# Clinical Profile and Immediate Outcomes of Suspected Neonatal Sepsis in a Tertiary Care Hospital in Bangladesh

F Islam[1], S Afroze[2], B H N Yasmeen[3], G Salauddin[4], L Sarker[5]

## Abstract

**Background:** Neonatal sepsis remains a leading cause of morbidity and mortality worldwide, with the burden disproportionately high in low- and middle-income countries. Nonspecific clinical signs, overlapping presentations with other neonatal conditions, and limited microbiological facilities complicate timely diagnosis and management. In Bangladesh, where neonatal mortality remains substantial, context-specific evidence is needed to refine empirical treatment and preventive strategies.

**Objective:** This study aimed to evaluate the clinical and bacteriological profile, maternal and neonatal risk factors, and immediate outcomes of neonates with suspected sepsis admitted to a Neonatal Intensive Care Unit (NICU)of a tertiary care hospital in Dhaka.

**Methods:** We conducted a prospective observational study at the NICU of Bangladesh Institute of Health Sciences (BIHS) General Hospital, Dhaka, between January 2024 and June 2024. A total of 40 neonates with one or more sepsis risk factors and/or clinical features suggestive of infection were enrolled. At the time of admission demographic, clinical, laboratory, and maternal variables were recorded and blood culture and septic screen also performed. Statistical analysis was done by using SPSS version 26. Data were summarized as frequencies and percentages for categorical variables, and continuous variables as means with standard deviations or medians with ranges, depending on distribution.

**Results:** Among the total 40 neonates, 67.5% were male, 50% had low birth weight, and 45% were preterm. Maternal risk factors included gestational diabetes (40%), urinary tract infection (30%), and premature rupture of membranes (20%). Poor activity (95%) and desaturation (85%) were the most common presenting features. Blood culture positivity was 20%, with Klebsiella pneumoniae and methicillin-resistant Staphylococcus aureus (MRSA) each accounting for 37.5% of isolates. C-reactive protein was elevated in 50% of cases. The survival rate was 95%, with an average ICU stay of 11 days; 5% of neonates died.

**Conclusions:** Neonatal sepsis was strongly associated with prematurity, low birth weight, maternal UTI, and PROM. Blood culture yield was low, but Klebsiella and MRSA predominated among isolates.

**Keywords:** Neonatal sepsis, Risk factors, Bacteriology, NICU, Bangladesh

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[1]Dr. Fahmida Islam
FCPS, MCPS (Paediatrics)
Assistant Professor
Dept. of Paediatrics
BIHS General Hospital, Dhaka

[2]Dr. Sharmin Afroze
Associate Professor & Head
Dept. of Neonatology
Dr. M R Khan Shishu Hospital & ICH

[3]Prof. Dr. B H Nazma Yasmeen
Professor and Head
Dept. of Paediatrics
Northern International Medical College
Dhaka

[4]Dr. Gazi Salauddin
Clinical Physician Assistant
Trans Canada Medical Centre
Calgary, Alberta, Canada

[5]Dr. Lamia Sarker
Clinical Physician Assistant
Trans Canada Medical Centre
Calgary, Alberta, Canada

**Correspondence**
Dr. Fahmida Islam
FCPS, MCPS (Paediatrics)
Assistant Professor
Dept. of Paediatrics
BIHS General Hospital, Dhaka
Email: fahmidaislam43@gmail.com

## Introduction

Neonatal sepsis is a life-threatening condition in which the immature immune system mounts a dysregulated inflammatory response to bloodstream infection (bacterial, viral or fungal) during the first 28 days of life.[1] It is often discussed as early-onset sepsis (EOS) when symptoms begin within 72 hours of birth, usually from vertically transmitted pathogens, or late-onset sepsis (LOS) when infection arises after 72 hours due to postnatal or nosocomial infection.[2,3] Despite improvements in perinatal care, neonatal sepsis remains a global problem, killing more than 3 million neonates annually and leaving many survivors with long-term neurodevelopmental impairments.[4,5] Neonates now account for almost half of under-five deaths;[6] global estimates suggest 3 million cases of sepsis and at least 570000 neonatal deaths each year.[7] Incidence and mortality are markedly higher in low- and middle-income countries (LMICs). The neonatal sepsis burden in LMICs is approximately 40 times greater than in high-income countries and accounts for ~24% of neonatal deaths.[8] Sub-Saharan Africa and South Asia carry most of the burden, with 99% of neonatal sepsis deaths occurring in LMICs.[9] Recent meta-analyses estimate incidence in

LMICs at 2824 per 100000 live births (increasing to 3930 per 100000 during 2009–2018) with a mortality rate around 17.6□%, and sepsis is responsible for 18–28% of neonatal deaths in these settings.[7] High-quality care in high-income countries has reduced EOS mortality, but LMICs struggle with delayed presentation, limited microbiological facilities and lack of standardized treatment protocols.[10]

The pathophysiology and risk profile of neonatal sepsis are complex. Newborns are susceptible because their innate and adaptive immune responses are immature, leading to impaired pathogen clearance and exaggerated inflammatory reactions.[11] Bacteria cross the neonate's mucosal barriers during or after birth; gram-positive organisms such as Staphylococcus aureus and Group B Streptococcus predominate in EOS, whereas gram-negative pathogens (E.coli, Klebsiella spp., non-lactose fermenters) dominate LOS and are increasingly resistant to multiple drugs.[12] Several maternal factors predispose to sepsis including premature rupture of membranes (PROM), maternal urinary-tract infection, intrapartum fever, chorioamnionitis and antepartum haemorrhage;[13] maternal febrile illness and foul-smelling liquor are particularly associated with EOS.[14] Neonatal risk factors include prematurity, low birth weight, low Apgar scores, male sex, birth asphyxia, mechanical ventilation, invasive procedures and prolonged NICU stay.[15,16] In a Ugandan case-control study, primigravida, multiple vaginal examinations after membrane rupture and delayed decision-to-delivery times markedly increased the odds of EOS.[14] These risk factors highlight the need for context-specific prevention strategies.

Diagnosis and management remain challenging. Non-specific symptoms such as temperature instability, feeding intolerance or respiratory distress overlap with other neonatal conditions and early manifestations occur within 24 hours in most EOS cases.[17] Blood culture, the diagnostic gold standard, is time-consuming and yields positive results in 9% of suspected cases.[18] In LMICs, resource constraints often force empirical antibiotic use, yet resistance rates are alarming: studies from Bangladesh report that 77% of isolates are gram-negative, mostly Klebsiella and E. coli, with 45–65% resistant to carbapenems and culture-positive mortality around 25%.[19] In Bangladesh, sepsis contributes to roughly 20% of neonatal deaths and the national neonatal mortality rate remains 30 per 1000 live births.[20] Prospective studies in Dhaka have shown that maternal urinary-tract infection, preterm delivery and low Apgar scores significantly increase sepsis risk and that virtually all isolates are multidrug-resistant.[21] Findings from a large NICU survey in Dhaka indicated that 49% of admitted neonates developed sepsis and 90% of cases occurred after 72 hours of life.[22]

There is a paucity of data from Bangladeshi tertiary hospitals on the clinical profile and short-term outcomes of suspected neonatal sepsis. Our study therefore aimed to describe the demographic and clinical features of neonates with suspected sepsis, identify key maternal and neonatal risk factors and examine immediate outcomes in a tertiary care hospital in Bangladesh.

## Materials and methods

This prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of BIHS General Hospital, Dhaka. The study period spanned 6 months, from January 2024 to June. 2024.Prior to the study, written informed consent was taken from parents or guardians of all participants.

**Inclusion criteria** All neonates admitted to the NICU during the study period were screened for inclusion. Infants were eligible if they had one or more recognized risk factors for sepsis, including prolonged rupture of membranes (>18 hours), clinical chorioamnionitis, meconium-stained amniotic fluid, low birth weight (<2.5 kg), prematurity (<37 weeks), more than three digital vaginal examinations during labor, need for active resuscitation at birth, attendance by untrained birth attendants, maternal fever during labor or maternal urinary tract infection. Neonates with clinical features suggestive of sepsis such as temperature instability, poor feeding, lethargy, respiratory distress, apneic episodes, hypotension, abdominal distension, vomiting, seizures or signs of circulatory or respiratory dysfunction were also enrolled. We defined early-onset sepsis if presentation found within the first 72 hours of life and late-onset sepsis thereafter.

**Exclusion criteria** were prior administration of systemic antibiotics for more than 24 hours before admission, blood culture and septic screen was not possible at admission, major congenital anomalies incompatible with life and parental refusal of consent.

Within the first hour of admission, sepsis screen was performed for all infants and which included blood culture and sensitivity, total leucocyte count, absolute neutrophil count, platelet count and qualitative C reactive protein. A C reactive protein level >6 mg/L, a total leucocyte count < 5,000 or > 30,000 cells/μL or a platelet count < 150 ×10^9/L were considered abnormal. The presence of any organism in the blood culture was considered culture positive.

Maternal characteristics (age, gravidity, parity, antenatal complications, mode of delivery) and neonatal variables (gestational age, birth weight, sex, presenting features, interventions, laboratory results and outcomes) were documented prospectively using a pre-designed case report form. All data were double-checked for completeness and entered into Microsoft Excel 2016. Statistical analysis was conducted using SPSS version 26. Data were summarized as frequencies and percentages for categorical variables, and continuous variables as means with standard deviations or medians with ranges,

depending on distribution.

## Results

In this study total 40 patients were enrolled with a male predominance (67.5%). Half of the neonates had low birth weight, and 45% were preterm, both of which are known risk factors for neonatal sepsis. Most were inborn (65%), which may reflect referral bias or hospital-based delivery predominance. Complications like perinatal asphyxia (30%), meningitis (20%), and NEC (15%) were observed (Table I).

High rates of gestational diabetes (40%), maternal UTI (30%), and PROM (20%) were observed, which are well-established risk factors for early-onset neonatal sepsis (Table II).

The most common presenting symptom was poor activity (95%), followed by desaturation (85%). Half of the neonates presented with abdominal distension or apnea. These nonspecific signs underscore the diagnostic challenge in neonatal sepsis and justify presumptive treatment based on clinical suspicion (Table III).

The study neonates had a mean hemoglobin of 15.62 ± 3.67 g/dL and mean total white blood cell count of 17,198.5 ± 8,219.96/µL, with predominance of neutropenia (Mean 31.55%) and relative lymphocytosis (Mean 64.44%) Platelet counts varied widely (mean 189,000/µL; range 10,000–1,000,000/µL), reflecting both thrombocytopenia and thrombocytosis. C-reactive protein was positive in 50% of cases, while blood culture was positive in only 20%.

**Table I: Neonatal Profile of Suspected Sepsis patients**

| Characteristics | | Frequency | Percentage |
|---|---|---|---|
| **Gender** | Male | 27 | 67.5 |
| | Female | 13 | 32.5 |
| **Birth weight** | Low birth weight | 20 | 50 |
| | Normal | 20 | 50 |
| **Place of birth** | Inborn | 26 | 65 |
| | Out born | 14 | 35 |
| **Gestational age** | Preterm | 18 | 45 |
| | Term | 22 | 55 |
| **Gestational size** | SGA | 14 | 35 |
| | AGA | 24 | 60 |
| | LGA | 2 | 5 |
| **Perinatal asphyxia** | Yes | 12 | 30 |
| | No | 26 | 65 |
| **Respiratory distress** | None/minimal lung disease | 28 | 70 |
| | HMD grade I | 10 | 25 |
| | HMD grade IV | 2 | 5 |
| **NEC** | Yes | 6 | 15 |
| | No | 34 | 85 |
| **PDA** | Yes | 6 | 15 |
| | No | 34 | 85 |
| **Meningitis** | Yes | 8 | 20 |
| | No | 32 | 80 |
| **Acquired pneumonia** | Yes | 4 | 10 |
| | No | 36 | 90 |

Data presented as frequency (percentage); PDA: Patent Ductus Arteriosus; HMD: Hyaline Membrane Disease; SGA: Small for Gestational Age; AGA: Appropriate for Gestational Age; LGA: Large for Gestational Age

**Table II: Maternal Profile of Suspected Sepsis patients**

| Maternal Factors | | Frequency | Percentage |
|---|---|---|---|
| Age (years) | Mean ± SD | 29.6 ±5.29 | |
| | Median (range) | 30.0 (18.0-41.0) | |
| Diabetes Mellitus | | 10 | 25 |
| Gestational Diabetes | | 16 | 40 |
| Hypertension | | 4 | 10 |
| Bronchial Asthma | | 2 | 5 |
| Urinary Tract Infection | | 12 | 30 |
| Preeclampsia | | 2 | 5 |
| Hypothyroidism | | 2 | 5 |
| Intrahepatic cholestasis | | 2 | 5 |
| Premature rupture of membrane | | 8 | 20 |
| Antibiotics during labor | | 4 | 10 |

**Data presented as frequency (percentage), mean ±SD, median (range)**

**Table III: Clinical Features of Suspected Sepsis**

| Symptoms | Frequency | Percentage |
|---|---|---|
| Poor activity | 38 | 95 |
| Desaturation | 34 | 85 |
| Abdominal distension | 20 | 50 |
| Feed intolerance | 18 | 45 |
| Apnea | 20 | 50 |

**Data presented as frequency (percentage)**

**Table IV: Laboratory findings of the participants of suspected sepsis**

| Laboratory parameters | | Values |
|---|---|---|
| **Hemoglobin** (g/dL) | Mean ± SD | 15.62± 3.67 |
| | Median (range) | 15.60 (10.0-20.90) |
| **Total white blood cell count (cells/µL)** | Mean ± SD | 17198.5±8219.96 |
| | Median (range) | 16800 (3500-36000) |
| **Neutrophil** | Mean ± SD | 31.55±16.23 |
| | Median (range) | 34.5 (7-60) |
| **Lymphocyte** | Mean ± SD | 64.44±18.04 |
| | Median (range) | 70 (30-89) |
| **Total Platelet count (cells/µL)** | Mean ± SD | 189000±262310.64 |
| | Median (range) | 120000 (10000-1000000) |
| **CRP** | Positive | 20 (50%) |
| | Negative | 20 (50%) |
| **Blood culture** | Positive | 8 (20%) |
| | Negative | 32 (80%) |

**Data presented as frequency (percentage), mean ±SD, media (range); CRP: C-reactive Protein.**

Our study revealed that among the suspected participants 8 (20%) were blood culture–positive indicate confirmed sepsis (Fig.1).

Regarding the distribution of organisms isolated from blood culture–positive Klebsiella and MRSA were the most frequent isolates, each accounting for 37.5% of the total, while

Acinetobacter and Staphylococcus were less common, each contributing 12.5% (Fig.2).

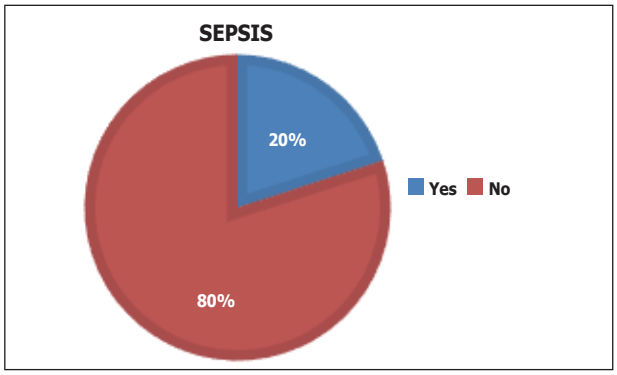


**Fig. 1: Distribution of the neonates according to blood culture positive sepsis**

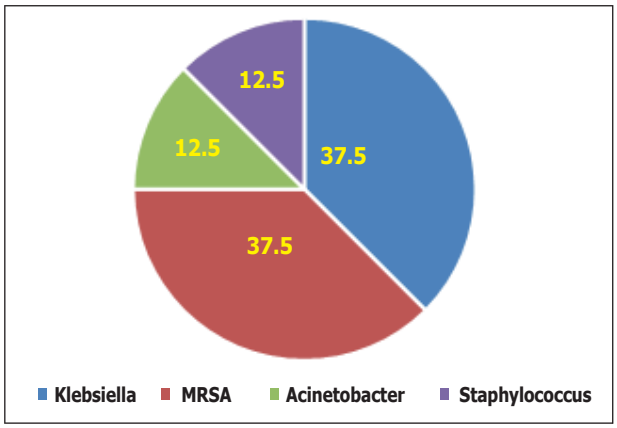


**Fig. 2: Distribution of Organisms Isolated from Blood Cultures (n=8)**

In this study the survival rate was encouragingly high (95%). More than half required oxygen therapy (55% hood O), and a smaller proportion needed CPAP (25%) or invasive ventilation (5%). The average ICU stay was 11 days, and total hospital stay was about 12 days. Additionally, the mortality was overall (5%) (Table V).

**Table V: Outcome of Neonates with suspected Sepsis**

| Outcome Indicators | | Frequency | Percentage |
|---|---|---|---|
| Survival | Survived | 38 | 95 |
| | Died | 2 | 5 |
| Ventilator support | None | 6 | 15 |
| | Hood O | 22 | 55 |
| | CPAP | 10 | 25 |
| | IPPV | 2 | 5 |
| Duration of ventilator support (days) | Mean ± SD | 2.25±2.96 | |
| | Median (Range) | 0.5 (0-8) | |
| Duration of $O_2$ therapy | Mean ± SD | 6.7±5.79 | |
| | Median (Range) | 5.5 (0-21) | |
| Duration of ICU stay (days) | Mean ± SD | 11.25±7.23 | |
| | Median (Range) | 10 (2-25) | |
| Duration of Hospital stay (days) | Mean ± SD | 12.1±6.73 | |
| | Median (Range) | 10 (3-26) | |

CPAP (Continuous Positive Airway Pressure), IPPV (Intermittent Positive Pressure Ventilation)

Data presented as frequency (percentage), mean ±SD, media (range)

## Discussion

The aim of this study was to describe the clinical profile and immediate outcomes of suspected neonatal sepsis in a tertiary care hospital in Bangladesh. According to the findings, the prevalence of sepsis among suspected cases was 20%, with male sex, prematurity, low birth weight, perinatal asphyxia, maternal UTI, and PROM emerging as key associated factors.

Our study comprised 67.5% males, a clear male predominance among infants with suspected sepsis. Half of the neonates were low-birth weight and 45% were born preterm. A meta-analysis from India found that male sex increases the odds of neonatal sepsis by 1.3 times (95% CI 1.02-1.68) and that out-born status and need for mechanical ventilation were also strong risk factors.[23] Similarly, a large cross-sectional study from Nigeria reported 59% male prevalence among suspected sepsis cases.[25] Nyma etal. observed 57.8% males among sepsis cases in Dhaka and highlighted that low birth weight and perinatal asphyxia were significant risk factors.[24]

Preterm and low-birth-weight infants constituted a substantial proportion of our study. A systematic review and meta-analysis in Ethiopia estimated that low birth weight increased sepsis risk by 1.42 times and prematurity tripled the odds of infection.[25] Manandhar et al. (2021) in Nepal found that 32% of suspected sepsis cases were culture-positive and that prematurity and low birth weight were among the strongest predictors.[26] Our proportion of preterm (45%) and low-birth-weight (50%) infants lies between the extremes reported in India (63% preterm and 53.8% low birth weight)[27] and Ethiopia (64.8% prevalence of neonatal sepsis and strong association with prematurity and maternal urinary tract infection).[28]

Perinatal asphyxia (30% in our study) and respiratory distress (minimal in 70%, HMD-I in 25%, HMD-IV in 5%) were common. These findings align with reports from Bangladesh and Ethiopia showing that birth asphyxia and low Apgar scores significantly increase sepsis risk.[13,29]

The mothers in our study were relatively young (mean 29.6±5.29 years) with no teenagers. Gestational diabetes was present in 40%, diabetes mellitus in 25%, urinary tract infection (UTI) in 30%, premature rupture of membranes (PROM) in 20% and hypertension in 10%. Maternal UTI and PROM are known risk factors for neonatal sepsis because ascending infection can contaminate the amniotic cavity. A case–control study from Northeast India reported that maternal UTI in the third trimester (adjusted odds ratio 5.4) and PROM (AOR 2.9) were significant predictors of early-onset sepsis.[30] A cross-sectional study from Northwest Ethiopia similarly found that duration of ruptured membranes > 18 h increased sepsis risk eleven-fold (AOR 11.3).[13] In addition, diabetic mothers often undergo operative delivery and have large-for-gestational-age babies that require intensive

care, increasing exposure to hospital pathogens. Hypertensive disorders and hypothyroidism were less common in our study. Maternal age has a complex association with neonatal sepsis. The case–control study in Northeast India found that maternal age >30 years tripled the odds of early-onset sepsis.[30] We found in this study that no mothers younger than 18 years.

This study found poor activity in 95% of neonates, desaturation in 85%, abdominal distension in 50%, feed intolerance in 45% and apnea in 50%. These symptoms mirror the typical subtle presentation of neonatal sepsis described in comprehensive reviews. A 2023 overview highlighted that fever or hypothermia, tachypnea, tachycardia, poor feeding and lethargy are early signs.[31] Another review noted that neonatal sepsis often manifests with respiratory distress, feeding intolerance and lethargy, reflecting systemic inflammatory response and organ dysfunction.[32] Hamer et al. defined a set of clinical signs predictive of severe illness in neonates, including feeding difficulty, convulsions, lethargy and chest indrawing;[33] these were comparable to our study , except convulsions were rare. The high prevalence of poor activity and desaturation in our study may underscore the challenge of diagnosing sepsis based on clinical presentation alone.

Laboratory results revealed moderate anemia (mean hemoglobin 15.6±3.7g/dL), total WBC (17,198±8,219cells/μL) with neutropenia (31.5%±16%) and relative lymphocytosis (64.4%±18%). Thrombocytopenia was common with median platelet count 189×10^9/L and wide range (10×10^9–1×10^6/μL). Elevated CRP was found in 50% of neonates, but only 20% had positive blood cultures. These findings illustrate the diagnostic difficulties of neonatal sepsis. Total leukocyte counts and differential counts are neither sensitive nor specific; Thrombocytopenia is a consistent marker, CRP production in response to IL-6 and IL-1, is widely used but rises 12–24 hours after infection and may be elevated in non-infectious conditions.[34] This explains why half of our suspected cases had elevated CRP without culture-proven sepsis.

Our culture-positivity rate (20%) is within the range reported by other studies but remains suboptimal. Studies from Bangladesh and India have reported culture positivity between 9% and 23%. Shirin et al. found 9.2% positive cultures among 913 suspected sepsis cases,[19] while an Indian study reported 23.1% culture positivity with 9.2% mortality.[27] The Nigeria study noted that cultures were drawn in only 4.4% of cases with just 1 positive result.[23] These variations reflect differences in blood sampling volume, timing, prior antibiotic exposure and laboratory capacity.

Among 8 culture-positive cases in our study, Gram-negative and Gram-positive organisms were equally represented. Klebsiella pneumoniae and methicillin-resistant Staphylococcus aureus (MRSA) each accounted for 37.5%, with Acinetobacter and Staphylococcus aureus comprising the rest. This distribution diverges slightly from other Bangladeshi studies. Shirin et al. reported that Gram-negative bacteria constituted 77.4% of isolates, with Klebsiella (41.7%) being the dominant pathogen.[19] In our study, the prominence of MRSA may reflect nosocomial late-onset sepsis, as MRSA thrives in hospital environments and spreads via contact. The case–control study from Northeast India found Pseudomonas (41%), Klebsiella (16.7%) and coagulase-negative staphylococci (20.5%) as the main pathogens.[30] A large retrospective series from Rajasthan, India recorded culture positivity in 209 out of 733 neonates; Klebsiella and E.coli were the most common organisms, with Staphylococcus aureus and Pseudomonas next.[35] These differences underline the importance of local surveillance; pathogen spectra vary across regions and over time, influenced by antibiotic policies, infection-control practices and colonization patterns.

Our study showed a high survival rate (95%) with only 5% mortality and a mean ICU stay of 11.3 days (±7.4). A majority of neonates required respiratory support: 55% received hood oxygen, 25% continuous positive airway pressure and 5% mechanical ventilation. These outcomes are favorable compared with other studies. The Nigerian study reported 13.7% mortality,[23] while an Indian cross-sectional study observed a case fatality of 9.2%.[27] Shirin et al. found 25% mortality among culture-positive infants.[19] hospital stay in our study (mean 12.1 days) may be explained by the inclusion of preterm infants requiring prolonged supportive care, as well as by hospital discharge policies.

Factors influencing recovery include initial disease severity, comorbidities and appropriateness of therapy. In our study, only 5% requires mechanical ventilation; mechanical ventilation is itself a risk factor for sepsis and prolongs recovery. The Ethiopian time-to-recovery study identified chest indrawing, low Apgar scores and septic shock as predictors of prolonged hospital stay.[36] We observed septic shock in 10% of cases and necrotizing enterocolitis in 15%, both of which likely contributed to longer ICU stays.

## Limitations of the study

Small sample size, single-center design, and reliance on descriptive analysis without establishing statistical associations are the limitations of the study. Blood culture yield was low, likely due to small sample volumes and early empirical antibiotic use, which may have underestimated pathogen diversity.

## Conclusion

Neonatal sepsis was common in prematurity, low birth weight, perinatal asphyxia. Maternal UTI, and PROM frequently observed among the affected neonates. Though culture positivity remained low, Klebsiella and MRSA predominated among isolates. Most

neonates presented with nonspecific features, posing diagnostic challenges. Survival outcome was favorable.

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