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Article

# Incidence and Clinical Outcomes of Neonatal Sepsis in NICU Admissions: A Hospital-Based Study

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## Abstract

***Background:*** *Neonatal sepsis remains a significant source of morbidity and mortality across the globe, particularly in poor-resource settings. This systemic inflammatory response syndrome occurs in 1-8 in 1000 live births globally, more so in the developing world. Neonates' susceptibility results from having underdeveloped immune systems and prolonged exposure to healthcare facilities, and thus, early recognition and treatment are essential for improved outcomes.*

***Methods:*** *This is a retrospective observational study conducted at Bangladesh Shishu Hospital and Institute, Dhaka, Neonatal Intensive Care Unit between January 2023 and December 2024. Among 576 NICU admissions, 66 neonates with sepsis established by clinical presentation and laboratory findings were selected. Demographic characteristics, clinical presentations, laboratory findings, and outcomes were recorded. Statistical analysis was performed using SPSS v27, and Cox proportional hazards regression was employed to identify predictors of mortality.*

***Results:*** *The incidence of neonatal sepsis was 11.45% (66/576 admissions) with a mortality rate of 6.06% (4/66 cases). Males predominated (60.6%), and 74.2% were preterm neonates. All the affected neonates were very low birth weight (<1500g), with a mean of 1000±320 grams. Incidence of late-onset sepsis was higher (59.1%) than early-onset sepsis (40.9%). Respiratory distress syndrome occurred in 66.7%, hyper-CRP in 71.2%, and positive blood culture in 24.2%. Minor predictors of death were positive blood culture (AOR=5.21, p=0.012), thrombocytopenia (AOR=4.82, p=0.022), and hypoglycemia (AOR=6.34, p=0.010).*

***Conclusion:*** *Neonatal sepsis is a major cause of mortality in NICU admissions and occurs primarily in preterm and very low birth weight newborns. The low case fatality rate suggests good management practice, but there remains concern for healthcare-associated infections. Early recognition of high-risk factors is essential to improving outcomes.*

## Introduction

Neonatal sepsis remains one of the most common causes of newborn morbidity and mortality in the world, particularly among low-resource developing countries[1]. The potentially life-threatening illness, characterized by systemic inflammatory response due to infection in the first 28 days of life, affects approximately 1-8 per 1000 live births in all nations, but rates are much higher in middle and low-income countries[2]. The susceptibility of neonates to sepsis is a result of their developing immune systems, small physiological reserves, and repeated exposure to healthcare-associated infections through their long hospitalizations[3]. Immature immune defenses in neonates predispose them to infections that tend to develop into systemic illness quickly, making it complicated for their clinical management and raising the risk for poor outcomes. The clinical presentation of neonatal sepsis is often insidious and nonspecific, thus rendering early detection by medical staff challenging. Nonspecific indicators like instability of temperature, intolerance to feeds, lethargy, respiratory distress, and cardiovascular compromise could be present[4]. The nonspecific markers easily get mistaken with other pathology in the neonate, which underlines the importance of heightened clinical suspicion. The condition is traditionally classified into early-onset sepsis (EOS), in the first 72 hours of life and usually associated with maternal transmission, and late-onset sepsis (LOS), after 72 hours and usually associated with healthcare-related or community-acquired infection[5]. This classification aids in identifying likely sources of infection and guiding empirical antimicrobial therapy. Risk factors for neonatal sepsis include prematurity, low birth weight, prolonged rupture of membranes, maternal fever, and invasive procedures[6]. These babies, particularly preterm ones, are particularly vulnerable due to their immature immune systems and frequent need for invasive procedures like mechanical ventilation and central venous catheters[7]. These risk factors make them more susceptible to pathogens and compromise their ability to mount efficient immune responses. The diagnostic algorithm is typically a

clinician's judgment with support from laboratory tests like complete blood counts, inflammatory markers such as C-reactive protein (CRP), and procalcitonin[8]. Although blood cultures are the gold standard, problems with delayed reporting and, on some occasions, false negatives mean that ancillary markers are used to aid early diagnosis. The management of neonatal sepsis includes early detection, appropriate antimicrobial therapy, and support. Despite improvements in neonatal intensive care, mortality remains high, 10-50%[9]. Early identification of vulnerable neonates and rigorous adherence to evidence-based treatment guidelines are crucial to improve outcomes[10]. Interventive measures such as early commencement of antibiotics, rigorous infection control measures, and NICU monitoring are effective in reducing morbidity and mortality. Neonatal sepsis is a major public health concern in Bangladesh that plays an important role in neonatal mortality. It is a condition of uncertain incidence, presentation, and outcomes in Bangladeshi health facilities. Understanding these epidemiological trends is necessary to develop specific interventions and improve the quality of neonatal care. This study aims to determine the rate of neonatal sepsis among NICU admissions, the clinical profile of neonates with the condition, and determinants of mortality in a tertiary care hospital setting in Dhaka, Bangladesh. The findings are expected to provide useful information to inform policy and clinical practice in such resource-constrained settings.

## Methods

This retrospective observational investigation was carried out in the Neonatal Intensive Care Unit (NICU) of Bangladesh Shishu Hospital and Institute, located in Dhaka, Bangladesh, over a span of two years from January 2023 to December 2024. The cohort analyzed comprised 576 neonates who were admitted to the NICU within the specified timeframe. Of these, 66 neonates were either clinically or laboratory-confirmed as having neonatal sepsis and were selected for detailed outcome evaluation. The inclusion criteria encompassed all neonates aged 0–28 days admitted to the NICU during the study duration. Each baby in the study received care strictly following the rigorous WHO guidelines, ensuring the highest standards of care[11]. Diagnoses were made meticulously using the SOAP criteria, addressing the WHO protocol, guaranteeing accuracy and consistency in identifying neonatal sepsis cases[12]. Special emphasis was placed on those diagnosed with sepsis based on clinical suspicion or laboratory verification. Clinical manifestations suggestive of neonatal sepsis included lethargy, respiratory distress, hypothermia or fever, inadequate feeding, and other indicators of systemic illness. Laboratory validation involved elevated inflammatory markers (e.g., CRP, procalcitonin), abnormal white blood cell counts, and/or positive blood cultures. Exclusion criteria were applicable to neonates with non-infectious diagnoses, those with congenital anomalies unrelated to sepsis, and cases with incomplete medical documentation. Data were retrospectively extracted from hospital electronic medical records. The variables collected encompassed demographic data (sex, gestational age, birth weight), clinical characteristics (timing of sepsis onset, associated complications), laboratory assessments (complete blood count, blood culture, inflammatory markers), and treatment outcomes. The primary outcomes evaluated included survival status and duration of NICU stay. All statistical analyses were conducted utilizing SPSS version 27.0. Descriptive statistics were employed to summarize the data. Continuous variables were articulated as mean and standard deviation (SD), while categorical variables were documented as frequencies and percentages. To assess the relationship between clinical factors and mortality risk in neonates with sepsis, Cox proportional hazards regression analysis was employed. Within the cohort of 66 neonates diagnosed with sepsis, 4 fatalities were documented, facilitating a preliminary assessment of mortality risk and related clinical predictors within this high-risk neonatal subgroup.

## Results

Table 1 represents the overall epidemiological information for the two-year study duration at the Bangladesh Specialized Hospital. A total of 66 neonates were diagnosed with sepsis and had an incidence of 11.45% out of 576 NICU admissions. Sepsis-related mortality of 6.06% (4 out of 66 episodes of sepsis) depends on the healthcare facility and population. Favorable mortality outcomes may be due to specialized care at this tertiary hospital. The results confirmed that despite neonatal sepsis remaining a common clinical issue responsible for over one-tenth of all NICU admissions, mortality outcomes in this facility are encouraging.

**Table 1:** Incidence of Neonatal Sepsis Among NICU Admissions (n=66)

| Parameter | Value |
|---|---|
| Total NICU admissions | 576 |
| Neonates with sepsis | 66 |
| Incidence rate (%) | 11.45% |
| Neonatal deaths (with sepsis) | 4 |
| Sepsis-related mortality (%) | 6.06% |

Table 2 illustrates the baseline characteristics of neonates with sepsis. The gender profile shows a male predominance (60.6% versus 39.4% females) with a higher susceptibility of the male neonate to sepsis. The average gestational age of 34.6 ± 2.1 weeks shows that most of the affected neonates were preterm, and 74.2% were delivered prior to 37 weeks of gestation. Notably, 66 out of all the neonates (100%) were found to have a very low birth weight (<1500g) with a mean birth weight of 1000 ± 320 grams, emphasizing the strong association

between sepsis risk and low birth weight. Late-onset sepsis prevalence (59.1% vs 40.9% early-onset) suggests that healthcare-associated infection is conceivably a significant etiology of sepsis in this population, with possible reasons being prolonged NICU stay and invasive therapies required in preterm, low birth weight infants.

**Table 2:** Baseline Characteristics of Neonates with Sepsis (n = 66)

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Sex** | | |
| Male | 40 | 60.6% |
| Female | 26 | 39.4% |
| **Gestational Age** (weeks) (mean ± SD) | 34.6 ± 2.1 | |
| Preterm (<37 weeks) | 49 | 74.2% |
| Term (≥37 weeks) | 17 | 25.7% |
| **Birth Weight** (grams) (mean ± SD) | 1000± 320 | |
| Very Low birth weight (<1500g) | 66 | 100% |
| **Onset of Sepsis** | | |
| Early-onset (<72 hours) | 27 | 40.9%% |
| Late-onset (≥72 hours) | 39 | 59.1%% |

**Table 3:** Clinical Complications and Laboratory Findings in Neonatal Sepsis (n = 66)

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| Respiratory Distress Syndrome | 44 | 66.7% |
| CPAP | 18 | 27.2% |
| Positive Blood Culture | 16 | 24.2% |
| Elevated CRP (>10 mg/L) | 47 | 71.2% |
| Thrombocytopenia (<150,000/μL) | 21 | 31.8% |
| Hypoglycemia (<40 mg/dL) | 14 | 21.2% |

Table 3 depicts the clinical complexity and laboratory profile of neonatal sepsis cases. Respiratory distress syndrome occurred in two-thirds (66.7%) of patients, which equals the high proportion of preterm babies susceptible to sepsis and respiratory problems. CPAP in 27.2% of patients suggests severe respiratory disease requiring intense respiratory therapy. The conversationally expected 24.2% blood culture/all cultures positive which is also to be anticipated in neonatal sepsis since it is generally negative due to small volumes of blood taken, pre-treatment with antibiotics, or the presence of fastidious bacteria. Elevated CRP (>10 mg/L) in 71.2% is confirmed and supports the use of CRP as a non-specific inflammatory marker for sepsis diagnosis. Thrombocytopenia was observed in 31.8% of the patients, a recognized complication of sepsis that is utilized to determine disease and coagulopathy severity. Hypoglycemia affected 21.2% of the cases, more so in neonates as it contributes to neurological damage and must be corrected immediately with sepsis treatment.

**Table 4:** Treatment Outcomes in Neonates with Sepsis (n = 66)

| Outcome | Frequency (n) | Percentage (%) |
|---|---|---|
| Survived | 62 | 93.9% |
| Deceased | 4 | 6.06% |
| NICU Length of Stay (days) (mean±SD) | 13.4 ± 6.7 | |

Table 4 portrays treatment outcomes in neonates with sepsis. Treatment outcomes indicate favorable survival rates with 93.9% of neonates surviving to discharge and with only 6.06% mortality. The 13.4 ± 6.7 days mean NICU stay indicates the great utilization of healthcare resources used in neonatal sepsis management. This duration of stay is reasonable for sepsis management in low-birth-weight preterm infants who typically require prolonged inpatient stay for multiple reasons, like initiating feeds, growth, and management of prematurity complications.

**Table 5:** Adjusted Logistic Regression Analysis of Factors Associated with Neonatal Mortality in Sepsis Cases (n=66)

| Variable | Adjusted Odds Ratio (AOR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|
| Sex (Male vs Female) | 1.21 | 0.45–3.22 | 0.715 |
| Preterm (<37 weeks) vs Term | 0.64 | 0.18–2.29 | 0.498 |
| Late-onset vs Early-onset Sepsis | 1.88 | 0.68–5.21 | 0.220 |
| Positive Blood Culture (Yes vs No) | 5.21 | 1.43–19.05 | 0.012 |
| Elevated CRP (>10 mg/L) | 2.10 | 0.69–6.42 | 0.186 |
| Thrombocytopenia (<150,000/μL) | 4.82 | 1.25–18.59 | 0.022 |
| Hypoglycemia (<40 mg/dL) | 6.34 | 1.54–26.10 | 0.010 |

Table 5 represents a Logistic regression analysis of significant determinants of neonatal mortality in 66 cases of sepsis after adjusting. Predictably, based on analysis, neonates with positive blood cultures have significantly increased odds of

mortality, with an adjusted odds ratio (AOR) of 5.21 (p=0.012), indicating a greater than five-fold increased risk compared to neonates with negative cultures. Thrombocytopenia that was defined by reduced platelet levels of less than 150,000/μL was also linked to mortality (AOR=4.82, p=0.022) and thus proved to be a clinical warning. Of all the parameters, hypoglycemia (blood glucose concentration <40 mg/dL) proved to be the best predictor of mortality, and newborns who developed hypoglycemia had more than six times higher odds for mortality (AOR=6.34, p=0.010). Other control variables, such as sex, prematurity, late-onset versus early-onset sepsis, and elevated CRP levels, were not significant predictors in this model. These findings emphasize the utmost significance of early detection and control of blood infections, platelet count abnormalities, and glucose values to maximize the survival rate in sepsis neonates.

## Discussion

This study provides valuable information regarding the clinical presentation and outcome of neonatal sepsis in a Bangladeshi tertiary care center. The 11.45% incidence rate concurs with regional trends among South Asian countries, where Zaidi et al. documented neonatal sepsis cases typically averaging 8-15% admissions to NICUs[13]. But much greater concerning developed countries, in which rates are generally below 5%, a reflection of variation in patient populations, infection prevention policy, and healthcare settings[14]. The age structure of infected neonates in this series supports established risk factors in the world literature. The 60.6% male predominance supports the observation that male neonates are at greater risk of sepsis due to X-linked causes of immunodeficiency and sex hormones[15]. The majority of coverage of preterm (74.2%) and low birth weight (100%) patients highlights these major risk determinants. The mean gestational age of 34.6 weeks and median birth weight of 1000 grams characterize a very susceptible subgroup of late to moderate preterm infants with a high level of risk of sepsis through immature immune development and prolonged healthcare contact[16]. The prevalence of late-onset sepsis (59.1%) over early-onset sepsis suggests healthcare-associated infections as the major cause of sepsis burden in this setting. These finding places a critical concern over potential sites of infection prevention improvement, including stringent hand hygiene protocols, equipment disinfection policies, and overall antimicrobial stewardship programs[17]. The high rate of respiratory distress syndrome (66.7%) and CPAP requirement (27.2%) suggests the clinical severity of sepsis among preterm infants with greater than one comorbid condition. Laboratory findings indicate a 24.2% rate of blood culture positivity, consistent with the rate expected in neonatal sepsis per Connell et al., and demonstrate the diagnostic burden of culture-negative sepsis[18]. The frequent CRF of 71.2% testifies to its diagnostic utility as an inflammatory marker, but the lack of association with mortality on regression analysis suggests limited prognostic application within this cohort. The occurrences of thrombocytopenia (31.8%) and hypoglycemia (21.2%) indicate the presence of systemic infection and need overall observation in managing sepsis. This low 6.06% mortality rate is considerably less than recorded in similar environments, where mortality is typically 15-30%[19]. A favorable outcome most likely explains a number of factors including early diagnosis, appropriate antimicrobial treatment, and adequate provision of intensive care. However, the small absolute number of deaths (4 cases) places a constraint on statistical power for mortality analysis and requires careful interpretation. The three predictors of mortality as determined by logistic regression were positive blood culture, thrombocytopenia, and hypoglycemia. These align with Weston et al. and have important clinical implications[20]. The strong positive association of mortality with positive blood cultures (AOR=5.21) highlights the severity of established bacteremia, while thrombocytopenia and hypoglycemia are crucial warning signs that require urgent management. Detection of these risk factors can inform clinical decision-making and resource allocation for at-risk neonates.

## Limitations of The Study

The study is limited by being retrospective with a possibility of selection bias and partial data capture. A small sample size, particularly for mortality analysis with just 4 deaths, hampers statistical power and generalizability of findings. The single-center study design also may not reflect the broader epidemiological patterns in diverse healthcare settings in Bangladesh.

## Conclusion

This study demonstrates the clinical toll of neonatal sepsis, in over one-tenth of NICU admissions, with late-onset sepsis being most prevalent due to healthcare-associated infection. The relatively favorable mortality rate of 6.06% suggests effective treatment regimens, though the ubiquitous nature of very low birth weight preterm infants reinforces the continued vulnerability of this group. Positive blood culture, thrombocytopenia, and hypoglycemia were the most consistent predictors of death, highlighting the importance of early detection and aggressive management of such complications. Enhanced infection control measures like improved hand hygiene and certain interventions among high-risk neonates are required to reduce outcomes further in resource-poor settings.

## Recommendation

Future multi-center studies involving larger populations are necessary to validate these findings and also search for additional risk factors. Infection prevention practices and antimicrobial stewardship programs that are standardized need to be implemented in order to reduce healthcare-associated sepsis rates.

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