrect Indication	2	5.30
<b>Amount</b>			<b>100</b>

Table 6 shows that 36 ISPA patients (94.7%) used antibiotics for appropriate indications, while 2 ISPA patients (5.3%) used antibiotics for inappropriate indications. Appropriate antibiotic use means the decision to use antibiotics is based on clear medical reasons and the most appropriate treatment.(Muharni et al. 2014). Correct indications are based on an accurate diagnosis, such as antibiotics are only given when the cause of the disease is proven to be bacterial.(Tobat et al.

2015)Each drug can cure a specific disease. Therefore, antibiotic use is considered appropriate if the medication is appropriate for the type of disease and symptoms experienced by the patient, thus maximizing its effectiveness. Antibiotic use is considered appropriate if the patient is diagnosed with a disease that, according to regulations, requires antibiotic treatment.(Tuloli et al. 2024).

Antibiotics are used to treat bacterial infections, so these drugs should only be given to patients who have symptoms of a bacterial infection.(Herawati et al. 2023)Errors in antibiotic use often occur in patients diagnosed with influenza (a viral infection). Influenza cases, approximately 40-80% of patients recover on their own (self-limiting). Therefore, influenza treatment does not require antibiotics. Antibiotics should only be given if there are bacterial complications, such as bacterial pneumonia, ear infections, or sinusitis. Using antibiotics without a bacterial complication can cause side effects and exacerbate microbial resistance to antibiotics.(Tuloli et al. 2024).

### Right Medicine

Evaluating the appropriate use of antibiotics in patients with acute respiratory infections (ARI) at Dr. Moewardi Regional Hospital, Surakarta, is crucial to prevent antibiotic resistance and ensure effective treatment. The following is a summary of the appropriateness of antibiotic selection in patients with acute respiratory infections (ARI) at Dr. Moewardi Regional Hospital, Surakarta, during the 2023-2025 period, as shown in Table 11.

**Table 7. Data on the Accuracy of Antibiotic Use in ISPA Patients**

No	Evaluation	Number of Patients	Percentage (%)
1.	Right Medicine	36	94.70
2.	Incorrect Medication	2	5.30
<b>Amount</b>			100

Based on Table 7, it is known that of the 38 ISPA patients at Dr. Moewardi Surakarta Regional Hospital in the 2023-2025 period who were evaluated, 36 ISPA patients (94.70%) received the correct dose, and 2 patients (5.30%) received the incorrect dose. Appropriate medication is the determination of the suitability of the prescribed medication to the diagnosis established by the doctor's ability and experience, based on scientific principles. (Aliena et al. 2021)Antibiotics should only be given to patients with ARI caused by bacteria, as using antibiotics without a bacterial indication constitutes irrational drug use. Furthermore, it's important to remember that antibiotics only work against bacteria, not viruses. Therefore, an accurate diagnosis is crucial for appropriate and efficient antibiotic use. (Salsabilla et al. 2024). Azithromycin is included in the macrolide class of antibiotics. Its mechanism of action is by inhibiting bacterial protein formation, namely by preventing the transfer of peptide chains or binding to the 50S ribosomal subunit. Azithromycin is often used to treat conditions such as community-acquired pneumonia, chronic bronchitis with acute exacerbations, sinusitis, urethritis, pelvic inflammatory disease, and other bacterial infections. However, this drug should not be used to treat viral infections. (Parisa et al. 2022).

The antibiotic used is ampicillin, which has a broad spectrum against gram-positive and gram-negative bacteria, and is sensitive to penicillinase. Drugs in the penicillin group are bactericidal, and their mechanism of action is by inhibiting the formation of cell walls or damaging the bacterial cell walls.(Hasti et al. 2020)Antibiotics should only be given to influenza patients if there are bacterial complications, such as pneumonia, ear infections, or sinusitis. Using antibiotics in the absence of bacterial complications will only harm the microbes and accelerate antibiotic resistance.(Tuloli et al. 2024)

### Right Dose

Dosage accuracy evaluation is a method for assessing the rational use of antibiotics in patients with acute respiratory infections (ARI). Dosage accuracy significantly impacts treatment outcomes. Too low a dose reduces the drug's effectiveness, while too high a dose can be harmful to the patient.(Tuloli et al. 2024). The following data on the accuracy of antibiotic doses given to ISPA

patients based on medical records at Dr. Moewardi Surakarta Regional Hospital, as seen in Table 8.

**Table 8. Data on the Accuracy of Antibiotic Dosage in ISPA Patients**

No	Evaluation	Number of Patients	Percentage (%)
1.	Right Dose	38	100
2.	Incorrect Dosage	0	0
<b>Amount</b>			100

From Table 8, there were 38 patients (100%) who received antibiotics at the correct dosage. According to the Indonesian Ministry of Health (2011, inIsmaya (2016)Overdosing, especially for drugs with a narrow therapeutic range, carries the risk of side effects. Meanwhile, too low a dose cannot guarantee the desired therapeutic effect. Dosing should be tailored to each individual's condition, the severity of the infection, the type of bacteria causing the infection, and the drug's pharmacokinetic and pharmacodynamic properties. When treatment uses a specific dose, continuous monitoring is necessary to evaluate the effectiveness of therapy after antibiotic use. This way, dose adjustments can be determined whether or not they are necessary.(Ismaya 2016)Clinically, bacterial resistance is a serious problem, as bacteria previously sensitive to a particular drug can become resistant. Dosage is a crucial aspect of antibiotic use because the susceptibility of pathogens to antimicrobial drugs can change due to inappropriate treatment, which can lead to unwanted side effects and toxicity.(Putri et al. 2023).

**On time**

The timing of antibiotic use is also very important to ensure the effectiveness of therapy, especially in patients with ARI. Drugs affect the availability of drugs in the body, which has an impact on the results of therapy.(Angin et al. 2021). The following data regarding the timeliness of antibiotic use in ISPA patients at Dr. Moewardi Surakarta Regional Hospital are shown in Table 9.

**Table 9. Data on the Timeliness of Antibiotic Use in ISPA Patients**

No	Evaluation	Number of Patients	Percentage (%)
1.	On time	38	100
2.	Incorrect Dosage	0	0
<b>Amount</b>			100

From Table 13, 38 patients (100%) received antibiotics at the correct time. The method of administration should be tailored to patient convenience and practicality. (Engko and Indrawaty 2011). Use antibiotics at the prescribed intervals; do not exceed or fall short of the established rules. If the intervals are appropriate, patients will be more compliant with treatment. However, if the intervals are not appropriate, it can affect the dose received and lead to overdose. Patient compliance with antibiotic use significantly impacts the success of treatment.(Putri et al. 2023).

**Exact Duration of Administration**

In addition to accurately determining the indication, type of drug, dosage, timing, and duration of antibiotic use, these factors are crucial for rational antibiotic use. If the duration of antibiotic administration is too short or too long, treatment outcomes can be affected.(RI 2011)Therefore, an evaluation was conducted to determine whether the duration of antibiotic administration in patients with ARI was in accordance with recommended therapy guidelines. The results of this evaluation are presented in Table 14.

**Table 10. Data on the Accuracy of the Duration of Antibiotic Administration in ISPA Patients**

No	Evaluation	Number of Patients	Percentage (%)
1.	Exact Duration of Administration	13	34.20
2.	Incorrect Duration Administration	25	65.80
<b>Amount</b>			100

Based on Table 10, 13 patients (34.20%) received antibiotics with the appropriate duration of administration. However, 25 patients (65.80%) received an inappropriate duration of administration, with 16 patients receiving treatment durations that were too short (less than 5 days) or too long. The duration of symptom-free periods can be increased by using antibiotic regimens that adjust the upper limit of the daily dose for 5-7 days.(Schwinghammer et al. 2021)If the antibiotic administration interval is too short, the drug levels in the body will increase, potentially causing toxicity. Conversely, if the interval is too long, the drug levels in the body will decrease or even fall below the minimum required level, potentially leading to bacterial resistance.(Yasir et al. 2021).

**Assessment of Antibiotics Used Using the Gyssens Method**

The appropriate or wise (rational) use of antibiotics according to the Gyssens method is indicated by all categories of antibiotics passing. The use of antibiotics is declared appropriate if the indication, type of drug, dose, time, and duration of administration are correct.(Yasir et al. 2021)In this method, each antibiotic administration is evaluated and categorized based on its accuracy, thus determining the extent of antibiotic use that is correct and the extent of non-standard use. The following are the results of the evaluation of antibiotic use in ISPA patients at Dr. Moewardi Regional Hospital in Surakarta using the Gyssens method, as shown in Table 15.

**Table 11. Assessment of Antibiotics Used Using the Gyssens Method**

No	Information	Number of Patients	Percentage (%)
1	Category III B (Too short duration)	22	57.90
2	Category 0 (Rational)	13	34.20
3.	Category V (No indication for antibiotic use)	2	5.30
4.	Category III A (Too long duration)	1	2.60
<b>Amount</b>		38	100

Based on Table 11, the assessment of antibiotic use in 38 ISPA patients at Dr. Moewardi Surakarta Regional General Hospital using the Gyssens method showed varying levels of accuracy in each aspect of the rationality evaluation. It was found that rational antibiotic use occurred only in 34.20% of patients, while the remainder were still inappropriate, especially in the duration of administration. Meanwhile, 2.60% of patients received antibiotics for too long a duration (category IIIA), while 57.90% received a duration that was too short (category IIIB). Meanwhile, cases with no indication for antibiotic use occurred in only 5.30% of patients.

Azithromycin is a semisynthetic macrolide antibiotic, which is a 15-ring compound derived from erythromycin. Azithromycin has a Better half-life in blood, better stability, and faster penetration ability into tissues, so it is widely used in practice.(Princess 2022)In category IIIA, with a percentage of 2.60%, patients were given azithromycin for 10 days. Azithromycin use is in accordance with the recommended adult dose of 500 mg, given once daily. However, the average duration of use is five days, depending on the type of causative bacteria and the severity of the patient's illness.(Parisa et al. 2022).

In category (V) patients, antibiotics may be prescribed if a bacterial infection is clearly present.

For example, antibiotics are used for a viral infection that does not actually require them. Ideally, antibiotic prescription is based on microbiological examination results. However, if examination is not possible, empiric therapy may be initiated. This takes into account the patient's clinical condition to prevent the disease from worsening. The use of broad-spectrum antibiotics aims to address the possibility of an unknown bacterial cause.(Parisa et al. 2022).

Table 15 shows that the majority of patients fall into the rational category, but some patients still received inappropriate doses or treatment durations, either too short or too long. These results indicate the need for routine evaluation and specific efforts to improve antibiotic dosage and duration to ensure more effective and safe therapy.

Improper or prolonged use of antibiotics can lead to resistance. Resistance prevents bacterial or viral growth from being inhibited, so even when given antibiotics regularly, the body becomes immune to certain bacterial infections. This makes the active compounds in antibiotics less effective at killing bacteria because they exceed the recommended dosage.(Sari et al. 2024).

## CONCLUSIONS

Based on the research results, it was found that the rational use of antibiotics in patients with acute respiratory infections (ARI) at Dr. Moewardi Hospital in Surakarta still requires special attention. Although most patients received antibiotics with the correct indication, type of drug, dosage, and time of administration, the correct duration of antibiotic administration remains a major challenge. Only 34.2% of patients received antibiotics for the appropriate duration, while 65.8% experienced inaccuracies, either too short or too long. Furthermore, evaluation using the Gyssens method showed that only 34.2% of antibiotic use was truly rational, while the remainder still contained inaccuracies, especially in aspects of duration and indications of administration. These findings are in line with previous research that also showed inaccuracies in antibiotic use in patients with acute respiratory infections, both in children and adults, which has the potential to increase the risk of bacterial resistance and reduce the effectiveness of therapy.

This study has several limitations, including data from only one hospital and a limited time period, so the results cannot be generalized to a wider population. Furthermore, limited medical record data and the failure to perform laboratory confirmation in all ARI cases may impact the accuracy of the antibiotic rationality evaluation. For future research, it is recommended that multi-center studies be conducted over a longer period of time and include laboratory confirmation for the etiological diagnosis of ARI. The practical implication of this study is the need for regular evaluation and increased education for healthcare workers regarding the importance of rational antibiotic use, particularly regarding the duration of administration, to reduce resistance rates and improve the quality of healthcare services in hospitals.

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