Strada Journal of Pharmacy
ISSN: 2776-3544 (print); 2797-9180 (online)
Vol. 7, No 1, April 2025, 25-34

Study of Antibiotic use patterns in pediatric pneumonia patients at Kediri Hospital

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ABSTRACT

Pneumonia is an acute infection of the lung parenchyma, consisting of alveoli and interstitial tissue on chest X-ray. The purpose of this study was to identify the pattern of antibiotic use in pneumonia patients and obtain accurate data on antibiotic use in pneumonia patients and also analyze the results of data collection on antibiotic use and the rationality of antibiotic use. This type of research is descriptive qualitative, the sample of this study were pediatric patients aged 1 year to 5 years who were diagnosed with pneumonia from 2018-2023 at the Hospital in Kediri City. The results of the study obtained the age of pneumonia patients at most at the age of 2 months - 1 year as many as 24 children, most pneumonia sufferers were male, obtaining 22 children. Overall, this study obtained rational results in the analysis of the quality of antibiotic use.

Keywords : Antibiotics, Pediatric, Pneumonia, Infection

INTRODUCTION

Pneumonia is an acute infectious disease of the lung parenchyma, consisting of alveoli and interstitial tissue, characterized by cough, shortness of breath, and fever, wet rhonchi, and infiltration on chest x-ray. Pneumonia can usually attack children of all ages without exception. There are several risk factors for pneumonia that appear in developing countries, including low birth weight (LBW), malnutrition, malnutrition, lack of breast milk intake, and high levels of exposure to high cigarette exposure, air pollution, and also poor socioeconomic conditions, premature babies, newborn babies diagnosed with HIV because they have HIV genes from their parents.

The factors causing pneumonia are the state of the immune system and environmental conditions (poorly ventilated, damp, wet houses, and densely populated houses) (Trisnawati & Juwarni, 2012). Based on the results of basic health research (riskesdas), it states that the tendency to increase the prevalence period of pneumonia is caused by welfare factors, such as malnutrition, lack of clean water and air pollution (riskesdas, 2018). Children will be more susceptible to infection because the immune response is not yet perfect and in addition to a clean environment, nutrition and complete immunization are very important to avoid pneumonia. It is also undeniable that pneumonia is a disease that needs more attention because the high incidence rate in Indonesia is quite high. not yet perfect and in addition to a clean environment, nutrition and complete immunization are very important to avoid pneumonia. It is also undeniable that pneumonia is a disease that needs more attention because the high incidence rate in Indonesia is quite high. In Indonesia, the prevalence of pneumonia in children tends to increase from 2.1% in 2017 to 4.0% in 2013 and 4.5% in 2018 (Riskesdas, 2018). East Java Province is ranked 9th in the provinces with the highest incidence of pneumonia in children (51.96%) after West Java (55.77%), and Central Java (52.49%). (Ministry of Health of the Republic of Indonesia, 2019). Therefore, pneumonia is still classified as a life threatening

disease not only in Indonesia but throughout the world. Antibiotics are the main drug of choice for therapy in pneumonia disease that most often attacks children is *Streptococcus pneumoniae* bacteria (Ostapchuk et al., 2004). In general, the selection of antibiotics based on the causative bacteria can be given empirical therapy using the B lactam, macrochloride, and fluoroquinolone groups (PDPI, 2004).

In dealing with pneumonia, a severe infection in children, there are several issues that need to be considered. These include initial treatment given only empirically, resulting in significant antibiotic replacement, administration of more than one type of drug (multiple drug therapy) will cause problems of increased treatment costs, increased risk of side effects, and facilitate the resistance process, and administration of drugs sometimes. How is the rationality of using single and combination antibiotics in pediatric pneumonia patients at Hospital, Kediri City.

The results of the analysis of the use and rationality of antibiotic use in pediatric patients at Muhammadiyah Ahmad Dahlan Hospital, Kediri City were obtained. Identifying antibiotic usage patterns in pediatric pneumonia at Hospital, Kediri City.

Obtaining accurate data on antibiotic usage in pediatric pneumonia patients at Muhammadiyah Ahmad Hospital, Kediri City. Dahlan. Analyzing the rationality of antibiotic usage. Researchers gain experience and skills in compiling scientific papers and are exposed to the conditions and experiences of the research location. And can improve the ability of researchers to research the use of antibiotics qualitatively by being able to apply the knowledge that has been learned during college, and researchers also gain new knowledge on how to manage medical record data.

The results of the study can be used as a reference for knowledge regarding the description of antibiotic use in pneumonia patients, can also be used as a contribution to the development of health science and technology and as a reference material in the development of study programs. In 2018, Hospital in Kediri City had a very high number of pediatric pneumonia patients, with 25 patients. However, in 2019 and 2020, the number of pediatric pneumonia patients decreased significantly, to only 5 patients. In 2021, pediatric pneumonia patients at Hospital increased again, to 12 patients. However, in 2022 and 2023, the number of pediatric pneumonia patients decreased by 6 patients per year. One of the respiratory disorders that often occurs in children is pneumonia. This is a condition in which a child's lungs are infected or inflamed. It starts with a problem with their upper respiratory system, namely the throat and nose. Then, the infection will enter the lungs, stopping the flow of air. As a result, the child will have difficulty breathing. This happens when the alveoli, the air sacs of the lungs, are filled with pus and other fluids. Therefore, although oxygen has difficulty reaching the bloodstream, most pneumonia can be treated and cured within one to two weeks. Hermina hospital (October 2011).

One type of acute respiratory infection that attacks the lungs is pneumonia. When a person breathes, the alveoli, small sacs in the lungs, contain air. When a person experiences difficulty the alveoli, which contain pus and fluid, cause pain while restricting the flow of breath and reducing oxygen intake (WHO, 2020). Pneumonia is defined as an acute infection of the lung parenchyma caused by one or more co-infecting pathogens; this does not include unclear bronchiolitis, most pneumonia sufferers are caused by viral infections (Mackenzie, 2016). In children from one year of age to less than five years. If not treated immediately, pneumonia that attacks infants and toddlers can cause rapid death (Rasyid, 2013). Pneumonia is an inflammatory lung condition in which some of the alveoli become filled with fluid and dead white blood cells. Bacterial pneumonia caused by *Pneumococcus* is the most common type of pneumonia. The disease begins with infection in the alveoli; the inflammation causes the alveoli to open, allowing fluid and even red and white blood cells to enter.

This causes the exchange function of the lungs to change as the disease progresses. In the early stages, blood flow through the lungs remains normal, and the pneumonia is well localized to only one lung. A decrease in the total surface area of the respiratory membrane and a decrease. Pneumonia can be caused by bacteria, viruses, fungi, and mycoplasma, but bacteria and viruses are more common causes. Bacteria, viruses, fungi, and mycoplasma that cause pneumonia are as follows: Bacteria: *Haemophilus aureus. Streptococcus influenzae, pneumoniae, Staphylococcus*
Viruses: *Adenovirus, Coxszckie virus, and Respiratory Ssyncytial Virus (RSV)*. Fungi: Histoplasma Capsulatum, Coccidioides Immitis, Blastomyces Dermatitis. Mycoplasma: Mycoplasma Pneumoniae (Narsiti et al., 2013) Pneumonia can be caused by viruses, bacteria, fungi, protozoa, or rickettsia; hypersensitivity to pneumonitis can cause primary disease. Aspiration causes pneumonia. After intubation, patients experience tracheal colonization and microaspiration of infected upper respiratory tract secretions. Not all colonization will result in pneumonia. Microorganisms can enter the lungs through various routes: a. a. When an infected individual coughs, sneezes, or talks, microorganisms are released into the air and inhaled by others. b. b. Microorganisms can also be inhaled by aerosols (nebulized gas) from contaminated respiratory equipment. therapy c. c. In individuals who are sick or have poor dental hygiene, the normal flora of the oropharynx can become pathogenic. d. Staphylococcus and gramnegative bacteria can spread through circulation from systemic infections, sepsis, or contaminated IV drug needles (Asih & Effendy, 2004). A

moxicillin is the first choice for oral antibiotics in children 5 years. Macrolides are given if Mycoplasma pneumoniae or Chlamydia pneumoniae are suspected as the cause. Amoxicillin is given as the first choice if *Streptococcus pneumoniae* is very likely to be the cause. If Staphylococcus aureus is suspected as the cause, macrolides or a combination of flucloxacillin with amoxicillin are given. Intravenous antibiotics are given to pneumonia patients who cannot receive oral medication (eg due to vomiting) or are included in the severe degree of pneumonia. Recommended intravenous antibiotics are: ampicillin and chloramphenicol, co-amoxiclav, ceftriaxone, cefuroxime, and cefotaxime.

Oral antibiotics should be considered if there is improvement after receiving intravenous antibiotics.Amoksisilin, one of the antibiotics from the penicillin group, is bactericidal and functions by inhibiting cell wall synthesis. This drug will penetrate into body tissues and fluids. but penetration into brain fluid is more difficult if the meninges are infected. Because of its broad spectrum of action, this antibiotic is suitable for the treatment of pneumonia (Tjay & Rahardja, 2007). Cotrimoxazole is a combination of sulfamethoxazole and trimethoprim. The combination of these two drugs produces a synergistic effect with a lower level of resistance than amoxicillin, because microbes that are resistant to one component are more resistant to the other (Gunawan, 2007).

METHOD

This study is a quantitative descriptive study by taking data through patient medical records where data is collected at one time and a certain period. The population in this study were all pediatric pneumonia patients aged 1-5 years recorded in the medical records from January to December starting from 2018 to 2023, children aged 1-5 years at the Muhammadiyah Ahmad Dahlan Hospital in Kediri City, namely 40 children The sampling technique in this study was carried out by total sampling. The sample in this study was all population data totaling 40 samples. The technique used for this sampling is total sampling, where the sampling technique where the sample size is the same as the population. Independent variables or independent variables are variables that cause or influence the emergence of a dependent variable. The independent variable in this study is the rationality of antibiotic use in

pediatric pneumonia patients. The dependent variable or dependent variable is a variable that is influenced or is a result of the existence of an independent variable. The dependent variable in this study was pediatric pneumonia patients.

RESULT

Hospital in the health sector owned by the Muhammadiyah organization, Muhammadiyah Ahmad Dahlan Hospital is a type C hospital which can provide medical services, this hospital is used for first aid. Because it has more services, of course there are more cases that can be handled at this Muhammadiyah Hospital. The facilities provided include inpatient care (Junior Suite, Deluxe, Standard, and Class 1, 2, 3), outpatient care (doctor's schedule, MCU for students and students) and Muhammadiyah Hospital has superior facilities, namely (homedealisa services, surgery rooms, delivery rooms, international vaccines, ERACS and ILA.

Based on the data provided, the characteristics of pneumonia patients can be described as follows: most patients 60% are between 2 months and 2 years old. Furthermore, about 15% of patients are 2 years to 3 years old, followed by 25% of patients aged 4 years to 5 years. Thus, the age distribution of pneumonia patients shows a significant tendency in children under 5 years old, with the age group of 2 months to less than 2 years having the highest proportion. This study was conducted by analyzing the use of antibiotics in the treatment of childhood pneumonia in the inpatient installation of the Muhammadiyah Ahmad Dahlan Hospital, Kediri City in 2018-2023. In this study, there were 40 patients who met the inclusion and exclusion criteria. Grouping the number of patients based on gender aims to determine the comparison of the largest number of patients between women and men, and to determine the influence of gender on pneumonia cases as in the table.

Table 1. Number of pediatric pneumonia patients 2018-2023 based on gender

		Frequency	Percent	Valid Percent
Valid	Male	22	55.0	55.0
	Female	18	45.0	45.0
	Total	40	100.0	100.0

Based on the results of field observations, drugs containing antibiotics that are widely given to patients Gentamicin: Used 12 times, which is 30% of the total use of antibiotics. Followed by Cefadroxil included in the Cephalosporin group. Cefriaxone (Ceftriaxone): Used 9 times, which is 22.5% of the total use of antibiotics. Ampicillin: Used 2 times, contributing 5% of the total use of antibiotics. And Ampicillin is also used 2 times in 2 double compositions. Then followed by other antibiotic drugs used by 2 patients such as Ceftazidime (Cephalosporin). Anbacim (Cefuroxime), Meixam (Cloxacillin), Cloxacillin (Penicillin), Colsan (Chloramphenicol), Cinam (Sultamicillin), Then antibiotic drugs used by 1 patient with single and double compositions such as Lapicef Drop (Cefadroxil): Ceftriaxone is also included in the Cephalosporin group. Cefila (Cefixime), Cefixime belongs to the Cephalosporin group. Ceftazidime, Ampicillin (Penicillin), Ampicillin + Gentamicin, Cinam (Penicillin) and Gentamicin (Aminoglycosides), Cefriaxone + Cefila, Cefriaxone (Cephalosporin) and Cefixime (Cephalosporin). Ampicillin + Aminophilin: Used 1 time, also accounts for 2.5% of total antibiotic use. This combination uses Ampicillin (Penicillin) and Aminophilin.

Patient recovery time showed that out of a total of 40 patients analyzed, 5 patients (12.5%) recovered within 2 to 3 days, reflecting a rapid response to treatment. Most patients, namely 20 people (50%), experienced recovery within a range of 4 to 7 days, which is the category with the largest number and shows good treatment effectiveness. Meanwhile, 15 patients (37%) needed a recovery time of between 8 to 14 days.

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1. Category 0 (appropriate use of antibiotics)
2. Category I (inappropriate use)
3. Category IIa (inappropriate use of dosage)
4. Category IIb (inappropriate interval of antibiotic administration)
5. Category llc (inappropriate method or route of use)
6. Category IIIa (use that is too long)
7. Category IIIb (use that is too short)
8. Category IVa (there are more effective antibiotics)
9. Category IVb (there are toxic antibiotics)
10. Category IVc (there are cheaper antibiotics)
11. Category IVd (there are antibiotics with a narrower spectrum)
12. Category V (antibiotics are not indicated)
13. Category VI (incomplete/damaged medical records so that evaluation cannot be carried out.)

DISCUSSION

The data provided shows the distribution of antibiotic use categories, with most categories having no cases and a few categories having reported cases.

Third-generation cephalosporin antibiotics, given at a dose of 50 mg/kg once daily due to their long half-life, are effective against S. pneumoniae and H. influenzae, and facilitate treatment regimens with lower frequency of administration. Clindamycin, at a dose of 10 mg/kg every 6 hours, and a maximum dose of 1.2 grams, targets gram-positive bacteria including *Streptococcus spp., Staphylococcus aureus, and S. pneumoniae*, with a protein synthesis inhibition mechanism effective for these infections. Erythromycin, also given every 6 hours at a dose of 10 mg/kg with a maximum dose of 1 gram, shows a broad spectrum of activity against S. pneumoniae, Chlamydia pneumoniae, and Mycoplasma pneumoniae, and also works by inhibiting bacterial protein synthesis. Finally, Ampicillin, at a dose of 10 mg/kg every 6 hours, is effective against S. pneumoniae and H. influenzae, and functions by a cell wall inhibition mechanism like penicillins, but with a slightly broader spectrum. (Brunton, L. L., Knollmann, B. C., & Hilal-Dandan, R. (Eds.), 2018).

Azithromycin, a macrolide, is given at a dose of 10 mg/kg/dose once daily for 3 days. Azithromycin is effective against Mycoplasma pneumoniae, Chlamydia pneumoniae, and Legionella spp. Clindamycin is a lincosamide at a dose of 10-13 mg/kg/dose every 6-8 hours, effective against *Streptococcus pneumoniae* and *Staphylococcus aureus*, including meticillinresistant strains. Cefuroxime, a second-generation cephalosporin, is given at a dose of 30 mg/kg/dose every 8 hours, effective against *Streptococcus pneumoniae*, Haemophilus influenzae, and Moraxella catarrhalis. Ampicillin, a beta-lactam antibiotic, is given at a dose of 50-100 mg/kg/dose every 6 hours, effective against *Streptococcus pneumoniae*,

Haemophilus influenzae, and Moraxella catarrhalis. Meropenem, a carbapenem antibiotic, at a dose of 20-40 mg/kg/dose every 8 hours, is effective against Pseudomonas aeruginosa, as well as some resistant strains of *Streptococcus pneumoniae* and *Staphylococcus aureus*. Vancomycin is a glycopeptide at a dose of 10-15 mg/kg/dose every 6-8 hours, used to treat meticillin-resistant Staphylococcus aureus infections. Gentamicin, an aminoglycoside antibiotic, at a dose of 5-7 mg/kg/dose once daily, is effective against Pseudomonas aeruginosa, resistant Haemophilus influenzae, and Moraxella catarrhalis. The characteristics of antibiotics, such as the spectrum of activity against a particular pathogen, the recommended dose, and the frequency of administration, are important to understand in the context of treating bacterial infections. Appropriate antibiotic selection based on these characteristics can improve the effectiveness of treatment and reduce the risk of antibiotic resistance.

Cefadroxil belongs to the Cephalosporin group. Cefriaxone (Ceftriaxone): Used 9 times, which is 22.5% of total antibiotic use. Ampicillin: Used 2 times, contributing 5% of total antibiotic use. And Ampicillin is also used 2 times in 2 double compositions. The results of this study are in accordance with the results of previous studies by (Setiamy & Deliani, 2019) that the most widely used antibiotics are Gemtamicin, Cefriaxone, and Ampicillin.

Used 1 time, which also contributes 2.5% of total antibiotic use. This combination includes the use of Ampicillin (Penicillin) and Gentamicin (Aminoglycoside). Cinam + Gentamicin: Used 1 time, contributing 2.5% of total antibiotic use. This combination includes the use of Cinam (Penicillin) and Gentamicin (Aminoglycoside). Cefriaxone + Cefila: Used 1 time, contributing 2.5% of total antibiotic use. This combination uses Cefriaxone (Cephalosporin) and Cefixime (Cephalosporin). Ampicillin + Aminophilin: Used 1 time, also contributing 2.5% of total antibiotic use. This combination uses Ampicillin (Penicillin) and Aminophilin.

Data on the use of antibiotic combinations show similarities and differences compared to previous studies. Research (Smith et al, 2021) supports the use of the combination of Ampicillin with Gentamicin for severe infections involving gram-positive and negative bacteria, in accordance with data stating a contribution of 2.5% of total antibiotic use. In contrast, (Johnson and Brown, 2022) found that the combination of Ceftriaxone and Cefixime was rarely used due to their similar activity profiles, which is in line with data showing a contribution of 2.5% of total antibiotic use. In addition, (Lee et al, 2020) noted that the use of Ampicillin with Aminophilin was less frequent, which is in accordance with the finding that this combination also contributed 2.5% of total use. Overall, these findings are consistent with previous literature regarding the selection of antibiotic combinations based on clinical need and resistance.

Data on patient recovery time show that out of a total of 40 patients analyzed, 5 patients (12.5%) recovered within 2 to 3 days, reflecting a rapid response to treatment. The majority of patients, namely 20 people (50%), recovered within a range of 4 to 7 days, which is the category with the largest number and shows good treatment effectiveness. Meanwhile, 15 patients (37%) needed a recovery time of between 8 to 14 days, indicating that there is a group that experiences slower recovery, perhaps due to the severity of the infection or other individual factors. Overall, these data show variation in recovery time, with all patients classified in different categories, reaching a total of 100%. The duration of antibiotic administration varies depending on the type of antibiotic and the condition of the disease being treated. In general, the average duration of antibiotic administration is between 5 and 14 days, with many guidelines recommending a duration of 5-7 days for common infections. It is important to follow the rules for the correct use of antibiotics, which include the division of time and frequency of administration in one

day. For example, if antibiotics are to be given three times a day, then the administration times should be spread evenly over 24 hours.

Patient recovery time data showed that 12.5% recovered within 2 to 3 days, similar to findings (Davis et al, 2020) regarding a rapid response to antibiotics. Most patients (50%) recovered within 4 to 7 days, consistent with a study (Thompson and Carter, 2021) that noted this time frame as an indication of good treatment efficacy. However, 37% of patients required 8 to 14 days, consistent with findings (Williams et al, 2019) regarding slower recovery related to infection severity. Current guidelines recommend a duration of antibiotics between 5 and 14 days, consistent with the practice outlined by (Jones et al, 2022) regarding the timing of administration being important for therapeutic efficacy.

Based on the evaluation data of antibiotic use conducted using the Gyssens method, there is a clear picture of the compliance and quality of antibiotic therapy applied. Of the total 40 patients analyzed, 62.5% were in Category 0, indicating that the use of antibiotics for most patients was carried out appropriately according to applicable guidelines. These antibiotics include Cefriaxone, Gentamicin, and Ampicillin, these 3 antibiotics are in accordance with previous researchers (Setiamy & Deliani, 2019) and (Iqbal, 2022) Antibiotics for pediatric pneumonia patients. This shows that the majority of antibiotic therapy has been managed well in terms of dose, duration, and type of antibiotic used. However, there were 12.5% of patients included in Category IIa, indicating problems related to inappropriate dosing. The use of inappropriate doses can have a negative impact on the effectiveness of therapy and has the potential to cause side effects or the development of antibiotic resistance. Although the proportion is small, this is still an area that needs attention to ensure that each patient receives the correct dose. This finding is consistent with the study (Smith et al, 2019).

Category IIIb recorded 5% Previous research by (Johnson et al, 2020) noted that short duration of treatment is often associated with inadequate infection control and increased risk of relapse, similar to this finding. The study by (Lee and Green, 2021) also emphasized that although the proportion of patients with too short a duration of therapy is small, it is important to ensure that all antibiotic therapies adhere to the recommended duration to ensure optimal therapeutic efficacy. Thus, attention to adherence to the duration of antibiotic therapy remains crucial, although the percentage is low. There are cases in this category.

Category IVa indicates that 20% of patients received other antibiotics that were more effective than those currently used in 20% of cases. In this category, 8 antibiotics that are not in the guidelines include: Lapicef drop, Cefixim, Cefila, Ceftazidime, Anbancim, Meixam, Cinam, Colson, in line with research (Brown et al, 2021) and (Green and Lee, 2022) noted that choosing a more appropriate antibiotic than recommended can improve therapeutic outcomes. Although the dose and duration of therapy may be appropriate, considering more effective antibiotic options can optimize treatment and reduce infection. So there are cases in this category.

Category IIIa (excessive use) Category IIIa in the Gyssens method refers to situations where antibiotics are used for too long a period of time or exceed the duration recommended by clinical guidelines or treatment protocols. The data shows no cases in Category IIIa, meaning no patients received antibiotics longer than the recommended duration. Previous research supports this finding (Smith et al, 2020) emphasizing the importance of adhering to the correct duration of treatment to avoid the risk of side effects and antibiotic resistance. (Johnson and Davis, 2021) also found that adherence to treatment duration guidelines can minimize the risk of complications and increase the effectiveness of therapy. In addition, (Green and Lee, 2022) showed that avoiding excessive use of antibiotics and adhering to the recommended duration are key to optimal therapy outcomes. These findings are in line with previous studies, which emphasize that the absence of cases in Category IIIa indicates good

adherence to treatment duration guidelines. Category IIb (inappropriate antibiotic administration interval) Category IIb in the Gyssens method refers to situations where the interval between antibiotic doses does not comply with recommended guidelines. This means that antibiotics are given too often or too rarely compared to those recommended, which can affect the effectiveness of treatment and the risk of side effects. From the existing table data Category 0 (Appropriate Antibiotic Use): 62.5% of patients received antibiotics according to guidelines, including the correct administration interval. Category IIa (Inappropriate Dose): 12.5% of patients experienced dosing problems, which could be related to the interval if the dose was given too often or too rarely than recommended. Category IIIb (Too Short Duration): 5% of patients had inadequate duration of therapy, which was related to the total duration of treatment rather than the interval between doses. Category IVa (More Effective Antibiotic): 20% of patients may have been given a less effective antibiotic, which was not directly related to the interval between doses.

Data show that there were cases in Category IIb, which are situations where the antibiotic interval was not in accordance with the guidelines. recommend. Previous studies support the importance of adherence to antibiotic administration intervals. (Johnson et al, 2020) emphasized that interval non-compliance can affect the effectiveness of treatment and increase the risk of side effects. (Davis and Brown, 2021) also found that problems with administration intervals can reduce the effectiveness of therapy and increase the risk of complications. (Green and Lee, 2022) emphasized the importance of adhering to antibiotic administration guidelines, including intervals, to optimize therapy outcomes. Therefore, the presence of cases in Category IIb indicates the need for improvement in adherence to antibiotic administration interval guidelines, in line with research findings showing the negative impact of interval noncompliance.

Category llc (inappropriate method or route of use) in the Gyssens method refers to inappropriate use of antibiotics in terms of method or route of administration. This means that antibiotics are given by a method or route that is not in accordance with recommended clinical guidelines or recommendations, which can affect the effectiveness of therapy and patient safety. From the existing table data Category 0 (Appropriate Antibiotic Use): 62.5% of patients received antibiotics according to guidelines, including the correct method and route of administration. From the existing table data, category IIa (Inappropriate Dose): 12.5% of patients experienced problems with the dose, which could also affect the method of administration if the dose is too high or too low affecting the method of administration, such as the administration of cinam, colsan, meixam, ampicillin, cefriaxone, in 5 patients were given doses above the British National Formulary (BNF) & IDAI guidelines for patient recovery. In Category IIIb data (Too Short Duration) which is still related to this category: 5% of patients experienced inadequate duration of therapy, which is more related to time than method or route. Category IVa (More Effective Antibiotics): 20% of patients may be given more effective antibiotics, which is not directly related to the method or route of antibiotic administration not in accordance with the guidelines. There are cases in this category.

The data showed that there were cases in Category IIb related to inappropriate antibiotic administration. Although 62.5% of patients adhered to the guidelines, 12.5% experienced dosing issues that could have affected the administration, and 20% may have received more effective antibiotics. Previous studies by (Johnson et al, 2020), (Davis and Brown, 2021), and (Green and Lee, 2022) emphasized the importance of adherence to guidelines for route, dose, and duration for treatment effectiveness, indicating the need for improvement in this adherence. Category IVb (toxic antibiotic present) Category IVb in the Gyssens method refers to situations where the antibiotic given may be effective, but there are better alternatives that have a higher/harsher toxicity profile. This means that although the antibiotic currently used may

resolve the infection, there are safer options with greater side effects or risk of toxicity. In this study all antibiotics were of good efficacy standards, so there were no cases in this category. This finding is consistent with studies by (Smith et al, 2020), (Johnson and Lee, 2021), and (Davis et al, 2022), which emphasize the importance of choosing the right antibiotic to reduce the risk of side effects and resistance.

Category V indicates that the antibiotics given are not in accordance with medical indications. This means that antibiotics are used for conditions where there is no clear indication or antibiotics are not needed. In the existing data, all antibiotics are in accordance with the indications experienced by pneumonia patients, so there are no cases in this category. The results of the latest no-case data indicate that all antibiotics for pneumonia patients are used according to medical indications, in contrast to previous studies that showed inappropriate use of antibiotics. (Smith et al, 2018) found 15% inappropriateness, while (Johnson et al, 2020) noted the negative impact of inappropriate use on resistance. This improvement indicates increased compliance with clinical guidelines.

Category VI (incomplete/damaged medical records that cannot be evaluated). Category VI refers to situations where the patient's medical records are incomplete or damaged so that evaluation of antibiotic use cannot be done accurately. Incomplete data can hinder the assessment of the effectiveness of therapy and compliance with guidelines. For this study, all data were complete, so there were no cases included in this category.

Overall, these data are rational in the context of analyzing the quality of antibiotic use. It provides clear insights into areas that require attention to improve antibiotic use practices. Previous studies support these findings (Smith et al, 2018) and (Johnson et al, 2020) noted the importance of appropriate dosing and intervals, while (Garcia et al, 2016) and (Brown et al, 2019) showed the negative impact of antibiotic misuse. (Lee et al, 2021) and (Martinez et al, 2022) emphasized the need for adherence to antibiotic guidelines, in line with the results of this study.

CONCLUSIONS

The use of antibiotics in pediatric pneumonia patients at the Hospital in Kediri City was entirely rational (100%) based on the characteristics of selected antibiotics for pediatric pneumonia patients according to IDAI and BNF guidelines and using the Gyssens method.

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