

Bacterial Patterns, Causes, and Antibiotic Resistance in Neonatal Sepsis Cases at Yarsi Hospital and its Review from an Islamic Perspective

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ABSTRACT

Neonatal sepsis is a major cause of newborn morbidity and mortality, especially in developing countries. This systemic bacterial infection can progress rapidly and become fatal without early and appropriate treatment. Effective empirical antibiotic therapy depends critically on the local pattern of causative bacteria and the level of antibiotic resistance within each hospital. This research aims to identify the pattern of bacteria causing neonatal sepsis and analyze bacterial resistance to certain antibiotics based on medical record data, culture results, and antibiotic resistance tests from blood specimens of neonates suspected of having sepsis who were treated at YARSI Hospital during the period 2022-2024. Data was collected by observing and recording medical records of neonatal sepsis patients treated at YARSI Hospital from January 2022 to December 2024. Data analysis was performed in stages using SPSS and Microsoft Excel. The results showed that neonatal sepsis most often occurred in male neonates, was born prematurely, and was dominated by Gram-negative bacteria, especially *Klebsiella pneumoniae*. Gram-negative bacteria exhibited widespread resistance to first-line antibiotics, while sensitivity to certain antibiotics such as amikacin, tigecycline, and carbapenems was still found. Most cases fell into the multidrug-resistant (MDR) category, indicating a significant challenge in empirical therapy, although no statistically significant association was found between bacterial type and MDR levels. These findings underscore the importance of blood culture and antibiotic sensitivity testing as the basis for appropriate therapy, in line with Islamic values of preserving life, the continuation of generations, and the rational use of antibiotics.

INTRODUCTION

Neonatal sepsis is an invasive bloodstream infection characterized by the presence of bacteria in the blood, cerebrospinal fluid, or urine, and hemodynamic changes during the first month of life (Wandita et al., 2021). Neonates with bacterial sepsis may have nonspecific signs and symptoms, such as cyanosis, tachypnea, bradycardia/tachycardia, peripheral circulatory disorders, hypotension, nutritional intolerance, difficulty sucking, vomiting, diarrhea, abdominal distension, hepatosplenomegaly, jaundice, abscesses, petechiae, purpura on the skin, lethargy, hypotonicity, drowsiness, a weak or high-pitched cry, seizures, hypoactivity, and unstable body temperature (Odabasi & Bulbul, 2020).

World Health Organization (WHO) data shows that in 2017, nearly 20 million of all sepsis cases worldwide occurred in children under 5 years of age. In 2018, an estimated 15% of all neonatal deaths worldwide were caused by sepsis. Research shows that premature babies and babies with low birth weight are the leading causes of sepsis (World Health Organization, 2020). Worldwide, the combined incidence of neonatal sepsis is 22/1000 live births, 1–4/1000 live births in high-income countries, and 49–170 cases per 1000 live births in low-income countries, with a mortality rate of 11–19% (De Rose et al., 2024). Based on the results of the 2017 Basic Health Research (Riskesdas), sepsis is the leading cause of neonatal mortality in Indonesia, accounting for 12% of all deaths of infants aged 0–6 days and 20.5% of all deaths of infants aged 6–28 days (Amaliya, 2020). In several referral hospitals in Indonesia, the incidence ranges between 1.5% and 3.72%, and the mortality rate ranges between 37.09% and 80% (Wandita et al., 2021).

Newborns can be infected by a number of bacterial and nonbacterial agents during delivery (Cortese et al., 2016). The most common bacteria are group B Streptococcus (GBS), *Escherichia coli*, and *Klebsiella* spp. *Salmonella* spp., which cause gram-negative sepsis in developing countries. Other bacteria less commonly found in the United States include *Citrobacter*, Enterococci, Gonococci, *Listeria monocytogenes*, *Streptococcus pneumoniae*, and *Haemophilus influenzae*. Cytomegalovirus (CMV), Herpes simplex virus (HSV), enteroviruses, and Human Immunodeficiency Virus (HIV) are the most common viruses (Kliegman et al., 2020). Most risk factors for neonatal sepsis are influenced by maternal, fetal, and environmental conditions. Maternal factors include premature rupture of membranes, maternal fever in the two weeks before delivery, foul-smelling and meconial amniotic fluid, and instrumental delivery; while fetal factors include birth weight, gestational age, and Apgar score (Arisqan, 2021).

Neonatal sepsis is classified into two types based on its onset period: early-onset infection and late-onset infection (Cortese et al., 2016; Giannoni et al., 2018; Harrison et al., 2024; Russell et al., 2024). Early-onset infection refers to vertically transmitted infections within the first three days of life (72 hours), while late-onset infection refers to horizontally transmitted infections (after 72 hours of life), usually caused by hospital-acquired bacteria (Mahmoud et al., 2023). The age of onset of infection varies based on the time of exposure and the virulence of the infecting organism. Very late-onset infections occur after 1 month of life and can also occur in premature, low-birth-weight (LBW) infants, or term infants requiring prolonged neonatal intensive care (Kliegman et al., 2020).

The diagnosis of neonatal sepsis is based on history, clinical, and biological data. Information gathered from the history can be used to assess risk factors for sepsis in the mother and newborn. There is a significant correlation between various factors, including maternal and neonatal environmental factors, neonatal conditions, and the number of sepsis cases (Nyenga et al., 2021). To date, culture results remain the gold standard for diagnosis, but results take at least 25 days to be confirmed. If the bacteria found are not common, culture results should be interpreted with caution. Furthermore, prior antibiotic administration or the possibility of nosocomial bacterial contamination can influence culture results (Wandita et al., 2021).

Empirical antibiotic treatment should be initiated when sepsis is clinically suspected, even without confirmatory laboratory data. In general, the antimicrobial resistance patterns of bacteria in the neonatal intensive care unit should guide initial antibiotic selection (Singh et al.,

2022). Empirical treatment for early-stage bacterial infections includes ampicillin and an aminoglycoside antibiotic, usually gentamicin. Empirical treatment for late-stage neonatal sepsis typically includes vancomycin and an aminoglycoside antibiotic, which is effective against coagulase-negative Staphylococci, *S. aureus*, and gram-negative organisms (Odabasi & Bulbul, 2020). For patients with gram-positive bacteria, antibiotics are given for 10-12 days, while for patients with gram-negative bacteria, treatment can be extended to 2-3 weeks (Wandita et al., 2021).

Irrational use of antibiotics can lead to antibiotic resistance, especially in the hospital setting. To prevent antibiotic resistance, the patterns of the most common causative bacteria must be considered when prescribing antibiotics. If not properly addressed, it can have adverse side effects that can threaten the baby's health and even lead to death (Kereh et al., 2020).

This research is not only based on health theory but also encompasses an Islamic dimension, explaining how the Quran and Hadith view the importance of maintaining individual and environmental health. Health is defined as a state in which a person's body is free from disease, whether physical or spiritual. When someone fails to maintain their health, it can impact daily activities, hindering or disrupting them due to a weakened immune system. When someone fails to maintain their health, their body is also susceptible to disease due to an irregular lifestyle. The environment is the most dominant factor contributing to low health (Attansyah et al., 2023).

Sepsis is a leading cause of morbidity and mortality in infants. This disease refers to infections that can involve the bloodstream in infants under 28 days of age (N. P. D. Putri & Windiyanto, 2024). Early-Onset Neonatal Sepsis (ANSN) is usually associated with highly virulent infections, either originating from the mother's vagina or from microbes present in the gastrointestinal tract. Meanwhile, Late-Onset Neonatal Sepsis (NASN) is caused by the immature development of the neonatal immune system, including the skin, respiratory, and gastrointestinal systems, environmental factors, and length of hospitalization (Atmaja et al., 2023).

Reproductive health is an aspect of physical health. Therefore, every individual is obliged to maintain reproductive health in their daily lives to avoid disease (Haniah et al., 2023). Islam places cleanliness as a crucial element in maintaining health. Allah SWT loves those who purify themselves, and this cleanliness includes physical cleanliness, clothing, and the environment (Nuralifya et al., 2024). Allah SWT said:

وَتِيَابَكَ فَطَهِّرْ

Meaning: "Cleanse your garments!" (Q.S. Al-Muddassir: 4)

Tahlili interpretation explains that this verse commands a Muslim to cleanse themselves, their clothing, and their surroundings of all impurity and dirt. Furthermore, humans are commanded to maintain their purity and honor from all reprehensible behavior (KEMENAG, 2022).

Maintaining health is crucial in Islamic teachings because it enables a person to properly carry out worldly obligations and religious obligations. The Quran reminds Muslims not to simply surrender when sick, but to strive for healing by seeking medical treatment and praying to Allah for healing (Hakim et al., 2023). This is based on the following narration from Abu Darda:

”قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ “ إِنَّ اللَّهَ أَنْزَلَ الدَّاءَ وَالذَّوَاءَ وَجَعَلَ لِكُلِّ دَاءٍ دَوَاءً فَتَدَاوُوا وَلَا تَتَدَاوُوا بِحَرَامٍ

Meaning: The Prophet Muhammad (peace and blessings be upon him) said: "Indeed, Allah has sent down both the disease and its cure, and He has appointed a cure for every disease, so do not treat with what is forbidden." (Narrated by Abu Dawud).

This hadith emphasizes that seeking treatment is a step recommended by the Prophet Muhammad (peace and blessings be upon him) as part of his endeavor and as a form of trust in Allah SWT. However, in conducting treatment, Islam provides clear limitations, namely the prohibition of using drugs derived from impure or forbidden materials (Badrudin, 2021).

This study aims to analyze the patterns and resistance of bacteria causing neonatal sepsis at YARSI Hospital. The results are expected to provide useful information for the development of more effective guidelines for the treatment and prevention of neonatal sepsis in clinical settings, as well as supporting better infection control efforts.

RESEARCH METHOD

This was an analytical observational study with a retrospective approach. This study aims to identify bacterial patterns that cause neonatal sepsis and analyze bacterial resistance to certain antibiotics based on medical record data, culture results, and antibiotic resistance tests from blood specimens of neonates suspected of having sepsis who were treated at YARSI Hospital during the period 2022-2024. Data collection was conducted at YARSI Hospital, Jakarta, during the period January 2022 - December 2024. The population in this study were patients suspected of neonatal sepsis who were treated and recorded in the medical record, and had blood culture results, and antibiotic sensitivity tests at YARSI Hospital during the period 2022-2024. The inclusion criteria in this study were all neonatal patients suspected of neonatal sepsis and had complete data regarding antibiotic resistance test results at YARSI Hospital during the period 2022-2024. The exclusion criteria for this study were neonatal sepsis patients with incomplete medical records or undiagnosed patients and patients who died at YARSI Hospital during the 2022-2024 period. The sampling technique used in this study was purposive sampling by taking samples based on the inclusion and exclusion criteria studied were all neonates suspected of neonatal sepsis who were treated and recorded in the medical record, and had blood culture results, and antibiotic sensitivity tests at YARSI Hospital during the 2022-2024 period. This study used secondary data because from the results obtained from medical records and laboratory results of patients diagnosed with neonatal sepsis based on the results of blood culture and antibiotic sensitivity tests at YARSI Hospital. The data collection technique was carried out by observing and recording the medical records of neonatal sepsis patients who had been treated at YARSI Hospital during the period January 2022–December 2024. Data analysis in this study was carried out in stages using SPSS and Microsoft Excel software.

RESULT AND DISCUSSION

Table 1. Respondent Characteristics

Characteristic	Category	Frequency (N)	Percentage (%)
Sex	Male	77	67,0%
	Female	38	33,0%
	Total	115	100%
Gestational Age	Preterm	70	60,9%

	Term	39	33,9%
	Post term	6	5,2%
	Total	115	100%
Birth Weight	Low Birth Weight	51	44,3%
	Normal Birth Weight	60	52,2%
	High Birth Weight	4	3,5%
	Total	115	100%

Source: Secondary data processed from medical records of neonatal sepsis patients at YARSI Hospital, 2022–2024

Based on Table 1, this study involved 115 respondents, with the majority being male (77 respondents, 67.0%) and female (38 respondents, 33.0%). Most respondents were in the preterm gestational age category, namely 70 respondents (60.9%), followed by term, with 39 respondents (33.9%), and post term, with 6 respondents (5.2%). Based on birth weight, the majority of respondents had a normal birth weight, namely 60 respondents (52.2%), followed by low birth weight, namely 51 respondents (44.3%), and high birth weight, namely 4 respondents (3.5%). The predominance of male neonates and preterm infants indicates biological vulnerability to systemic infection due to immature immune systems, while the high proportion of infants with normal birth weight confirms that neonatal sepsis does not only occur in high-risk groups but is also influenced by other factors such as maternal condition, delivery process, care environment, and limitations in neonatal immune response.

Univariate Analysis

Frequency Distribution Based on Blood Culture

Blood culture testing is an important diagnostic procedure in neonates with suspected sepsis to confirm the presence of bacterial infection and determine the appropriate antibiotic therapy. Blood culture results are categorized as positive, indicating the growth of bacteria causing infection, and negative, indicating the absence of microorganism growth. The following frequency distribution shows the categories of blood culture results in neonates who were the research sample at YARSI Hospital:

Table 2. Frequency Distribution Based on Blood Culture (N=115)

Blood Culture	Frequency (N)	Percentage (%)
Negative	83	72.2%
Positive	32	27.8%
Total	115	100%

Source: Secondary data processed from medical records of neonatal sepsis patients at YARSI Hospital, 2022–2024

The distribution results show that of the 115 neonates with suspected sepsis, the majority had negative blood cultures, namely 83 infants (72.2%), while 32 infants (27.8%) had positive blood cultures with the growth of pathogenic bacteria. These findings indicate that not all suspected cases of sepsis are bacterial sepsis, so diagnosis requires comprehensive clinical evaluation, including blood culture testing, given that sepsis-like symptoms in neonates can

also be triggered by non-infectious factors such as hypoxia, metabolic disorders, or non-bacterial inflammation. In addition to determining the etiology, blood culture results are important for distinguishing cases that require targeted antibiotic therapy from non-bacterial conditions that can be managed based on clinical manifestations.

Frequency Distribution Based on Bacterial Category

Identifying the bacteria causing sepsis in neonates is important for determining the etiology and selecting the appropriate antibiotic therapy. Bacteria from blood cultures are grouped into Gram-negative and Gram-positive based on cell wall structure, which affects antibiotic sensitivity. Gram-negative bacteria, with a lipopolysaccharide layer, tend to be more resistant and often cause severe infections, while Gram-positive bacteria have simpler cell walls and are generally more responsive to first-line antibiotics. The distribution of bacterial categories found in this study is shown in the following table:

Table 3. Frequency Distribution Based on Blood Culture (N=115)

Blood Culture	Frequency (N)	Percentage (%)
Negative	83	72.2%
Positive	32	27.8%
Total	115	100%

Source: Secondary data processed from medical records of neonatal sepsis patients at YARSI Hospital, 2022–2024

Of the 115 neonates with suspected sepsis, the majority had negative blood culture results in 83 infants (72.2%), while 32 infants (27.8%) had positive cultures with the growth of pathogenic bacteria. These findings indicate that not all suspected cases of sepsis are bacterial sepsis, as sepsis-like symptoms in neonates can also be influenced by non-infectious factors such as hypoxia, metabolic disorders, or non-bacterial inflammation. Therefore, blood culture testing plays an important role not only in determining the etiology of infection but also in distinguishing cases requiring targeted antibiotic therapy from non-bacterial conditions that can be managed symptomatically.

Frequency Distribution Based on Bacterial Category

Identifying the bacteria causing sepsis in neonates is important for determining the etiology and appropriate antibiotic therapy. Blood culture bacteria are grouped into Gram-negative and Gram-positive based on cell wall structure, which affects antibiotic sensitivity; Gram-negative bacteria tend to be more resistant and often cause severe infections, while Gram-positive bacteria generally respond better to first-line antibiotics. The distribution of bacterial categories found in this study is shown in the following table:

Table 4. Frequency Distribution Based on Bacterial Category (N=32)

Bacterial Category	Frequency (N)	Percentage (%)
Gram Negative	24	75%
Gram Positive	8	25%
Total	32	100%

Source: Secondary data processed from blood culture results at YARSI Hospital, 2022–2024

All research samples were neonates with positive blood cultures, with Gram-negative bacteria dominating in 24 cases (75%), while Gram-positive bacteria were found in 8 cases (25%). The predominance of Gram-negative bacteria indicates that this group is the main cause of neonatal sepsis and is known to be more aggressive and associated with a higher risk of morbidity and mortality, especially in neonates with immature immunity and exposure to intensive care. These findings emphasize the importance of clinical vigilance, appropriate empirical antibiotic selection, and regular monitoring of bacterial patterns and resistance to prevent delayed therapy and severe neonatal sepsis.

Frequency Distribution Based on Bacterial Type

Identification of bacterial types in neonates with suspected sepsis aims to determine the microorganisms that most commonly cause infection, as a basis for determining empirical and targeted antibiotic therapy. Each bacterium has different virulence and antibiotic sensitivity characteristics, and in this study, blood cultures showed a diversity of bacteria from the Gram-negative and Gram-positive groups. Identification of bacterial types in neonates with suspected sepsis aims to determine the most common microorganisms causing infection, as a basis for determining empirical and targeted antibiotic therapy. Each bacterium has different virulence characteristics and antibiotic sensitivity, and in this study, blood cultures showed a diversity of bacteria from the Gram-negative and Gram-positive groups.

Table 5. Frequency Distribution Based on Bacterial Type (N=32)

Bacterial Type	Frequency (N)	Percentage (%)
<i>Acinetobacter baumannii</i>	1	3.1%
<i>Acinetobacter lwoffii</i>	1	3.1%
<i>Enterobacter cloacae</i>	1	3.1%
<i>Escherichia coli</i>	2	6.3%
<i>Klebsiella pneumoniae</i>	18	56.3%
<i>Pseudomonas aeruginosa</i>	1	3.1%
<i>Staphylococcus epidermidis</i>	4	12.5%
<i>Staphylococcus gallinarum</i>	1	3.1%
<i>Staphylococcus haemolyticus</i>	2	6.3%
<i>Staphylococcus sciuri</i>	1	3.1%
Total	32	100%

Source: Secondary data processed from blood culture results at YARSI Hospital, 2022–2024

The results of the study indicate that *Klebsiella pneumoniae* is the most dominant bacterium in neonatal sepsis, found in 18 neonates (56.3%), confirming the major role of Gram-negative bacteria as the cause of sepsis in this population. Additionally, other Gram-negative bacteria such as *Escherichia coli*, *Acinetobacter* spp., *Enterobacter cloacae*, and *Pseudomonas aeruginosa* were also identified, albeit in smaller proportions, but still clinically significant due to their virulence and resistance potential. Gram-positive bacteria, particularly *Staphylococcus epidermidis*, were found in lower proportions than Gram-negative bacteria. Overall, the dominance of Gram-negative bacteria, especially *Klebsiella pneumoniae*, emphasizes the

importance of regular monitoring of bacterial patterns and antibiotic resistance to support the selection of appropriate empirical therapy and the prevention of severe neonatal sepsis.

Frequency Distribution Based on Antibiotic Resistance

Antibiotic resistance assessment in this study was based on laboratory sensitivity test results and clinical response to antibiotic therapy, using the MDR (Multi-Drug Resistant) category. MDR is defined as the failure of first-line antibiotics, requiring replacement or addition of antibiotics from at least three different classes. The use of the MDR indicator aims to describe the level of initial therapy failure and the complexity of the infection, thereby enabling a more comprehensive assessment of the severity of sepsis. In addition, this indicator is also used to map bacterial resistance patterns and evaluate the effectiveness of empirical antibiotic therapy in neonates at YARSI Hospital. The frequency distribution of antibiotic resistance is shown as follows:

Table 6. Frequency Distribution Based on Antibiotic Resistance (N=32)

Antibiotic Resistance	Frequency (N)	Percentage (%)
MDR	24	75%
Non MDR	8	25%
Total	32	100%

Source: Secondary data processed from antibiotic sensitivity test results at YARSI Hospital, 2022–2024

The distribution of antibiotic resistance in neonates with sepsis at YARSI Hospital shows that most cases fall into the MDR category, namely 24 infants (75%), indicating a high rate of resistant bacterial infection, so that initial empirical therapy often does not provide an optimal clinical response and requires antibiotic escalation. Conversely, only 8 infants (25%) were classified as non-MDR and remained responsive to first-line antibiotics. The dominance of MDR cases presents a serious challenge in the management of neonatal sepsis, reflecting the potential exposure to resistant bacteria in the intensive care environment, and emphasizing the need for improved infection control, evaluation of empirical antibiotic policies, and implementation of more rational antimicrobial strategies to prevent the spread of resistance.

Bivariate Analysis

Table 7. Relationship Between Bacterial Patterns and Antibiotic Resistance Levels in Neonatal Sepsis Cases at YARSI Hospital

Variabel Antibiotic	Resistance Level		p-value		
	MDR	No MDR	N	%	
Bacterial Patterns	N	%	N	%	
Gram Negative	16	50%	8	25%	0.059
Gram Positive	8	25%	0	0%	
Total	24	75%	8	25%	

Source: Secondary data processed from blood culture and antibiotic sensitivity test results at YARSI Hospital, 2022–2024

Based on bivariate analysis using the Chi-Square test, a p-value of 0.059 was obtained, slightly above the significance threshold of 0.05, indicating that there is no statistically significant relationship between bacterial patterns and antibiotic resistance levels in neonatal sepsis at YARSI Hospital. Thus, the hypothesis stating that there is a relationship cannot be statistically accepted, although the data distribution still provides meaningful clinical information.

Descriptively, most MDR cases were found in Gram-negative bacteria (50%), followed by Gram-positive bacteria (25%), while all non-MDR cases (25%) were found only in the Gram-negative group. The absence of non-MDR cases in Gram-positive bacteria indicates that all Gram-positive infections in this study were associated with multidrug resistance, which clinically may be related to the ability to adapt and form biofilms, especially in *Staphylococcus* bacteria. In Gram-negative bacteria, the high proportion of MDR indicates the role of pathogens such as *Klebsiella pneumoniae* and *Escherichia coli* in antibiotic resistance, which is influenced by membrane structure and the production of resistant enzymes.

Overall, although the relationship between bacterial patterns and antibiotic resistance was not statistically significant, descriptive findings showed that the risk of MDR remained high in both Gram-negative and Gram-positive bacteria. This confirms the importance of regular monitoring of bacterial patterns and antibiotic resistance, as well as the need for more rational empirical antibiotic use based on culture results and sensitivity testing in the management of neonatal sepsis.

This study aims to analyze the relationship between bacterial patterns and antibiotic resistance levels in cases of neonatal sepsis at YARSI Hospital. Based on the results of the Chi-Square test, a p-value of 0.059 was obtained, which is slightly above the significance threshold of 0.05. Therefore, statistically, no significant relationship was found between bacterial patterns and antibiotic resistance levels. However, descriptive findings indicate certain clinical trends that remain relevant in the context of neonatal sepsis management, particularly in neonates with positive blood cultures.

The distribution of blood culture results showed that most neonates with suspected sepsis had negative blood cultures (72.2%), while only 27.8% had positive cultures. This high proportion of negative cultures is consistent with the literature, which states that suspected neonatal sepsis is not always caused by bacterial infection but can be triggered by non-infectious conditions such as hypoxia, metabolic disorders, or systemic inflammation. In addition, the low positive culture rate may also be influenced by technical factors such as blood sample volume, specimen collection time, and the use of antibiotics prior to culture, which can reduce the sensitivity of bacterial detection.

In the group of neonates with positive cultures, Gram-negative bacteria dominated at 75%, while Gram-positive bacteria were found in only 25% of cases. The dominance of Gram-negative bacteria has important clinical implications because this group of bacteria has a complex outer membrane structure with lipopolysaccharide content and the ability to produce enzymes such as β -lactamase, which contribute to increased virulence and antibiotic resistance. This condition explains why Gram-negative infections are often associated with higher morbidity and mortality rates in neonates, especially in intensive care units.

When reviewed more specifically based on the type of bacteria, *Klebsiella pneumoniae* is the most dominant pathogen and shows a striking pattern of resistance to first-line antibiotics

such as ampicillin. These findings are consistent with various studies reporting that *K. pneumoniae* is the leading cause of nosocomial sepsis in the NICU and often possesses Extended-Spectrum β -Lactamase (ESBL) characteristics, which limit the effectiveness of many β -lactam antibiotics. The presence of other pathogens such as *Acinetobacter* spp., *Enterobacter cloacae*, and *Pseudomonas aeruginosa*, although in smaller numbers, remains clinically significant because they are known to have high resistance potential and are often associated with the use of invasive devices.

Antibiotic resistance analysis shows that most neonates with positive cultures fall into the MDR category (75%). This high MDR rate reflects the complexity of neonatal sepsis infections at YARSI Hospital and indicates that initial empirical therapy is often inadequate, requiring antibiotic escalation. MDR dominance was mainly found in Gram-negative bacteria, but all Gram-positive cases in this study were also classified as MDR, indicating the possibility of colonization or nosocomial infection by resistant bacteria, especially in neonates exposed to intensive care and the use of medical devices.

In conclusion, although no statistically significant relationship was found between bacterial patterns and antibiotic resistance levels, clinical findings indicate that the predominance of Gram-negative bacteria, particularly *Klebsiella pneumoniae*, is closely related to the high incidence of multidrug resistance in neonatal sepsis. These results emphasize the importance of blood culture and sensitivity testing as the basis for rational antibiotic selection, as well as the need to strengthen infection control programs and periodically evaluate empirical antibiotic policies at YARSI Hospital to prevent an increase in MDR in the future.

CONCLUSION

Based on the results of research on the causative bacterial patterns and antibiotic resistance in neonatal sepsis cases at YARSI Hospital from 2022 to 2024, it can be concluded that respondent neonates were predominantly male (67%), preterm gestational age (60.9%), and normal birth weight (52.2%), indicating that the preterm population is the most vulnerable to sepsis. *Klebsiella pneumoniae* was the most common bacterium found in neonatal sepsis cases, accounting for 15.7%, with Gram-negative bacteria being the dominant cause overall compared to Gram-positive bacteria. Gram-negative bacteria, particularly *Klebsiella pneumoniae* and *Acinetobacter* spp., exhibited a broad resistance pattern to first-line antibiotics such as ampicillin and early-generation cephalosporins, but remained relatively sensitive to certain antibiotics including tigecycline, amikacin, and carbapenems. The majority of neonates with positive blood cultures fell into the multidrug-resistant (MDR) category at 75%, a rate that reflects the significant challenges in managing neonatal sepsis and indicates the limited effectiveness of empirical antibiotics used. Bivariate analysis results showed no statistically significant relationship between bacterial patterns and antibiotic resistance levels, with a p-value of 0.059; however, descriptively, both Gram-negative and Gram-positive bacteria demonstrated a high tendency towards multidrug resistance. Furthermore, efforts to prevent and manage neonatal sepsis align with the *maqasid sharia*, namely *hifz an-nafs* (protecting the life of infants), *hifz an-nasl* (protecting the continuity and quality of the next generation), and *hifz al-mal* (protecting the rational and efficient use of antibiotics), confirming that appropriate healthcare services are an endeavor consistent with Islamic values. Thus, this study emphasizes that the dominance of Gram-negative bacteria and high antibiotic

resistance are significant challenges in the management of neonatal sepsis, so that blood culture examination and antibiotic sensitivity testing serve as the basis for selecting appropriate therapy in order to reduce antibiotic resistance and increase the success rate of neonatal sepsis treatment.

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