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Identification of Drug Related Problems (DRPs) Use of Antibiotics in Pediatric Pneumonia Patients at General Hospital Bengkulu City

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ABSTRACT

Pneumonia in pediatrics has a high mortality rate. Primary antibiotic therapy can increase antibiotic use and cause Drug Related Problems (DRPs). This study examines the treatment profile and identifies DRPs of antibiotic use in pediatric pneumonia patients at General Hospital, Bengkulu City. This study uses a cross-sectional approach method where data is collected retrospectively through patient medical records. The population includes all pediatric patients with the main disease community-acquired-pneumonia who were treated at the General Hospital, Bengkulu City during the July-December 2022 period. The sampling technique in this study was using purposive sampling. Data was analyzed univariately, and DRPs were identified using the Pharmaceutical Care Network Europe Foundation (PCNE) algorithm version 9.1 and analyzed descriptively. The treatment profile included ampicillin inj + gentamicin inj (54.7%), sultamicillin inj (15.8%), sultamicillin inj + gentamicin inj (8.4%), ampicillin inj (8.4%), gentamicin inj (7.4%), ceftriaxone inj (3.2%), and sultamicillin inj + gentamicin inj + ceftriaxone inj (2.1%). There were 367 cases in 95 patients. Cases of DRPs included overdose (27.8%), the duration of treatment is too short (22.9%), infrequent dose regimen (18.8%), adverse drug incidence (16.9%), underdose (10.1%), drugs not following the guidelines (1.9%), the duration of treatment is too long (1.1%), and therapeutic group duplication (0.5%). The study concluded that the most common treatment was ampicillin inj + gentamicin inj (54.7), with the most frequent DRPs being overdose (27.8%), the duration of treatment is too short (22.9%), infrequent dose regimen (18.8%), adverse drug incidence (16.9%), and underdose (10.1%).

INTRODUCTION

Pneumonia is an acute respiratory infection that causes 740,180 deaths in children under 5 years of age each year worldwide. Pneumonia mainly attacks children with low immunity. This disease causes the alveoli to fill with pus and fluid, inhibiting oxygen intake (WHO, 2022). In 2018, there were 505,331 cases of pneumonia in toddlers in Indonesia. These cases decreased in 2019 and continued to decline until in 2021 it reached its lowest figure of 278,261 cases. However, according to the 2022 Indonesian Health Profile, cases of pneumonia in toddlers increased drastically with a total of 386,724 cases and 459 toddlers dying (Kemenkes RI, 2022).

Based on data from the Indonesian Health Profile in 2022, Bengkulu Province is one of the provinces with the highest mortality rate of toddlers with pneumonia in Indonesia. When compared to the provinces around Bengkulu, the infant mortality rate for pneumonia in Bengkulu Province is among the highest, at 43 deaths out of 459 cases (Kemenkes RI, 2022). The high infant mortality rate for pneumonia in

Bengkulu Province can be caused by the low immunity of the toddler's body. This can be caused by incomplete immunization status, not receiving exclusive breastfeeding, and being underweight (Hartini & Ismiati, 2017; Sari et al., 2016). In addition, inaccurate drug dosage in the management of pediatric patients with pneumonia, which generally occurs frequently, can increase mortality rates (Birarra et al., 2017).

The main method of management of pneumonia is the empirical use of antibiotic therapy (Suci, 2020). Based on this, pneumonia is one of the diseases that is specific to the use of antibiotics. Mistakes in the use of antibiotics can cause fatal side effects, so it is necessary to identify Drug Related Problems (DRPs) (Simanjuntak et al., 2017). DRPs are events or incidents involving drug therapy that can affect or interfere with the desired therapeutic outcomes (PCNE, 2020). Identification of DRPs can increase the effectiveness of drug therapy and help reduce morbidity, mortality, and drug therapy costs (Simanjuntak et al., 2017).

Based on research in Ethiopia, the disease that causes the most DRPs is pneumonia (Birarra et al., 2017). Other studies in several countries have stated that antibiotics are drugs with the highest DRPs rates in children's hospitals (Abrogoua et al., 2017; Al azmi et al., 2019; Bizuneh et al., 2020; Leopoldino et al., 2019). In Indonesia itself, DRPs cases still often occur, such as in Central Sulawesi Province (60 cases) and DI Yogyakarta Province (69 cases) (Astiti et al., 2017; Pramudya, 2020).

The occurrence of DRPs in the management of pneumonia can increase cases of death in toddlers with pneumonia, morbidity, and therapy costs borne by patients. Mistakes in drug dosing can cause the management given to be ineffective or overdose, in the case of antibiotics, it can increase the prevalence of antibiotic resistance. The further impact of DRPs can affect patient clinical outcomes, and quality of life, and contribute to unnecessary healthcare costs that are a burden for developing countries (Birarra et al., 2017).

The increasing number of cases of pediatric pneumonia can increase the chances of drps occurring. Seeing the high number of drps cases of antibiotics and pediatric pneumonia in hospitals emphasizes the importance of identifying drps to prevent the same mistakes from happening again. Therefore, a study was conducted to identify DRP cases that occurred in hospitalized pediatric patients suffering from pneumonia at general hospital, bengkulu city.

METHODS

Study Design

This study serves as a continuation of the umbrella research on pneumonia in pediatrics conducted previously in 2023. The research was conducted in May–June 2024 using a retrospective in the form of secondary data obtained from medical records using the approach method cross-sectional method and the data obtained from July to December 2022. The sampling technique uses a purposive sampling technique. Identification of Drug related problems (DRPs) based on the PCNE V9.1 classification and only discusses the problem and cause categories.

Inclusion and Exclusion Criteria

The inclusion criteria are age less than or equal to 17 years, primary diagnosis is Community-Acquired-Pneumonia (CAP), receiving antibiotic therapy, and inpatients in the period July-December 2022. The exclusion criteria are patients with comorbidities of asthma, congenital heart disease, impaired kidney function, incomplete medical records (name, age, gender, diagnosis, laboratory data), and illegibility.

Population and Sample

The sample used in this study was all pediatric patients with pneumonia (CAP) in the Inpatient Unit of General Hospital, Bengkulu City for the period July-December 2022 who met the inclusion and exclusion criteria. From Ummi General Hospital Bengkulu City, 95 medical records of antibiotic utilization in pediatric inpatients were employed as a sample.

Instruments

The research instruments are the Patient Data Collection Sheet and the PCNE DRPs form (V9.1).

Data Analysis

The data is summarized in a table that includes case number, initials, gender, age, weight, length of hospitalization, major complaint, primary diagnosis, clinical data, antibiotic name, dosage, route of administration, interval of use, duration of administration, and reason for discharge. From the data, univariate analysis was then conducted to examine the distribution of gender and age among the patients and to identify DRPs in the problem and cause categories (C1-C4) based on compliance with the DiPiro guidelines.

RESULT AND DISCUSSION

Table 1. Characteristics of pediatric pneumonia

Characteristics	Category	Frequency	% (n=95)
Gender	Male	62	65.3%
	Femal	33	34.7%
Age	28 days to 23 months	50	52.6%
	2 -11 years old	45	47.4%

Table 2. Antibiotic treatment profile of pediatric pneumonia patients

Types of Therapy	Antibiotics	Frequency	% (n=95)
Monotherapy	Ampicillin inj	8	8.4%
	Sultamicillin inj	15	15.8%
	Ceftriaxone inj	3	3.2%
	Gentamicin inj	7	7.4%
Combination	Ampicillin inj + Gentamicin inj	52	54.7%
	Sultamicillin inj + Gentamicin inj	8	8.4%
	Sultamicillin inj + Gentamicin inj + Ceftriaxone inj	2	2.1%
	Total	**95**	**100%**

Patient Characteristics

Based on research conducted at General Hospital in Bengkulu City, the characteristics of pediatric patients with pneumonia (CAP) during the period of July-December 2022, including age and gender, were analyzed. The pediatric age grouping in this research is based on the guidelines of the Food and Drug Administration (FDA) (FDA, 2023). According to **Table 1**, 95 patients met the inclusion criteria, with the majority being male, comprising 62 children (65.3%). Female patients were fewer, with 33 children (34.7%). These results are consistent with previous research on pediatric pneumonia, which also found that male pediatric patients are more prevalent than females (Astiti et al., 2017; California et al., 2018; Hartini & Ismiati, 2017). Based on the British Thoracic Society (BTS) and the 2022 Bengkulu Provincial Health Profile, it was stated that boys of all ages had a higher incidence of pneumonia compared to girls (Dinkes Provinsi Bengkulu, 2023; Harris et al., 2011). Boys have a higher rate of infectious disease cases because they are influenced by humoral and cellular immune reaction factors and lower sex hormone factors in increasing body immunity (Mitul et al., 2024; Muenchhoff & Goulder, 2014).

No research samples from the neonates and adolescents age groups met the inclusion and exclusion criteria, as samples were only found in the infants and children age groups. On the sum of both age groups, the infant age group had a slightly higher proportion (52.6%) compared to the children's age group (47.4%). These findings align with previous studies indicating that children aged 28 days to 23 months have a higher incidence of cases than those in other age groups (California et al., 2018; Hartini & Ismiati, 2017). According to the British Thoracic Society (BTS) and the 2022 Bengkulu Provincial Health Profile, children under 2 years old are at a higher risk of developing pneumonia (Dinkes Provinsi Bengkulu, 2023; Harris et al., 2011). Data from Bengkulu Province in 2022 indicate that 31% of children under 6 months do not receive exclusive breastfeeding, which increases their risk of developing pneumonia by 3.7 times (Dinkes Provinsi Bengkulu, 2023; Sari et al., 2016). Additionally, the development of fine motor skills in children aged 13-24 months, which includes the ability to hold objects, can lead to a tendency to put objects in their mouths, increasing the risk of bacterial infections, particularly in the respiratory and digestive systems (Black et al., 2005; Passali et al., 2015).

Table 3. Cases of DRPs in pediatric pneumonia patients

Code V9.1	Primary Domain	Subdomain		Frequency	% (n=367)
P1	Treatment effectiveness	P1.1	No effect of drug treatment despite correct use	0	0%
		P1.2	Effect of drug treatment not optimal	0	0%
		P1.3	Untreated symptoms or indication	0	0%
P2	Treatment safety	P2.1	Adverse drug event (possibly) occurring	62	16.9%
P3	Other	P3.1	Unnecessary drug-treatment	0	0%
		P3.2	Unclear problem/complaint. Further clarification necessary (please use as escape only)	0	0%
C1	Drug selection	C1.1	Inappropriate drug according to guidelines/formulary	7	1.9%
		C1.2	No indication for drug	0	0%
		C1.3	Inappropriate combination of drugs, or drugs and herbal medications, or drugs and dietary supplements	0	0%
		C1.4	Inappropriate duplication of therapeutic group or active ingredient	2	0.5%
		C1.5	No or incomplete drug treatment in spite of existing indication	0	0%
		C1.6	Too many different drugs/active ingredients prescribed for indication	0	0%
C2	Drug form	C2.1	Inappropriate drug form/formulation (for this patient)	0	0%
C3	Dose selection	C3.1	Drug dose too low	37	10.1%
		C3.2	Drug dose of a single active ingredient too high	102	27.8%
		C3.3	Dosage regimen not frequent enough	69	18.8%
		C3.4	Dosage regimen too frequent	0	0%
		C3.5	Dose timing instructions wrong, unclear or missing	0	0%
C4	Treatment duration	C4.1	Duration of treatment too short	84	22.9%
		C4.2	Duration of treatment too long	4	1.1%

Treatment Profile

Based on **Table 2**, the most commonly used antibiotics are penicillin, 3rd generation cephalosporins, and aminoglycosides. In the penicillin group, ampicillin and sultamicillin are used, the cephalosporin group is used in the 3rd generation, namely ceftriaxone and the aminoglycoside group in the form of gentamicin. This result is in accordance with previous research that the most widely given antibiotics are the β-lactam group (Monica et al., 2021; Suharjono et al., 2009). Ampicillin (8.4%), with its broader spectrum of activity, is the first choice for treating *S. pneumoniae*, the most common cause of pneumonia in children. The combination of ampicillin with sulbactam (sultamicillin 15.8%) extends its activity against *Staphylococcus strains*, making it suitable for pediatric patients suspected of having pneumonia caused by these bacteria. Ceftriaxone (3.2%) is highly effective against *S. pneumoniae strains* that are resistant to penicillin and is recommended as an empirical treatment for such infections. It is the antibiotic with the least toxicity and is suitable for treating sepsis in patients with normal or compromised immunity (Harris et al., 2011; B. Katzung et al., 2019; B. G. Katzung, 2018).

Gentamicin (7.4%) is used for patients suspected of having pneumonia caused by *Pseudomonas* bacteria due to its effectiveness against this pathogen. A combination of β-lactam antibiotics is indicated for pneumonia with severe symptoms, MRSA infection, or cases caused by *M. pneumoniae* and *C. pneumoniae* (DiPiro et al., 2020; Harris et al., 2011). The combination of β-lactam and gentamicin injections (65.3%) is administered to achieve a synergistic effect in patients with severe pneumonia symptoms, although this increases the nephrotoxic potential associated with gentamicin (Baxter, 2010; California et al., 2018; B. Katzung et al., 2019; B. G. Katzung, 2018).

Analysis of Drug Related Problems (DRPs)

Of the 95 patients sampled, it was found that 95 patients as a whole experienced DRPs. Some patients experienced 3-4 cases of DRPs at the same time that occurred with antibiotics given to one patient. In the final results of the analysis, 367 cases of DRPs were obtained from 95 patients. Cases of DRPs that occur in pediatric patients with pneumonia can be seen in **Table 3.**

Problems

Of the 95 patients sampled, in P2 (treatment safety) there were 62 cases that had the possibility of adverse events related to drugs. The interaction caused was in the form of nephrotoxicity arising from the combination of the aminoglycoside group and the penicillin group which was given < 5 days in 58 cases and 2 cases > 5 days. Incidence of DRPs in P2 (treatment safety can be seen in **Table 4**. The combination of gentamicin with ampicillin causes an increase in the nephrotoxic effect of gentamicin. The administration of this combination is intended to enhance the effects of antibiotics (synergism) and expand the therapeutic spectrum. The addition of ceftriaxone further exacerbates the potential nephrotoxic effects. Monitoring of kidney function and monitoring of levels of both antibiotics should be done if the combination is given (Baxter, 2010; Marcus et al., 2011).

Based on a study comparing ampicillin monotherapy and the combination of ampicillin with gentamicin, it was found that there was no difference in effectiveness between the group of patients who were given ampicillin monotherapy and the group that was given ampicillin and gentamicin. The addition of aminoglycosides is empirically only to expand the spectrum of bacterial coverage so as to guarantee or increase the percentage of treatment success. The use of β-lactam combination with aminoglycosides on a regular basis should also be avoided to promote appropriate and optimal antibiotic monotherapy (California et al., 2018; Marcus et al., 2011). Stockley's Drug Interaction does not clearly explain the severity of the combination, but nephrotoxicity is more common in the combination of ampicillin and gentamicin at a duration of < 5 days. This is because the combination of ampicillin with gentamicin is still more often given in the treatment of pneumonia with a treatment duration of < 5 days while the use of gentamicin > 5 days has begun to be abandoned because it is related to the increase in the potential for aminoglycoside side effects (nephrotoxic, ototoxic, and vestibulotoxic). A combination solution of drugs that can be given in cases of pneumonia with severe symptoms in the form of β-lactam + vancomycin/clindamycin which can expand the spectrum of therapy and does not cause interaction. In addition, vancomycin is the drug of choice in treating MRSA or bacteria that are resistant to the penicillin group or the β-lactam group so it is effective in treating pneumonia with more severe symptoms. The combination of β-lactam with clindamycin is a second choice in the treatment of pneumonia with severe symptoms when vancomycin is not available (DiPiro et al., 2020; B. Katzung et al., 2019; Mar).

Table 4. Problem subdomain P2.1 (Adverse drug event (possibly) occurring)

Number of Cases	Case	Recommendation	Solution
60 cases	The interaction of aminoglycoside (gentamicin) with penicillin (ampicillin) causes nephrotoxic effects	Monitoring of kidney function and monitoring of levels of both antibiotics	Avoid routine use of the combination by using a combination of β-lactam + vancomycin/clindamycin
2 cases	The interaction of aminoglycosides (gentamicin) with penicillin (ampicillin) and cephalosporins (ceftriaxone) causes nephrotoxic effects		

Causes

Information from the patient's medical record can only be used to identify the C1-C4 domain. The study did not identify the C5-C9 domain because the researchers did not follow the patient's progress during treatment. Based on the analysis of DRPs problems according to PCNE V9.1, the C1-C4 domain obtained 305 cases in the cause category. Cases of DRPs subdomains that occur can be seen in **Table 3**.

Antibiotic data obtained from medical records were compared with the Dipiro and Katzung guidelines to assess conformity. In subdomain C1.1 (Inappropriate drug according to guidelines/formulary), 7 cases were identified. Gentamicin monotherapy was likely administered because the patient was suspected of having pneumonia caused by *Pseudomonas* bacteria. However, as an empirical treatment for pediatric pneumonia patients, gentamicin monotherapy is not recommended and is not considered first-line therapy. Instead, third-generation cephalosporin monotherapy (e.g., cefepime), which is effective against *Pseudomonas* infections, should be used. Meanwhile, in one case patients, a combination of β-lactam with a macrolide, fluoroquinolone, or doxycycline should have been administered, as the patient was likely suffering from pneumonia caused by *M. pneumoniae* and *C. pneumoniae*, which commonly affects children over 5 years old (DiPiro et al., 2020; Harris et al., 2011). Currently, a combination therapy for CAP that is increasingly recommended involves the use of ampicillin with azithromycin or a β-lactam with fluoroquinolone. Both combinations have been extensively researched for their efficacy in reducing mortality due to CAP. The combination has been shown to lower lung inflammation and accelerate bacterial clearance. The combination of ampicillin with azithromycin has not been reported to have adverse effects that require regular monitoring or evaluation (Baxter, 2010; Majhi et al., 2014). Cases of DRPs and corresponding treatment solutions can be seen in **Table 5**.

Table 5. Causes subdomain C1.1 (Inappropriate drug according to guidelines/formulary)

Number of cases	Case	Solution
6 cases (< 5 years old), 1 case (> 5 years old)	Getting gentamicin monotherapy	Cephalosporin monotherapy is given. Children > 5 years old can be given a combination of β-Lactam + macrolide / fluoroquinolone / doxycycline

In subdomain C1.4 (Inappropriate duplication of a therapeutic group or active ingredient), there are 2 cases. Duplication of therapeutic groups occurs with the use of sultamicillin and ceftriaxone, both of which belong to the β-lactam group. Sultamicillin performs similarly to the cephalosporin group in treating *Staphylococcus* bacteria. Moreover, there is no research indicating a synergistic effect from the combination of ampicillin and ceftriaxone. Therefore, the recommended solution is to use only one agent from the β-lactam group, which can then be combined with another antibiotic if combination therapy is needed (DiPiro et al., 2020; B. G. Katzung, 2018). The cases of DRPs and corresponding treatment solutions can be seen in **Table 6**.

Table 6. Causes subdomain C1.4 (Inappropriate duplication of a therapeutic group or active ingredient)

Number of Cases	Case	Solution
2 cases	Duplication of the β-lactam group in the form of penicillin (sultamicillin) and cephalosporin (ceftriaxone)	Only one of the β-lactam groups (penicillin alone or cephalosporin only) is given.

Table 7. C3 causes domain (dose selection)

Subdomain	Number of Cases	Case	Solution
C3.1	37 Cases	The dose given is too low than the dose that should be given based on the patient's body weight	Readjust the dose based on the child's weight • Ampicillin 150-200 mg/kg/day • Gentamicin 7.5-10 mg/kgBB/day
C3.2	102 Cases	The dose given is too high than the dose that should be given based on the patient's weight	Readjust the dose based on the child's weight • Ampicillin 150-200 mg/kg/day • Gentamicin 7.5-10 mg/kgBB/day
C3.3	69 Cases	Medication regimen is not very frequent	The dosing interval is added according to the antibiotic dosing interval. • Ampicillin every 6 hours • Gentamicin every 8 hours

Note: the numbers in parentheses indicate the number of antibiotics administered by DRPs

Table 8. C4 causes domain (treatment duration)

Subdomain	Number of Cases	Case	Recommendation	Solution
C4.1	84 Cases	Duration of treatment ≤ 4 days	Monitoring of pneumonia recurrence	Follow the guidelines for the duration of therapy, which is for 5 days
C4.2	4 Cases	The duration of gentamicin treatment is more than 5 days increasing the nephrotoxic and ototoxic potential that can lead to vestibulotoxic	Monitoring of kidney function, hearing function, and vestibular function tests	Switching the antibiotic regimen when gentamicin therapy is approaching the limit of duration of use

Dose calculation was carried out using the guidelines provided by DiPiro *et al.* (2020). The therapeutic doses based on these guidelines were then compared to the administered antibiotic doses. In the subdomains C3.1 (Drug dose too low), C3.2 (Drug dose of a single active ingredient too high), and C3.3 (Dosage regimen not frequent enough), there were 37, 102, and 69 cases, respectively. Dosage errors frequently occur when doses are calculated based on the child's weight, which can lead to inaccuracies. Additional issues may arise from incorrect weight measurements, improper dose fractionation, the use of decimals, an increase in the number of prescribed drugs, and extended hospitalization (Al azmi et al., 2019; Birarra et al., 2017). Previous research has also shown that incorrect dosing is the most common cause of DRPs in pediatric patients (Abrogoua et al., 2017; Al azmi et al., 2019; Astiti et al., 2017; Birarra et al., 2017; Nasution et al., 2022). Short-term effects of dose inaccuracies in this population include ineffective treatment due to underdosing or toxic effects from overdosing, both of which are associated with increased mortality (Birarra et al., 2017). Continuous incorrect dosing can lead to the development of drug resistance, which is a significant long-term concern (Astiti et al., 2017). Ineffective treatment can also prolong hospitalization, leading to longer treatment durations and higher costs. The long-term effect of concern is the development of antibiotic resistance (Nasution et al., 2022). Additionally, too infrequent a drug regimen can result in insufficient drug availability in the body to effectively eradicate or inhibit bacteria during the early stages of susceptibility. This insufficient exposure may contribute to the emergence of drug-resistant subgroups within the population (Martinez et al., 2012). Cases of DRPs and corresponding treatment solutions can be seen in **Table 7**. To get the total number of cases in the C4 domain, a comparison was made between the duration of treatment or antibiotic administration and the recommended treatment duration according to DiPiro *et al*. (2020). In the subdomains C4.1 (Duration of treatment too short) and C4.2 (Duration of treatment too long), there were 84 and 4 cases, respectively. The duration of CAP treatment is adjusted based on the severity of the disease, the causative pathogen, and the pattern of microbial resistance. For severe cases, patients may require treatment for more than 7 days. If efficacy is not observed within the initial 48-72 hours, physicians are advised to change the treatment regimen. Treatment can be discontinued on days 5-7 if the patient shows no indicators of CAP recurrence for 48-72 hours (Chua dan Hearsey, 2023; Thom *et al*., 2019). Previous studies have shown that short-term treatment (5 days) results in clinical cure rates similar to those of long-term treatment (10 days), with fewer side effects and a lower risk of resistance (Pernica et al., 2021; Williams et al., 2022). Early termination can be considered if the patient meets clinical stability criteria for 48-72 hours without showing CAP markers and satisfies procalcitonin (PCT) discontinuation criteria (Same et al., 2021; Uranga et al., 2020; van Oers et al., 2018). In 84 cases of DRPs, these requirements were not met, making early termination unjustified.

The results of the study found that there were 4 cases of the duration of use of gentamicin antibiotics longer than it should be, namely more than five days. The use of gentamicin for more than five days increases the possibility of nephrotoxicity and ototoxicity and can lead to vestibulotoxicity. The use of aminoglycoside therapy for more than 3-5 days causes nephrotoxicity in 5-25% of patients and ototoxicity in 57% of patients. The recommendations that can be given are monitoring kidney function to see the level of nephrotoxicity that may occur, in addition to hearing tests and vestibular function tests. In addition, the solution given if the patient has not met clinical stability but the use of gentamicin antibiotics has approached the maximum limit of treatment duration, gentamicin should be replaced with vancomycin (first choice) or clindamycin (second choice) in patients receiving combination therapy. In patients receiving monotherapy, gentamicin can be substituted with cefepime (B. G. Katzung, 2018; Rivetti et al., 2023). Cases of DRPs that occurred and treatment solutions can be seen in **Table 8**.

CONCLUSIONS

Based on research, pneumonia cases are more common in patients with the male sex (65.3%) and patients in the age range of 28 days-23 months (52.6%). The most widely given treatment is ampicillin inj + gentamicin inj (54.7%). There were 367 cases in 95 patients. A total of 62 cases occurred in the problem domain and 305 cases occurred in the causes domain. Cases of Drug Related Problems (DRPs) that occurred included 102 cases (27.8%) of drug doses that were too high, 84 cases (22.9%) of treatment duration that were too short, 69 cases (18.8%) of infrequent dose regimens, 62 cases (16.9%) of adverse drug events, 37 cases (10.1%) of drug doses that were too low, 7 cases (1.9%) of drugs that did not comply with the guidelines, and 4 cases (1.1%) of treatment duration. and duplication of the therapeutic group 2 cases (0.5%).

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AUTHORS' CONTRIBUTIONS

H.B.M. Collected the data, Contributed data or analysis tools, Performed the analysis, and wrote the manuscript with support from D.H.. R.R. and S.P.Y.S. All authors contributed to the conceived and designed the analysis and verified the analytical methods.

CONFLICT OF INTERESTS

This research has no personal interest.

ETHICAL CONSIDERATION

The research carried out has received approval for ethical permission issued by the Health Research Ethics Commission, Faculty of Nursing, Jember University by No. 2399/UN25.8/KEPK/DL/2024.

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