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Early Detection and Management of Neonatal Sepsis in Low-Resource Settings

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Abstract

Introduction: *Neonatal sepsis is a life-threatening condition and a major contributor to neonatal morbidity and mortality, particularly in low-resource settings. Early detection and timely management are crucial to reducing the burden of sepsis-related deaths among newborns. This study aimed to assess the early detection, clinical profile, microbial pattern, and treatment outcomes of neonatal sepsis in a low-resource setting.*

Methods: *This hospital-based observational study was conducted in the neonatal unit of Aichi Medical College and Hospital, Dhaka in Bangladesh from January 2024 to May 2025. A total of 97 neonates aged 0 to 28 days, admitted with clinical suspicion of sepsis, were enrolled using a purposive sampling technique. Data were analyzed using SPSS version 26.*

Result: *In this study of 97 neonates with suspected sepsis, 63.9% had early-onset sepsis and 36.1% had late-onset sepsis. The most common clinical features were poor feeding (79.4%), lethargy (72.2%), and respiratory distress (58.8%). Blood cultures were positive in 50.5% of cases, with Klebsiella pneumoniae (21.6%) being the most frequently isolated pathogen. The overall recovery rate was 83.5%, while the mortality rate was 11.3%, highlighting the importance of early detection and timely management in improving outcomes.*

Conclusion: *This study highlights that early detection and prompt management of neonatal sepsis using simplified clinical signs remain effective strategies for improving neonatal outcomes in low-resource settings. The predominance of Gram-negative pathogens, the high proportion of early-onset sepsis, and the observed mortality rate emphasize the ongoing challenges in such environments.*

Keywords: *Early Detection, Neonatal Sepsis, Low-Resource Settings*

I. INTRODUCTION

Neonatal sepsis remains a major global health challenge, particularly in low-resource settings where access to healthcare is limited and diagnostic facilities are often inadequate. It is a significant cause of neonatal morbidity and mortality, accounting for nearly one-third of all neonatal deaths globally, with the highest burden reported in sub-Saharan Africa and South Asia [1]. The World Health Organization (WHO) estimates that approximately 2.5 million neonates die annually, with infections, including sepsis, contributing substantially to these deaths [2]. Early detection and prompt management of neonatal sepsis are therefore critical to improving neonatal survival rates, especially in resource-constrained environments. Neonatal sepsis is a clinical syndrome characterized by systemic signs of infection in the first 28 days of life, caused by bacterial, viral, or fungal pathogens [3]. It is broadly categorized as early-onset sepsis (EOS), occurring within the first 72 hours of life,

and late-onset sepsis (LOS), occurring after 72 hours [4]. EOS is often associated with vertical transmission from the mother during labor or delivery, whereas LOS is more commonly linked to nosocomial or community-acquired infections [5]. The most frequently isolated pathogens include *Group B Streptococcus*, *Escherichia coli*, *Klebsiella spp.*, and *Staphylococcus aureus* [6]. Detecting neonatal sepsis in low-resource settings poses unique challenges. Clinical signs such as poor feeding, lethargy, respiratory distress, and temperature instability are often nonspecific, making early diagnosis difficult [7]. Laboratory confirmation, which ideally includes blood cultures, complete blood count, C-reactive protein (CRP), and procalcitonin levels, is often unavailable or unreliable in low-income settings [8]. Moreover, inadequate infrastructure, scarcity of trained healthcare personnel, and delayed healthcare-seeking behavior further compound the problem [9]. In recent years, efforts have been made to develop simplified algorithms and clinical guidelines for the early detection of neonatal sepsis tailored to low-resource settings. The WHO's Integrated Management of Childhood Illness (IMCI) and Young Infants Clinical Signs (YICSS) guidelines recommend the use of key clinical signs such as difficulty feeding, convulsions, lethargy, severe chest indrawing, and abnormal temperature to identify serious bacterial infections in neonates [10]. These algorithms have been shown to improve early detection and facilitate timely referral, particularly in primary healthcare or community settings where laboratory resources are scarce [11]. Management of neonatal sepsis in low-resource settings is largely empirical due to the limited availability of diagnostic tools. The WHO recommends the use of broad-spectrum antibiotics such as ampicillin and gentamicin as first-line therapy [12]. However, emerging antimicrobial resistance, especially among Gram-negative pathogens, poses a significant threat to effective treatment [13]. Studies have reported increasing resistance to commonly used antibiotics, emphasizing the need for antimicrobial stewardship programs, even in resource-limited contexts [6,13]. In addition to antibiotic therapy, supportive care plays a vital role in the management of neonatal sepsis. This includes thermal regulation, respiratory support, nutritional support, and management of hypoglycemia or electrolyte imbalance [4]. Yet, in many low-resource settings, essential supportive care measures are often lacking due to infrastructural and logistical constraints [9]. Preventive strategies are equally important in reducing the burden of neonatal sepsis. These include maternal screening and treatment for infections during pregnancy, promotion of hygienic delivery practices, timely cord care, exclusive breastfeeding, and early postnatal care [2,11]. Community health worker programs and home-based neonatal care interventions have demonstrated success in improving early detection, facilitating timely treatment, and reducing neonatal mortality in several low-resource countries [11]. This study aimed to assess the early detection, clinical profile, microbial pattern, and treatment outcomes of neonatal sepsis in a low-resource setting.

II. METHODS

This hospital-based observational study was conducted in the neonatal unit of Aichi Medical College and Hospital, Dhaka in Bangladesh from January 2024 to May 2025. A total of 97 neonates aged 0 to 28 days, admitted with clinical suspicion of sepsis, were enrolled using a purposive sampling technique. Neonates with major congenital anomalies or those already on prolonged antibiotic therapy before admission were excluded. Diagnosis of sepsis was based on clinical signs such as poor feeding, lethargy, respiratory distress, temperature instability, and convulsions, following the WHO Young Infant Clinical Signs (YICSS) guidelines. Relevant laboratory investigations, including blood culture, were performed where feasible. All enrolled neonates received empirical antibiotic therapy as per hospital protocol, and outcomes were recorded. Data were analyzed using SPSS version 26, with results presented as frequencies, percentages, and relevant statistical comparisons.

III. RESULTS

Table 1: Demographic Characteristics of the Study Population (n=97)

Variable	Frequency (n)	Percentage (%)
Sex		
Male	59	60.8
Female	38	39.2
Place of Birth		
Home	37	38.1
Health Facility	60	61.9
Gestational Age		
Preterm (<37 weeks)	34	35.1
Term (≥37 weeks)	63	64.9

Out of the 97 neonates included in the study, 59 (60.8%) were male and 38 (39.2%) were female, showing a male predominance. A total of 37 neonates (38.1%) were delivered at home, while 60 (61.9%) were born in healthcare facilities. Regarding gestational age, 34 neonates (35.1%) were preterm, and the remaining 63 (64.9%) were term. [Table 1]

Table 2: Classification of Neonatal Sepsis (n=97)

Type of Sepsis	Frequency (n)	Percentage (%)
Early-Onset Sepsis (≤72 hrs)	62	63.9
Late-Onset Sepsis (>72 hrs)	35	36.1

Among the 97 neonates, early-onset sepsis (occurring within the first 72 hours of life) was observed in 62 cases, accounting for 63.9% of the study population. Late-onset sepsis, developing after 72 hours, was noted in 35 neonates (36.1%). [Table 2]

Table 3: Clinical Presentation of Neonates with Sepsis (n=97)

Clinical Features	Frequency (n)	Percentage (%)
Poor Feeding	77	79.4
Lethargy	70	72.2
Respiratory Distress	57	58.8
Temperature Instability	47	48.5
Convulsions	12	12.4

The most frequently observed clinical feature was poor feeding, present in 77 neonates (79.4%). Lethargy was noted in 70 cases (72.2%), and respiratory distress in 57 cases (58.8%). Temperature instability was documented in 47 neonates (48.5%), while convulsions were observed in 12 cases (12.4%). [Table 3]

Table 4: Blood Culture Results and Isolated Pathogens (n=97)

Pathogen Isolated	Frequency (n)	Percentage (%)
Klebsiella pneumoniae	21	21.6
Escherichia coli	14	14.4
Staphylococcus aureus	9	9.3
Group B Streptococcus	5	5.2
No Growth/Negative Culture	48	49.5

Blood culture results were positive in 49 (50.5%) of the neonates. The most common pathogen isolated was *Klebsiella pneumoniae*, detected in 21 cases (21.6%), followed by *Escherichia coli* in 14 cases (14.4%), and *Staphylococcus aureus* in 9 cases (9.3%). *Group B Streptococcus* was identified in 5 neonates (5.2%). In 48 neonates (49.5%), blood cultures showed no growth. [Table 4]

Table 5: Outcome of Neonates with Sepsis (n=97)

Outcome	Frequency (n)	Percentage (%)
Recovered	81	83.5
Expired	11	11.3
Left Against Medical Advice (LAMA)	5	5.2

Out of the 97 neonates with suspected sepsis, 81 (83.5%) recovered following treatment. Eleven neonates (11.3%) died during hospital stay. Additionally, 5 neonates (5.2%) left against medical advice before completing treatment. [Table 5]

IV. DISCUSSION

The predominance of male neonates (60.8%) among sepsis cases in this study aligns with global observations that male neonates have a higher susceptibility to sepsis, potentially due to X-linked immunological factors or hormonal influences [14,15]. Fleischmann et al. (2021) in their global burden analysis also reported a higher incidence of neonatal sepsis among males, particularly in resource-limited regions [6]. In terms of sepsis classification, 63.9% of neonates in this study had early-onset sepsis (EOS), while 36.1% had late-onset sepsis (LOS). This pattern is similar to findings from South Asia and sub-Saharan Africa, where EOS continues to be more prevalent, often due to peripartum and vertical transmission associated with inadequate antenatal care or unhygienic delivery practices [5]. A recent study by Islam et al. (2023) from Bangladesh also reported that EOS accounts for approximately 65% of neonatal sepsis cases, underscoring the ongoing burden of perinatal infections in such settings [7]. The clinical features observed in this study, including poor feeding (79.4%), lethargy (72.2%), respiratory distress (58.8%), and temperature instability (48.5%), mirror the simplified clinical criteria recommended by the WHO Young Infants Clinical Signs (YICSS) guidelines for early detection of neonatal sepsis in resource-limited areas [16]. Downie et al. (2013) also emphasized the diagnostic value of these clinical signs in their systematic review of neonatal sepsis identification in low- and middle-income countries [8]. This reinforces the importance of relying on clinical acumen and structured assessment in settings where advanced diagnostics are often unavailable. The microbiological profile in this study revealed *Klebsiella pneumoniae* (21.6%) and *Escherichia coli* (14.4%) as the predominant pathogens, followed by *Staphylococcus aureus* (9.3%). These findings align with the results of Fleischmann-Struzek et al. identified Gram-negative organisms, particularly *Klebsiella* and *E. coli*, as the leading causes of neonatal sepsis in low-resource settings [6]. The high isolation rate of multidrug-resistant *Klebsiella pneumoniae* has been a growing concern globally and reflects the challenge of antimicrobial resistance (AMR), especially in environments with limited infection control and diagnostic capabilities [17,13]. In this study, the mortality rate among neonates with sepsis was 11.3%, which falls within the range reported by other studies in similar settings. For instance, a multi-country analysis by Liu et al. (2022) reported neonatal sepsis-related mortality ranging from 9% to 19% in low- and middle-income countries, depending on healthcare access and availability of timely interventions [1]. The recovery rate of 83.5% in this study suggests that early detection through clinical signs and prompt empirical antibiotic therapy, even in low-resource settings, can lead to favorable outcomes, consistent with the evidence from large-scale community and hospital-based interventions [11,9]. However, the finding that 5.2% of neonates left against medical advice (LAMA) highlights the persistent barriers to healthcare utilization, including financial constraints, lack of caregiver education, and limited health system support, all of which have been documented as challenges in neonatal care in resource-limited settings [18]. This study also underscores the need for strengthening preventive measures such as improving antenatal care coverage, ensuring clean delivery practices, and enhancing infection prevention programs, as emphasized by the WHO and other international stakeholders [16,19]. Furthermore, the rising threat of antimicrobial resistance, as reflected by the predominance of Gram-negative sepsis in this cohort, emphasizes the urgent need for antimicrobial stewardship and enhanced laboratory capacity in these settings [13,17].

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. CONCLUSION

This study highlights that early detection and prompt management of neonatal sepsis using simplified clinical signs remain effective strategies for improving neonatal outcomes in low-resource settings. The predominance of Gram-negative pathogens, the high proportion of early-onset sepsis, and the observed mortality rate emphasize the ongoing challenges in such environments. Strengthening clinical assessment, timely empirical antibiotic therapy, preventive measures during delivery, and addressing antimicrobial resistance are essential to reduce the burden of neonatal sepsis and improve survival in resource-limited settings.

VI. RECOMMENDATION

Strengthening early detection through standardized clinical assessment, ensuring timely initiation of empirical antibiotics, promoting clean delivery practices, and enhancing caregiver education are essential to reduce neonatal sepsis-related mortality in low-resource settings. Additionally, investments in laboratory capacity and antimicrobial stewardship programs are recommended to address the growing challenge of drug-resistant infections.

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