International Journal of Research in Medical Sciences
Jahan I et al. Int J Res Med Sci. 2026 Feb;14(2):630-635
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20260253

Original Research Article

Incidence and clinical outcomes of neonatal sepsis in neonatal intensive care unit admissions: a hospital-based study

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Received: 09 December 2025
Accepted: 08 January 2026

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ABSTRACT

Background: Neonatal sepsis is among the leading causes of mortality and morbidity among neonates, particularly in developing countries. There is limited data regarding the clinical presentation and epidemiological pattern of neonatal sepsis in Bangladesh. This study aimed to ascertain the incidence, clinical profile, and predictors of mortality of neonatal sepsis in a tertiary care center.
Methods: A retrospective observational study was conducted in Bangladesh Specialized Hospital (BSH), Dhaka, between January 2023 and December 2024. Among 576 neonatal intensive care unit (NICU) admissions, 66 neonates with sepsis diagnosed after clinical and laboratory criteria were observed. Data were extracted from electronic medical records related to demographics, clinical presentation, laboratory findings, and outcomes. Binary logistic regression analysis was performed to identify the predictors of mortality.
Results: The incidence of neonatal sepsis was 11.45% (66 out of 576 NICU admissions), with a mortality rate of 6.06% (4 out of 66 cases). Male neonates predominated (60.6%), and the majority were preterm (74.2%). All affected neonates were very low birth weight infants (<1500 g), with a mean birth weight of 1000 ± 320 g. Late-onset sepsis was more common than early-onset sepsis (59.1% vs 40.9%). Respiratory distress syndrome was observed in 66.7% of cases, and 27.2% required continuous positive airway pressure support. Blood culture positivity was detected in 24.2% of cases, while elevated C-reactive protein levels were present in 71.2%. The mean duration of NICU stay was 13.4 ± 6.7 days. Independent predictors of mortality included positive blood culture (AOR=5.21, p=0.012), thrombocytopenia (AOR=4.82, p=0.022), and hypoglycemia (AOR=6.34, p=0.010).
Conclusions: Neonatal sepsis accounted for 11.45% of NICU admissions and had a relatively low mortality (6.06%). Most cases occurred in preterm, very low birth weight neonates, with late-onset sepsis predominating. Positive blood culture, thrombocytopenia, and hypoglycemia were the key predictors of death, supporting early risk stratification and prompt targeted management.

Keywords: Neonatal sepsis, Early-onset sepsis, Late-onset sepsis, Epidemiological

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 EOS, in the first 72 hours of life and usually associated with maternal transmission, and 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 clinician 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 NICU of BSH, 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. 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 BSH. 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 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 low birth weight (<1500 g) with a mean birth weight of 1000±320 grams, emphasizing the strong association between sepsis risk and low birth weight. LOS prevalence (59.1% vs 59.1% 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 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. Mechanical ventilation 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 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 in-patient stay for multiple reasons like initiating feeds, growth, and management of prematurity complications.

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 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.

Table 1: Incidence of neonatal sepsis among NICU admissions.

Parameters	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: Baseline characteristics of neonates with sepsis (n=66).

Variables	N	Percentage (%)
Sex		
Male	40	60.6
Female	26	39.4
Gestational age (weeks) (mean±SD)	34.6±2.1	
Preterm (<37)	49	74.2
Term (≥37)	17	25.7
Birth weight (gm) (mean±SD)	1000±320	
Low birth weight (<2500)	66	100
Normal birth weight (≥2500)	0	0
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).

Variables	N	Percentage (%)
Respiratory distress syndrome	44	66.7
Mechanical ventilation	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 4: Treatment outcomes in neonates with sepsis (n=66).

Outcomes	N	Percentage (%)
Survived	62	93.9
Deceased	4	6.06
NICU length of stay (days) (mean±SD)	13.4±6.7	

Table 5: Binary logistic regression table, predictors of mortality in neonatal sepsis (n=66).

Predictor variables	Adjusted Odds Ratio (AOR)	95% CI for OR	P value
Preterm (<37 weeks)	0.64	0.45-3.22	0.715
Positive blood culture	5.21	1.43-19.05	0.012
Elevated CRP (>10 mg/L)	2.10	0.69-6.42	0.186
Constant (Intercept)	0.04	-	0.008
Sex (male vs. female)	1.21	0.45-3.22	0.715
Late-onset vs early-onset sepsis	1.88	0.68-5.21	0.220
Thrombocytopenia (<150,000/µl)	4.82	1.25-18.59	0.022
Hypoglycemia (<40 mg/dl)	6.34	1.54-26.10	0.010

DISCUSSION

This study provides significant data regarding the epidemiology and clinical implications of sepsis in newborns in a Bangladesh tertiary care environment. The rate of incidence that has been found at 11.45% is comparable with other South Asian countries as shown by Zaidi et al where rates of neonatal sepsis are typically reported between 8-15% of NICU admissions.[11] However, this is more than incidence rates from developed countries, which tend to be less than 5%, and reflects variations in patient demographics, infection control protocols, and healthcare facilities.[12] The demographic pattern of the affected neonates shows high-risk factors according to international literature. Male preponderance (60.6%) reaffirms the established fact that male neonates are at a higher risk of sepsis because of X-linked immunodeficiency and hormonal influences.[13] The overwhelming majority of preterm (74.2%) and low birth weight (100%) sepsis patients emphasize these known risk factors. The mean gestational age of 34.6 weeks and 1000 gm birth weight define a group of moderate to late pre-terms at particularly high risk for sepsis due to immature immune systems and extended healthcare exposure.[14] The proportionate burden of LOS (59.1%) over EOS suggests that healthcare-associated infection may be the prime reason for sepsis burden in this setting. It is a cause for concern since it points towards potential areas of infection prevention with increased hand hygiene, equipment disinfection, and antimicrobial stewardship programs.[15] The prevalence of respiratory distress syndrome (66.7%) and mechanical ventilation requirement (27.2%) reflects the clinical severity of sepsis in preterm infants with prevalent multimorbid conditions. Laboratory findings reflect the rate of positivity of blood culture of 24.2% as expected in neonatal sepsis with Connell et al but reflect the challenge in the diagnosis of culture-negative sepsis.[16] The high frequency of elevated CRP (71.2%) reaffirms its utility as a marker of diagnosis, yet failure to correlate with mortality in the model of regression proves limited prognostic utility in this group. The prevalence of thrombocytopenia (31.8%) and hypoglycemia (21.2%) indicates widespread infection of the body and the need for comprehensive monitoring in the course of treating sepsis. The 6.06% mortality is considerably lower than in most published series coming from similar settings, where mortality has been reported to range from 15-30%.[17] This suggests a favorable outcome due to various factors such as early diagnosis and treatment, appropriate antimicrobial treatment, and adequate intensive care. However, the relatively small absolute number of deaths (4 cases) results in limited statistical power for mortality analysis and should be interpreted cautiously. The logistic regression model identified three independent predictors of mortality among neonates with sepsis: positive blood culture, thrombocytopenia, and hypoglycemia. These findings are consistent with previous reports, including those by Weston et al, and carry important clinical implications.

Culture-proven sepsis reflects a higher burden of systemic infection and is often associated with more severe disease progression. Similarly, thrombocytopenia serves as a marker of disease severity and evolving coagulopathy, while hypoglycemia represents a critical metabolic derangement that can exacerbate organ dysfunction in septic neonates. Recognition of these high-risk features allows for earlier escalation of care, closer monitoring, and more targeted clinical decision-making, thereby supporting improved outcomes and more efficient resource utilization in neonatal intensive care settings.

Limitations

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 that neonatal sepsis affects 12.5% of NICU admissions with a relatively low mortality of 5.6%. Premature and low birth weight infants are affected most, with LOS being more common than EOS. Prematurity, mechanical ventilation requirement, and positive blood culture are all predictors of mortality. These findings emphasize the need for preventive measures and early detection protocols as a means to improve outcomes in this vulnerable population.

Recommendations

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.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Jahan I, Akter J, Ferdousi J, Sultana Z, Sabrin Z. Incidence and clinical outcomes of neonatal sepsis in neonatal intensive care unit admissions: a hospital-based study Int J Res Med Sci 2026;14:630-5.