An Evaluative Study of the Rationality of Antibiotic Use in Children with Outpatient Acute Respiratory Infections (ARI) at the Fastabiq Sehat Pati Clinic in 2021

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Abstract. Acute Respiratory Tract Infection (ARI) is a major cause of morbidity and mortality in children, especially in developing countries. Irrational antibiotic use in the treatment of ARI remains a common problem, even though most cases are self-limiting. This study aims to evaluate the rationality of antibiotic use based on the 4T parameters (correct dose, correct drug, correct indication, and correct interval of administration) in pediatric patients with ARI outpatients at the Fastabiq Sehat Pati Clinic during 2021. This is a descriptive study with a retrospective approach of 31 pediatric patients aged 5–13 years who received antibiotics and had complete medical records and prescriptions. Data were analyzed based on standards from the *British National Formulary* (BNF) 74th edition, *Drug Information Handbook* (DIH) 17th edition, and other therapeutic guidelines. The results showed that the majority of patients were female (64.5%) and aged 5 years (42%). The most commonly prescribed antibiotics were amoxicillin dry syrup (48.39%) and tablets (32.26%). The rationality evaluation showed 100% indication accuracy, 96.8% time interval accuracy, 77.4% medication accuracy, and 54.8% dosage accuracy. Although most rationality parameters were met, inaccuracies remained, particularly in dosage and drug selection. Regular evaluation and increased adherence to therapy guidelines are needed to prevent antibiotic resistance and ensure the effectiveness of ARI treatment in children.

Key words: Antibiotics, ISPA, Rational use of drugs, Correct dosage, Correct indication, Correct interval, Correct medication

INTRODUCTION

Acute Respiratory Tract Infection (ARI) is a disease with high morbidity and mortality rates in children, especially in developing countries. According to data from the World Health Organization (WHO, 2020), approximately 4 million people die each year from acute respiratory infections (ARI), 98% of which are caused by lower respiratory tract infections. Children, particularly those aged 6 to 13, are the most vulnerable group to ARI due to their immature immune systems (Arfa, 2020). In Indonesia, ARI remains a leading cause of pediatric patient visits to primary healthcare facilities, such as community health centers (Puskesmas) and primary care clinics (Ministry of Health of the Republic of Indonesia, 2021).

Although most cases of ARI in children are caused by viruses and are self-limiting, antibiotics are still often prescribed irrationally. However, the selection and use of appropriate and rational antibiotic therapy are crucial for successful treatment and are crucial for preventing the emergence of bacterial resistance (Ministry of Health of the Republic of Indonesia, 2011). Inappropriate antibiotic use, whether in terms of indication, dosage, or duration, can cause adverse side effects and increase the risk of antimicrobial resistance (Permata & Fitriani, 2020). A study by Rahmah and Wulandari (2019) showed that more than 50% of antibiotics were prescribed for non-bacterial ARI cases when they were unnecessary. These results are supported by research by Lestari, Puspitasari, and Handayani (2018), which found that 61% of antibiotic prescriptions for children with ARI did not comply with WHO or Ministry of Health therapy guidelines.

Evaluation of the rationality of antibiotic use is very important to ensure that the therapy provided is in accordance with the principles of safe, effective and efficient treatment. Research by Sari and Wicaksono (2022) also showed that low compliance of medical personnel with clinical guidelines is one of the main factors causing inappropriate antibiotic use in pediatric patients.

Given the high rate of irrational antibiotic use in pediatric acute respiratory infections (ARI), an

evaluative study is needed to determine the extent to which rational antibiotic use has been implemented in healthcare facilities. The Fastabiq Sehat Pati Clinic, one of the outpatient clinics in Pati Regency, is strategically located.

METHODS

This research is a descriptive, non-experimental study with a retrospective approach that aims to evaluate the rationality of antibiotic use in pediatric patients diagnosed with Acute Respiratory Tract Infection (ARI) at the Fastabiq Sehat Pati Clinic during 2021. The location of this study is the Fastabiq Sehat Pati Clinic, Central Java. Data collected were from January to December 2021, using medical records and documented patient prescriptions.

The population in this study were all pediatric patients aged 5 to 13 years who were outpatients at the clinic with a diagnosis of ARI and receiving antibiotic therapy. Sampling was conducted using purposive sampling with inclusion criteria: pediatric patients (5-13 years) diagnosed with ARI, receiving antibiotics, and having complete medical records and prescriptions. Exclusion criteria were patients with diagnoses other than ARI or incomplete medical records. Data were collected through document review, including copies of prescriptions and patient medical records, which were then analyzed to assess the rationality of antibiotic use.

The research data was taken retrospectively from patient medical records in 2021. Based on the screening results, the number of medical records that met the inclusion criteria was 31 patients out of a total of 106 children's medical records with a diagnosis of ARI obtained using the total sampling method. Evaluation of the rationality of antibiotic use was carried out based on clinical and pharmacotherapeutic parameters sourced from several references, including the *Drug Information Handbook*, 17th Edition, 2009, Pharmacotherapy: *A Pathophysiologic Approach* (Dipiro, 7th edition, 2008), and the *British National Formulary* (BNF), 12th edition, 1986 & edition No. 74, 2018.

RESULTS AND DISCUSSION

Based on medical records of 106 outpatients diagnosed with Acute Respiratory Tract Infection (ARI) at the Fastabiq Sehat Pati Clinic between January and December 2021, a selection process was conducted based on inclusion criteria: pediatric patients receiving antibiotic therapy and having complete medical records and prescriptions. After selection, 31 patients met the inclusion criteria and were eligible for this study. The remaining 75 patients did not meet the criteria, one reason being that they did not receive antibiotic therapy as part of their ARI treatment.

Prior to data collection, the researcher obtained ethical clearance from the Health Research *Ethics Committee* (KEPK) of Muhammadiyah University of Purwokerto. This approval aims to protect the rights and safety of research subjects from potential harm, whether physical, psychological, social, or legal consequences. Ethical clearance was issued under letter number KEPK/UMP/99/VII/2023.

A. Patient Characteristics

Patient characteristics for pediatric ISPA patient data undergoing antibiotic therapy at the Fastabiq Sehat Pati Clinic based on gender and age.

Table 1. Characteristics of Outpatient Pediatric ISPA Patients at the Fastabiq Sehat Pati Clinic from January to December 2021 Who Received Antibiotic Therapy.

Patient Characteristics	Number of Patients	Percentage
Gender		
Man	11	35.5%
Woman	20	64.5%
Age		
5 years	13	42%
6 years	4	13%
7 years	1	3.2%
8 years	3	9.7%
9 years	1	3.2%
10 years	2	6.4%
11 years old	3	9.7%
12 years old	2	6.4%

Patient Characteristics	Number of Patients	Percentage
13 years old	2	6.4%
TOTAL	**31**	**100%**

Source: Processed primary data (2023)

Based on the research results as seen in Table 1. Gender shows that 20 girls (64.5%) suffered more from ARI than 11 boys (35.5%). This indicates that more pediatric patients with Acute Respiratory Tract Infections (ARI) are female than male, which can be caused by a combination of biological, environmental, and behavioral factors. Biologically, although boys are generally considered more susceptible to infection due to immature immunity. Meanwhile, girls have a more active immune response, which can actually cause more severe inflammation of the respiratory tract when exposed to pathogens. In addition, in some cultures and environments, girls are more often indoors and exposed to indoor pollution (cigarette smoke, kitchen smoke from traditional fuels). On the other hand, it is possible that parents are more likely to take girls to health facilities when they show symptoms of illness, so that the recorded incidence of ARI in girls is higher.

In line with research by Sari et al. (2021), hormonal factors, immunity, as well as differences in parenting patterns and environmental exposures may contribute to the higher prevalence of ARI in girls. Girls, especially in environments with high domestic habits, tend to be more frequently exposed to kitchen smoke or indoor pollution, which increases the risk of respiratory disorders. Research by Putri and Wahyuni (2020) also states that differences in immunological responses between boys and girls may contribute to differences in ARI incidence, where girls show a tendency for a higher immune response but are also more sensitive to airway inflammation. Furthermore, research by Syamsul et al. (2019) states that the use of health facilities such as primary health care is often visited by women and children, so the recorded illnesses are likely to be different.

Based on the results of outpatient research with a diagnosis of Acute Respiratory Tract Infection (ARI) in children aged 5-13 years, the most common was found at the age of 5 years, as many as 13 patients (42%), because at this age the child's immune system is still in the development stage and is not yet fully mature. Children aged 5 years often begin to enter new environments, such as schools or playgrounds, where they are more often exposed to viruses and bacteria that cause ARI from interactions with peers. In addition, personal hygiene habits, such as washing hands and covering the mouth when coughing or sneezing, are not yet fully formed at this age, thus increasing the risk of infection transmission. Environmental factors, such as air pollution and exposure to cigarette smoke, can also worsen the condition of the child's respiratory tract, making them more susceptible to ARI. The combination of a less than optimal immune system, high levels of exposure, and immature hygiene habits make children aged 5 years the age group most often suffering from ARI.

In line with research by Fadlyana & Rusmil (2021), the immune systems of children aged 3-5 years are still developing, making them more susceptible to viral and bacterial infections. Furthermore, according to Zhang et al. (2020), 5-year-old children begin to actively interact in preschool or kindergarten environments, which increases their exposure to pathogens. Furthermore, habits such as lack of handwashing awareness and close contact with peers facilitate the transmission of ARI. Environmental factors, such as air pollution and exposure to cigarette smoke, also contribute to the high incidence of ARI at this age.

B. Profile of Antibiotic Drug Use in Outpatient Pediatric ISPA Patients

Acute Respiratory Tract Infection (ARI) is one of the most common illnesses affecting children. Treatment of ARI often involves the use of antibiotics, although not all cases require such therapy. Therefore, it is important to understand the profile of antibiotic use in pediatric patients with ARI to evaluate the appropriateness of therapy and prevent antimicrobial resistance. The profile of antibiotic use in pediatric ARI outpatients at the Fastabiq Sehat Pati Clinic in 2021 is as follows:

Table 2. Profile of Medication Use in Pediatric ISPA Patients at the Fastabiq Sehat Pati Clinic

No	Name Of Drug	Total Number Of Recipes	Percentage
1	Amoxicillin 500mg	10	32.26%
2	Amoxixilin dry syrup 125mg/5ml	15	48.39%
3	Cefadroxil dry syrup 125mg/5ml	5	16.13%

No	Name Of Drug	Total Number Of Recipes	Percentage
4	Cefadroxil 500mg	1	3.22%
TOTAL RECIPE		**31**	**100%**

Source: Processed primary data (2023)

Based on Table 2, it is known that the profile of antibiotic use in pediatric ARI patients at the Fastabiq Sehat Pati Clinic shows that amoxicillin dry syrup is the most commonly used antibiotic, namely 15 patients (48.39%), followed by amoxicillin tablets with 10 patients (32.26%). The high use of these two dosage forms of amoxicillin is due to the characteristics of amoxicillin as a penicillin antibiotic with a broad spectrum that is effective against various bacteria that cause ARI. Amoxicillin is recommended as first-line therapy in cases of uncomplicated ARI in children, because it has high effectiveness against major pathogens such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. These two bacteria are the most common causes of upper respiratory tract infections in children, and amoxicillin has been shown to inhibit the growth of both bacteria effectively.

According to Arfa (2020b), amoxicillin is known to be free from toxic properties and is one of the antibiotics that is often misused, both in dosage and indications for use. The mechanism of action of amoxicillin is explained by Lowy (1986), namely by killing bacteria directly by inhibiting bacterial cell wall synthesis, especially in the final stage of synthesis, namely the transpeptidation reaction which is important in the formation of peptidoglycan. This inhibition disrupts the integrity of the cell wall structure and causes lysis of bacterial cells. In addition to its effectiveness and mechanism of action, the use of amoxicillin also needs to consider side effects, especially in children who are more susceptible to drug reactions. According to Tambunan *et al*. (2012), side effects of amoxicillin use in children include nausea, vomiting, diarrhea, rashes, and hypersensitivity reactions. These side effects are generally mild to moderate, but can become serious if severe allergic reactions such as anaphylaxis occur.

Dry syrup is preferred for toddlers because it's easy to consume and tailored to their body weight. Wulan and Rahayu (2021) added that liquid preparations also improve patient compliance with treatment, as children are more receptive to the taste and form. This finding is further supported by Lestari and Hidayah (2020), who also stated that parents find it more practical to administer syrup than tablets, especially in outpatient settings.

Meanwhile, the use of the antibiotic amoxicillin preparationThe use of tablets is also quite high, especially among school-aged children who are able to swallow solid medications. Tablets have several advantages, including greater stability, no shaking required, a longer shelf life, the possibility of administering higher doses with fewer units of medication, and a more economical price. Fitriyani *et al*. (2021) revealed that amoxicillin tablets are often used for school-aged children because they are more practical and economical, especially for short-term therapy. Praseteya *et al*. (2023) also explained that tablet preparations facilitate the administration of combination therapies, especially if there are accompanying symptoms such as fever or severe cough.

The findings in this study are supported by previous research conducted by Fitriani et al., (2019), which found that 77 patients (81.06%) used amoxicillin. Amoxicillin was the most frequently prescribed antibiotic compared to other antibiotics. Another study (Nasfia, 2021) found that 43 patients (71.67%) used amoxicillin out of a total of 60 antibiotics.

C. Rationality of Antibiotic Drug Use in Children's ISPA based on 4T

a. Right Dose

Correct dosage can be assessed by administering a dose that meets the parameters of the dose range, frequency, route, and duration of treatment. Evaluation of correct dosage is achieved by comparing the medical record data of non-pneumonia ARI patients who meet the criteria. Inclusion criteria using the guidelines that can be seen in table 3.

Table 3. Rationality of Appropriate Dosage for Outpatients with ISPA in Children at the Fastabi1 Sehat Pati Clinic

NO	INFORMATION	NUMBER OF RECIPES (N=31)	Percentage
1	Appropriate	17	54.8
2	Not exactly	14	45.2
	TOTAL	**31**	**100%**

Source: Processed primary data, (2023)

Based on Table 3, it is known that antibiotic prescriptions prescribed by doctors for pediatric outpatients with acute respiratory infections (ARI) at the Fastabiq Sehat Pati Clinic during the period January–December 2021 showed that 17 prescriptions (54.8%) were categorized as appropriate. This accuracy is based on the standards listed in the 74th edition of the *British National Formulary* (BNF), which serves as a reference for antibiotic dosing in children. However, several cases of inaccurate dosing were recorded in the patient data appendix. For example, in patient number 5, the administration of amoxicillin was found to be inappropriate. Based on her age and weight, the patient should have received a daily dose of 467–1400 mg, but was only given 450 mg per day, thus the dosage was deemed insufficient.

A similar case occurred with patient number 28, an 11-year-old weighing 27 kg who was prescribed 375 mg of cefadroxil per day. However, according to the 74th edition of the BNF, the recommended dose of cefadroxil for that age group is 640–1600 mg per day. This indicates that the patient received a substandard dose, resulting in suboptimal therapy. The results of this study align with those of Frianto and Dewi (2021), who stated that 77% of the 160 medications prescribed to patients met the appropriate dosage criteria, but a significant percentage were still administered at inappropriate doses.

Administering antibiotics in insufficient doses can result in the drug not producing the expected pharmacological response, thus decreasing its therapeutic effectiveness. This is explained by Fujiastuti (2016), who stated that inadequate doses can lead to therapeutic failure because drug concentrations in the body do not reach therapeutic levels. Furthermore, the Indonesian Ministry of Health (2019) also emphasized that the use of antibiotics in inappropriate doses contributes to an increased risk of bacterial resistance, which is a serious challenge in controlling infectious diseases today.

b. Right Medicine

The right medication is one of the main indicators of rational drug use. According to the Ministry of Health of the Republic of Indonesia (2019), the right medication is the accuracy in providing the correct therapy, meaning the drug chosen must be appropriate for the patient's illness and have the desired therapeutic effect.

Table 4. Rationality of Appropriate Medication for Outpatients with ISPA in Children at the Fastabi1 Sehat Pati Clinic

NO	INFORMATION	NUMBER OF RECIPES (N=31)	Percentage
1	Appropriate	24	77.4
2	Not exactly	7	22.6
	TOTAL	**31**	**100%**

Source: Processed primary data, (2023)

Based on Table 4, it is known that antibiotic prescriptions prescribed by doctors for pediatric outpatients with ARI at the Fastabiq Sehat Pati Clinic from January to December 2021 showed that 27 prescriptions (77.4%) were categorized as appropriate. This appropriateness assessment refers to the 17th edition of the *Drug Information Handbook* (DIH) standards as a reference for selecting appropriate antibiotics. However, cases of inappropriate drug selection were still found, such as that recorded in patient number 2 (appendix 8), where the patient had only experienced ARI symptoms for one day but was immediately prescribed antibiotics. However, according to clinical guidelines, antibiotics are not recommended for mild ARI cases that have not been proven to be caused by a bacterial infection.

The principle of appropriate drug selection not only considers clinical diagnosis but also the effectiveness, safety, and pharmacological relevance of the drug to the patient's condition. In the treatment of acute respiratory infections in children, this means that antibiotics are only prescribed when there is a strong indication of a bacterial infection, such as those caused by Streptococcus pneumoniae or Haemophilus influenzae, and are avoided if the symptoms are caused by a virus. Implementing this principle is crucial to ensure successful therapy, prevent irrational drug use, and reduce the risk of antimicrobial resistance, a global concern.

The results of this study align with those of Runtu *et al.* (2020), who reported that at Siloam Hospital Manado, 109 of 129 medical records of pediatric ARI patients (84.5%) demonstrated appropriate antibiotic selection based on the indication and timing of administration. Antibiotic

administration was also consistently recorded in daily medical records. These findings indicate that medical personnel's awareness of the importance of appropriate drug selection, particularly antibiotics, is increasing in various healthcare facilities. Nevertheless, regular evaluation is still necessary to reduce the number of inappropriate therapies and improve overall service quality and patient safety.

c. Right Indication

Appropriate indications are one of the basic principles of rational antibiotic use. According to the Indonesian Ministry of Health (2019), appropriate indications refer to the appropriateness of administering antibiotics to patients suspected of having a bacterial infection.

Table 5. Rationality of Appropriate Indications for Outpatient ISPA Patients in Children at the Fastabi1 Sehat Pati Clinic

NO	INFORMATION	NUMBER OF RECIPES (N=31)	Percentage
1	Appropriate	31	100
2	Not exactly	0	0
	TOTAL	**31**	**100%**

Source: Processed primary data, (2023)

Based on Table 5, it is known that all antibiotic prescriptions given to pediatric outpatients with acute respiratory infections (ARI) at the Fastabiq Sehat Pati Clinic from January to December 2021 were categorized as appropriate for indication, with 31 prescriptions (100%). This accuracy indicates that antibiotic selection was carried out in accordance with applicable treatment guidelines, namely the *British National Formulary* (BNF) 74th edition and the *Drug Information Handbook* (DIH). One example is seen in patient number 1 (appendix 9), who received amoxicillin therapy. According to the BNF 74th edition, amoxicillin is indicated for the treatment of various bacterial infections such as urinary tract infections, otitis media, sinusitis, community-acquired pneumonia, salmonellosis, and oral infections. Therefore, antibiotic selection in this case was appropriate for the patient's disease indications.

These results align with studies conducted by Runtu et al. (2020) and Hoirunisa et al. (2013), which both reported a 100% accuracy rate in antibiotic prescriptions for pediatric ARI patients. Accurate indications are crucial because antibiotics should only be administered if there is clinical evidence or strong suspicion that the patient's infection is caused by bacteria, not viruses or other non-bacterial agents. This is particularly relevant in ARI cases, given that most cases are caused by self-limiting viral infections and do not require antibiotic therapy.

d. Correct time interval for administration

The right interval is the accuracy of the timing of drug administration, carried out in a practical and simple manner, so that it is easy for patients to understand, remember, and comply with. This principle aims to ensure that drugs can achieve optimal concentrations in the blood, maintain their therapeutic effect consistently, and minimize the risk of side effects and drug resistance. According to the Indonesian Ministry of Health (2019), regular administration intervals are very important, especially for drugs such as antibiotics, whose effectiveness is highly dependent on the correct timing of each dose.

Table 6. Appropriate Rationale for Time Intervals for Administration of ISPA to Outpatients in Children Fastabi1 Healthy Clinic Pati

NO	INFORMATION	NUMBER OF RECIPES (N=31)	Percentage
1	Appropriate	31	100
2	Not exactly	0	0
	TOTAL	**31**	**100%**

Source: Processed primary data, (2023)

Based on Table 6, it is known that of all antibiotic prescriptions prescribed to pediatric outpatients with acute respiratory infections (ARI) at the Fastabiq Sehat Pati Clinic from January to December 2021, 30 prescriptions (96.8%) were categorized as having an appropriate drug administration interval. This assessment refers to the standards listed in the *Drug Information Handbook* (DIH) and the 12th edition of the *British National Formulary* (BNF). Appropriate interval refers to the accuracy of scheduling drug administration, both in terms of frequency and the time between doses, to maintain optimal therapeutic drug concentrations in the blood. One example of

appropriate intervals can be seen in patient number 1 (appendix 10), who received amoxicillin three times daily. This is in accordance with the DIH guidelines, which recommend administration every 8 hours.

However, there was one case of inaccurate intervals, namely in patient number 25 (appendix 10), who was given cefadroxil three times daily. According to the DIH, cefadroxil should be given twice daily or every 12 hours. Administering medication at a frequency exceeding the standard does not necessarily increase the effectiveness of therapy. It can even increase the risk of side effects, decrease patient compliance, and unnecessarily burden the body's metabolic system.

These results are consistent with the findings of Benua et al. (2019), who recorded an 81% accuracy of the interval from 126 prescription data, where most drugs were administered at appropriate time intervals, namely every 8 hours (three times daily) or every 12 hours (twice daily). Inappropriate or inconsistent drug administration intervals can cause drug levels in the blood to fall below the therapeutic threshold, potentially leading to therapy failure or even microbial resistance, especially in the use of antibiotics for bacterial infections. Therefore, the accuracy of the interval in drug administration is an important aspect in the practice of rational medicine, especially in children, who are vulnerable to the risk of suboptimal therapy.

CONCLUSION

Based on the results of the study, it can be concluded that the characteristics of outpatient pediatric ARI patients who received antibiotics at the Fastabiq Sehat Pati Clinic during the period from January to December 2021 were dominated by female patients, with 20 patients (64.5%), with the most patients being under 5 years old, with 13 patients (42%). The most frequently prescribed type of antibiotic was amoxicillin in dry syrup form, with 15 prescriptions (48.39%) and tablets, with 10 prescriptions (32.26%). The level of rationality of antibiotic prescriptions showed varying results, with dosage accuracy of 54.8%, drug accuracy of 77.4%, indication accuracy of 100%, and medication administration interval accuracy of 96.8%.

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