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Evaluation of Antibiotic Use in Child Patients with Acute Respiratory Tract Infection (ARI)

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ABSTRACT

Background: Acute respiratory infections (ARI) are still a major cause of high morbidity and mortality, with more than 12 million cases per year worldwide. Indonesia is one of the countries with a high burden of ARI with 6 million cases. Antibiotic resistance in bacteria that causes ARI is also increasing, so it is important to evaluate the rationality of antibiotic use. Objective: To evaluate the use of antibiotics in pediatric patients with acute respiratory infections (ARI) using the Gyssens method at Medan Hospital. Methods: Descriptive research with Gyssens method. Results: The majority of patients were toddlers with an age range of 12-59 months (47.7%). Male (64.6%), and female (35.4%). The most common diagnosis was pneumonia with a percentage of 90.8%. Ceftriaxone injection (78.5%) was most commonly used. The Gyssens method showed that category 0 was 52.3%, IIA 24.6%, and IIIB 23.1%. Conclusion: The use of antibiotics in pediatric ARI patients at Medan Hospital is mostly rational.

Keywords: *Acute Respiratory Infection (ARI), Antibiotic use, Gyssens method.*

1. INTRODUCTION

Acute Respiratory Infection (ARI) is still the main cause of high morbidity and mortality due to infectious diseases worldwide. More than 12 million cases of ARI in children under five are hospitalized each year. Around 1.3 million children under five die each year from ARI worldwide, with ARI causing one third of under five deaths in low-income countries. The World Health Organization (WHO) estimates that ARI contributes around 6% of the global disease burden (Ilmaskal et al., 2023).

The incidence of ARI in toddlers is estimated to reach 0.29 cases per child per year in developing countries and 0.05 cases per child per year in developed countries. These data show that there are around 156 million new cases of ARI each year worldwide, with 96.7% occurring in developing countries. The countries with the highest cases of ARI are India (43 million), China (21 million), Pakistan (10 million), and Bangladesh, Indonesia, and Nigeria each have 6 million cases. Of all ARI cases in the community, around 7-13% of them are severe cases that require hospitalization (Ministry of Health, 2022).

North Sumatra Province has an ISPA prevalence of 6.8%. The prevalence of ISPA in North Sumatra Province in the age group <1 year reached 4.91%, the age group 1-4 years was 9.56%, and the age group 5-14 years was 6.61%, indicating that the proportion of toddlers suffering from ISPA was higher (Riskes., 2018).

There were 6668 cases of ISPA in toddlers in North Sumatra, with the highest cases in Deli Serdang Regency with 986 cases, followed by Medan City with 865 cases, and the lowest cases in Pakpak Bharat Regency with 29 cases (Rahmadhani, 2021).

The results of a national survey on antibiotic resistance conducted by the Centers for Disease Control and Prevention (CDC) also showed that some

The types of bacteria that cause ARI in children have experienced increased resistance to antibiotics that are often used in the treatment of ARI (Prevention., 2022).

To ensure the proper use of antibiotics, doctors need to establish their rationality. One method that can be used to assess the rationality of antibiotic use and observe the quality of its use is by using the Gyssens method (Agustina & Rahmawati, 2024). The Gyssen method, created by Gyssens in 2005, uses a 0–VI level category to evaluate

antibiotic use. The assessment includes appropriateness of indication, drug selection based on effectiveness, toxicity, spectrum, price, interval, dose, route, and time of administration (Kirana et al., 2023)

According to research conducted by Christi D. Mambo et al. (2023), referring to the literature review and selection of the Gyssens method, it was found that as much as 65% of antibiotic use in children with ARI was considered irrational, while 35% was considered rational.(Mambo et al., 2023).Research by Amalia and colleagues (2023), using the Gyssens Method, showed that 62.2% of antibiotic use was considered rational and 37.8% was considered irrational (Amalia et al., 2023) .

The problem of irrational antibiotic use also requires deeper attention. Medan Hospital is a hospital owned by the Province of North Sumatra with type B located at Deli Serdang Regency, North Sumatra Province. Based on literature searches, no data has been found on "Evaluation of Antibiotic Use in Pediatric Patients with Acute Respiratory Tract Infections (ARI) at Medan Hospital" so that researchers are interested in conducting this study.

2. METHOD

This study is an observational study or non-experimental study with a descriptively processed design using the Gyssens method and retrospective data collection. This study is to evaluate the quality of antibiotic use in pediatric ISPA patients at the Medan Hospital. This research will be conducted at the Medan Hospital Deli Serdang Regency, North Sumatra Province. The sample in this study was part of the population of pediatric ISPA patients as recorded in medical records.

Data collection in this study used secondary data, namely medical records obtained at the Medan Hospital. Secondary data processing in the form of medical records that have been collected will be processed with the following steps:

- Editingdata
  Check the completeness of the secondary data that has been collected.
- Enteringdata
  Process the prepared data into a master table using the Microsoft Excel application.
- Cleaningdata
  Data is rechecked to avoid errors when entering data.
- Savingdata
  Save data that has been processed.

3. RESULTS AND DISCUSSION

3.1. Research Result

The data collection for this study used medical record data from pediatric patients with Acute Respiratory Tract Infection (ARI) at the Medan Hospital for the period August-December 2023. This study was conducted on samples that met the inclusion criteria totaling 65 pediatric patients.

Characteristics of pediatric patients with Acute Respiratory Tract Infection at Medan Hospital are as follows.

Table 1. Sample Frequency Distribution of Age

Patient Age	Frequency	Percentage (%)
Infant (0-11 months)	8	12.3
Toddlers (12-59 months)	31	47.7
Children (60-144 months)	26	40
Total	65	100.0

Based on the Ministry of Health, the age category in this study is divided into three categories, namely infants (0-11 months), toddlers (12-59 months), children (60-144 months) (Ministry of Health, 2021). It is known that the largest number of patients is the toddler category (12-59 months) with 31 patients (47.7%), then the children category (60-144 months) with 26 patients (40%), and infants (0-11 months) with 8 patients (12.3%).

Table 2. Frequency Distribution of Samples by Gender

Gender	Frequency	Percentage (%)
Man	42	64.6
Woman	23	35.4
Total	65	100.0

The distribution of the largest gender category was male with 42 patients (64.6%), while female with 23 patients (35.4%).

Table 3. Frequency Distribution of Samples by Gender

Patient Diagnosis	Frequency	Percentage (%)
Pneumonia	59	90.8
Acute pharyngitis	2	3.1
Bronchitis	1	1.5
Upper ISPA	3	4.6
Total	65	100.0

The distribution of the largest diagnostic categories was pneumonia with 59 samples (90.8%), then upper respiratory tract infection with 3 patients (4.6%), acute pharyngitis with 2 patients (3.1%), and bronchitis with 1 patient (1.5%).

The profile of antibiotic use used in pediatric ISPA patients at the Medan Hospital, is as follows.

Table 4. Distribution of frequency of antibiotic use in pediatric patients with ARI

Types of Antibiotics	Frequency	Percentage (%)
Ceftriaxone Inj.	51	78.5
Cefotaxime Inj.	9	13.8
Gentamicin Injection	1	1.5
Meropenem Inj.	1	1.5
Inj. Cefotaxime + Inj. Gentamicin	1	1.5
Cefixime	1	1.5
Amoxicillin	1	1.5
Total	65	100.0

From Table 4, it is known that there are 7 types of antibiotics used in pediatric patients with acute respiratory infections (ARI) consisting of Cefriaxone Injection for 51 patients (78.5%), Cefotaxime Injection for 9 patients (13.8%), then there is Gentamicin Injection for 1 patient (1.5%), Meropenem Injection for 1 patient (1.5%), then a combination of Cefotaxime Injection + Gentamicin Injection for 1 patient (1.5%). There is also an oral antibiotic Cefixime for 1 patient (1.5%). and Amoxycline for 1 patient (1.5%).

Evaluation of the use of antibiotics used in pediatric ISPA patients at the Medan Hospital, as follows.

Table 5. Frequency distribution of antibiotic use evaluation in pediatric ISPA patients based on the Gyssens method

Gyssens Category	**Frequency**	**Percentage (%)**
Use of antibiotics too short	15	23.1
Incorrect use of antibiotics	16	24.6
Appropriate/rational use of antibiotics	34	52.3
Total	65	100.0

The data from the table above shows the results of the analysis of the quality of antibiotic use in pediatric ISPA patients hospitalized at RSU Haji Medan from August-December 2023 using the Gyssens method. Based on the evaluation of medical records from 65 patients, with a total of 65 recorded antibiotic regimens given.

From the analysis results, it was found that 34 antibiotics (52.3%) were in category 0, namely the antibiotic prescription was correct. As many as 16 antibiotics (24.6%) were included in category II A, namely the antibiotic prescription was not the right dose. Furthermore, 15 antibiotics (23.1%) were in category III B, namely the use of antibiotics was carried out for too short a time

3.2. Discussion

On Table 1 Distribution of characteristics of ISPA patients who use antibiotics based on age category, which is very common in the toddler category (12-59 months), which is31 patients or 47.7% of the total 65 patients. This is in line with Riskesdas data (2018) which shows that ISPA sufferers are often found in children aged 1-4 years (Riskes., 2018).

In addition, this research is also supported by research He et al. (2023), which states that children aged ≤5 years (50.76%) with ARI received the most antibiotics. Followed by children aged 6-15 years (45.33%) and finally 16-18 years (3.91%) (He et al., 2023). This condition is caused by the immune system in children which is not yet mature, so they are more susceptible to microbial infections and tend to experience more severe symptoms than adults (Kloc et al., 2020)

Based on the results of the study of patient characteristics based on gender, it was found that male patients were the ones with the most Acute Respiratory Tract Infections (ARI), namely42 patients (64.6%) compared to women, namely 23 patients (35.4%). Boys are more susceptible to infection because the immunological response in boys tends to be less reactive.

The results of this study are in line with research Maidi et al. (2024),The results were obtained from 80 respondents, namely 43 men (53.8%) and 37 women (47.4%) (Maidi et al., 2023). Another study conducted by Amalia et al. (2023) showed that out of 37 respondents, the dominant results were male patients suffering from ARI, namely 25 people (67.6%) compared to female patients, namely 12 people (32.4%) (Amalia et al., 2023). Also supported by the fact that the sex steroid hormone factor plays an important role in influencing the immune system. The dominant estrogen hormone in women plays a role in stimulating the immune system by increasing cellular and humoral immunity. Administration of 17 β-estradiol can stabilize or increase the secretion of TNF, IL-2, IL-4, IL-6, IL-10. While the dominant testosterone hormone in men has a role in inhibiting (IL-2, IL-4, IL-10) or tends to inhibit the secretion of stimulated cytokines (TNF, IFNγ) (Falagas et al., 2007).

The most frequently found ISPA diagnosis category in antibiotic use was Pneumonia, namely 59 patients (90.8%). This is in line with research Alharbi et al. (2024)stated that bronchopneumonia was the most common respiratory disease in children in 123 patients (43.4%), followed by acute bronchiolitis in 55 children (19.4%) and acute upper respiratory tract infection in 40 children (14.1%) (Alharbi et al., 2024). Given the fact that pneumonia is often caused by bacterial infections, which makes the use of antibiotics very relevant (Sattar et al., 2024).

Based on Table 4.4, the most commonly used antibiotic in pediatric patients with ISPA who are hospitalized is Ceftriaxone Injection, with a total of 51 patients (78.5%). This finding is in line with the research of Sari et al. (2023), which showed that Ceftriaxone (cephalosporin group), is the most frequently prescribed antibiotic, namely 25 cases (73.5%) of the total cases of 34 ISPA cases at RSI Sultan Agung Semarang (Sari, 2023). In addition, this is also in line with the Pediatric Respirology textbook by IDAI (2018), which states that the first-line antibiotics in pediatric patients with ARI are the beta-lactam group, consisting of the cephalosporin group (such as ceftriaxone, cefotaxime, cefixime, cefadroxil, etc.), then the carbapenem group (such as Meropenem), and penicillin (Rahajoe, N. N., Supriyatno & Setyanto, 2018).

Table 5 above shows the quality of antibiotic use from the results of analysis using the Gyssens method, then classified based on category VI-0, where the use of antibiotics is rational (category 0) and irrational (category I-VI).

Incomplete medical record data (Category VI)
In this study, all patient medical records had complete data, so they met the requirements and passed category VI.

No indication for antibiotic use (Category V)
In this study, cases of Acute Respiratory Infection (ARI) were identified based on the doctor's diagnosis recorded in the patient's medical record. The diagnosis was confirmed by laboratory test results and symptoms experienced by the patient. Based on the diagnosis and symptoms, the patient was then prescribed antibiotics according to clinical needs. Based on the evaluation results in this study, there were no patients who fell into category V.

There are other antibiotics that are more effective (Category IVA)
In this study, there were no patients in category IVa, indicating that the selection of antibiotics was in accordance with the recommended effectiveness.

There are other antibiotics that are less toxic (Category IVB)
The results of this study did not show any indication of safer antibiotic use, and there were no patients included in category IVb.

There are other cheaper antibiotics (Category IVC)
In this study, all patients recorded in the medical records received generic antibiotic therapy in accordance with hospital guidelines, thus meeting the criteria for category IVc.

There are other antibiotics that have a narrower spectrum (IVD Category)
The selection of antibiotics with a narrower spectrum should be based on the results of microbiological examinations or based on microbial patterns and sensitivity patterns. In this study, the selection of broad-spectrum antibiotics was appropriate because there was no bacterial culture test so that the patient's medical record passed category IVd.

Excessive use of antibiotics (Category IIIA)
Excessive antibiotic use is the use of antibiotics for a duration longer than the duration specified by the guidelines. The optimal duration of antibiotic therapy depends on the clinical syndrome, the causative microorganism, and the patient's response to therapy (Pouwels et al., 2019). The evaluation results showed that the antibiotics used in patients passed category IIIa.

Use of antibiotics too short (Category IIIB)
The duration of antibiotic administration is too short if the antibiotic is given less than the time specified in the guidelines. This assessment can generally be done on the "third day," which is within 24 to 72 hours after treatment

begins. This is the stage where the best opportunity is available to assess the effectiveness of empirical therapy (Pasquau-Liaño, 2022). However, this study has limitations, namely that it does not include an evaluation of the drugs given to patients when they go home. The results of this study found category IIIb as many as 15 antibiotics (23.1%), namely Ceftriaxone antibiotics and a combination of Cefotaxime and Gentamicin. With a duration range of 1-2 days of antibiotic use. This finding is in line with Ramlah's research (2021), which revealed that administration with a duration that is too short (category IIIB) occurred at 12.50% (Ramlah et al., 2021).

Inappropriate use of antibiotics (Category IIA)

The use of antibiotics is categorized as inappropriate dosage if the dose given is not in accordance with the recommended range as described in the relevant guidelines, either too high (overdose) or too low (underdose). Antibiotic overdose can increase the risk of toxic effects for patients, while antibiotic underdose can reduce the effectiveness of antibiotics because they do not reach the minimum levels needed to provide therapeutic effects. (Tabun, 2020). In this study, 16 antibiotics (24.6%) were included in category IIa, including ceftriaxone, cefotaxime, and gentamicin. This is in line with Yasir's research (2021), 19.6% of antibiotic users did not use the correct dosage because the dose given exceeded the correct dose (overdose) (Yasir et al., 2021)

Inappropriate use of antibiotics at intervals (Category II B)

Inappropriate antibiotic use interval if the antibiotic administration interval time is less than or exceeds the recommended interval. In this study, there were no patients who fell into category IIb.

Inappropriate use of antibiotics by route (Category II C)

Incorrect route of antibiotic administration occurs when antibiotics are not given according to recommendations. In this study, there were no patients who fell into category IIc.

Untimely use of antibiotics (Category I)

From the evaluation results, no antibiotic prescriptions were found that fell into category I.

Rational/appropriate use of antibiotics (Category 0)

Based on Table 4.5, it is known that the use of antibiotics in pediatric patients with ARI is mostly included in category 0, which is 34 antibiotics (52.3%). This shows that most of the antibiotic prescriptions in these patients are in accordance with the recommended standards. The results of this study are in line with and higher than the study by La Tho et al. (2020) that the use of antibiotics that is already rational (Category 0) at the South Tangerang City Hospital was 63 patients (49.2%) out of a total of 130 pediatric patients (Tho & Purnama, 2020). In a study conducted by Waty et al. (2023), it showed 76.4% rationality of the appropriateness of antibiotic use in ISPA patients in outpatient pharmacy installations at the Surakarta Health Center (Waty et al., 2023).

4. CONCLUSION

Based on the results of research and discussion on the evaluation of antibiotic use in pediatric patients with acute respiratory infections (ARI) at the Medan Hospital with a research sample of 65 samples. Patient characteristics show that the largest age group is toddlers (12-59 months) with 31 patients (47.7%), with the majority of male patients, namely 42 samples (64.6%), and the most frequently found patient diagnosis is pneumonia with 59 cases (90.8%). The most frequently used type of antibiotic is Cefriaxone (78.5%). Evaluation using the Gyssens method showed that 34 antibiotics (52.3%) were rational (category 0). The majority of antibiotic use is rational.

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