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RESEARCH ARTICLE

Culture Positive Neonatal Sepsis - A Retrospective Analysis of Clinical Profile, Microbial Pattern and Outcome in a Tertiary NICU in Chennai

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Abstract

Background: Neonatal sepsis continues to be a leading cause of morbidity and mortality, particularly in preterm and low birth weight infants. The spectrum of organisms and their resistance patterns vary across centres, making local data essential to guide management. **Aim**: To describe the clinical profile, microbial pattern and outcomes of culture-positive neonatal sepsis in a tertiary NICU in Chennai. **Methodology**: This retrospective study included all neonates with positive blood cultures admitted to the NICU of Government RSRM Lying-In Hospital, Stanley Medical College, between January and December 2024. Demographic data, risk factors, clinical features, organism profile, antibiotic sensitivity, hospital stay and outcomes were analysed. **Results**: In this study 68 neonates were studied, of whom 57.4% were male. Nearly 80% were preterm and more than 80% had a birth weight below 2.5 kg. Late-onset sepsis was more frequent (61.8%) than early-onset sepsis (38.2%). *Klebsiella pneumoniae* (22.1%) and *Acinetobacter baumannii* (16.2%) were the most common Gram-negative isolates, while *Enterococcus faecalis* (16.2%) and *Staphylococcus haemolyticus* (13.2%) were the predominant Gram-positives. Gram-negatives showed high resistance to first-line agents; carbapenems and colistin were the most effective, whereas vancomycin and linezolid were reliable against Gram-positives. The mean hospital stay was 14.2 ± 6.5 days (EOS: 11.6 ± 5.2; LOS: 15.8 ± 7.4). Overall mortality was 16.2%, with higher fatality in multidrug-resistant Gram-negative and fungal infections. **Conclusion**: Culture-positive neonatal sepsis in our unit was closely linked to prematurity, low birth weight and invasive procedures. Gram-negative organisms predominated and contributed to most deaths, highlighting the need for updated local antibiograms, infection-control bundles and strict antibiotic stewardship to improve outcomes in this vulnerable population.

Keywords: Antibiotic Resistance, Culture-positive, *Klebsiella pneumoniae*, Mortality, Neonatal Sepsis, Preterm Infants

1. Introduction

Neonatal sepsis remains a major cause of morbidity and mortality worldwide, particularly in Low- and Middle-Income Countries (LMICs). It is estimated to contribute significantly to neonatal deaths, with a disproportionate burden in South Asia and sub-Saharan Africa[1,2]. Sepsis is traditionally classified into Early-Onset Sepsis (EOS), occurring within the first 72 hours of life, and Late-Onset Sepsis (LOS), which presents after 72 hours. EOS is usually related to vertical transmission from the mother, whereas LOS is more often associated with nosocomial pathogens and invasive procedures[3].

The microbiological profile of neonatal sepsis varies by geography and healthcare setting. In high-income countries, Group B *Streptococcus* and *Escherichia coli* remain leading causes of EOS[3]. By contrast, studies from LMICs have reported a predominance of Gram-negative organisms, particularly *K. pneumoniae* and *A. baumannii*, along with Coagulase-Negative *Staphylococci* (CoNS), such as *S. haemolyticus*, in LOS[4,5]. A systematic review noted that Gram-negative pathogens accounted for the majority of culture-positive

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cases in NICUs across Asia and Africa, with high levels of antimicrobial resistance[5].

Several studies highlight the clinical challenge of CoNS infections. While often dismissed as contaminants, *S. haemolyticus* and *Staphylococcus epidermidis* have emerged as true pathogens in preterm infants, associated with central line-related infections, biofilm formation, and multidrug resistance[6]. Similarly, *A. baumannii* has been implicated in NICU outbreaks, with many isolates showing carbapenem resistance and limited treatment options[7]. These trends are mirrored in Indian NICU data, where *Klebsiella* and *Acinetobacter* frequently dominate blood culture isolates[4].

Risk factors for neonatal sepsis include prematurity, very low birth weight, prolonged rupture of membranes, intrapartum fever, mechanical ventilation, and central line use[8]. Outcomes are strongly influenced by organism and resistance pattern: Gram-negative sepsis is associated with higher mortality compared to Gram-positive infections, and delays in initiating effective antibiotics worsen prognosis[9].

Diagnosis remains challenging due to nonspecific clinical features. Blood culture is the gold standard, though its sensitivity is limited by low blood volumes and prior antibiotic exposure[3]. Biomarkers such as C-Reactive Protein (CRP) and procalcitonin can aid diagnosis, but their predictive value is variable. Advances in molecular techniques show promise, though availability and cost remain barriers in LMICs[3].

Management of neonatal sepsis requires prompt empiric antibiotic therapy, guided by local antibiograms, with subsequent de-escalation when culture results are available. WHO guidelines recommend ampicillin plus gentamicin as empiric therapy for EOS, but high resistance rates in LMIC settings have forced many units to adopt broader empiric regimens[10]. Infection control measures- strict hand hygiene, central line bundles, and antibiotic stewardship- are essential to reduce sepsis burden and combat antimicrobial resistance[11].

Understanding the clinical profile, organism distribution, and antibiotic susceptibility in culture-positive neonatal sepsis is therefore crucial for timely and rational management. Such data not only helps guide empirical therapy but also strengthens infection-control measures, thereby improving outcomes in vulnerable newborn populations.

1.1 Aim of the Study

To study the clinical profile, microbiological pattern and outcome of culture positive neonatal sepsis in a tertiary care centre in Chennai.

1.2 Review of Literature

The epidemiology of causative organisms and their resistance patterns varies considerably across regions and even between different Neonatal Intensive Care Units (NICUs) within the same country. Several recent Indian and international studies have attempted to characterise these trends and their implications for clinical practice.

The National Neonatal-Perinatal Database (NNPD, 2021-22) reported that sepsis continues to account for a significant proportion of neonatal admissions and deaths in India[12]. The data showed a predominance of Gram-negative organisms, particularly *K. pneumoniae* and *A. baumannii*, with increasing levels of multidrug resistance. The report strongly recommended that each centre maintain and regularly update its antibiogram to guide empirical therapy and reduce mortality.

Sharma *et al.*[13] in a comprehensive review of neonatal sepsis across Indian hospitals, confirmed the predominance of Gram-negative pathogens, especially *Klebsiella* and *Acinetobacter*. They also noted a steep decline in the effectiveness of first-line agents such as ampicillin and gentamicin. The authors concluded that changing microbial profiles, coupled with poor sensitivity to commonly used antibiotics, demand continuous surveillance and revision of empirical regimens.

Pawar *et al.*[14] studied 176 culture-positive neonatal sepsis cases in a tertiary NICU in South India. They found that Gram-negative bacilli were responsible for nearly two-thirds of cases, with *K. pneumoniae* and *E. coli* being common. Importantly, they observed significantly higher mortality among neonates infected with multidrug-resistant strains. The study emphasised that routine monitoring of microbial trends and resistance profiles is essential to improve survival rates.

Patel *et al.*[15] from Western India highlighted the dual burden of *Klebsiella* and *S. aureus* as leading causes of sepsis. They differentiated early- and late-onset sepsis, noting that early cases were more often linked to maternal risk factors such as prolonged rupture of membranes, while late-onset infections were mostly

hospital-acquired. This study shed light on the role of hospital-acquired infections in perpetuating resistant strains and highlighted the need for strict infection-control measures.

On a broader policy level, the WHO Scoping Report on Antimicrobial Resistance (Gandra *et al.*[16]) identified India as one of the global epicentres of antimicrobial resistance. Neonatal sepsis was highlighted as a major driver of antibiotic use and resistance in the country. The report stressed the urgency of antimicrobial stewardship programs, rational antibiotic use, and enhanced infection-prevention protocols in hospitals.

Chaurasia *et al.*[17] in a South Asia-focused review published in the BMJ, described neonatal sepsis in the region as a "silent pandemic". They noted not only the high incidence but also diagnostic challenges due to nonspecific clinical presentations and limited laboratory facilities. The rising prevalence of Extended-Spectrum Beta-Lactamase (ESBL)- producing *Entero bacteriaceae* and carbapenem-resistant non-fermenters was particularly concerning.

Kumaravel *et al.*[18] provided recent data from a NICU in Tamil Nadu, focusing specifically on Gram-negative infections. They reported carbapenem resistance in nearly one-quarter of *K. pneumoniae* isolates and over half of *A. baumannii* isolates. Mortality was highest among preterm infants with multidrug-resistant infections. The study underscored the urgent need for antimicrobial stewardship and stringent infection-control policies in Indian NICUs.

In addition, the ICMR-AMR surveillance network (2019-22) has consistently reported high levels of resistance among neonatal sepsis pathogens, with >50 % carbapenem resistance in Acinetobacter and rising colistin resistance[19]. AIIMS and other tertiary NICUs in India have reported similar findings, with Gram-negative infections associated with significantly higher case fatality rates compared to Gram-positive sepsis. Reports of fungal sepsis, particularly Candida species, are also increasing among very low birth weight neonates, adding further complexity to management.

Across these studies, three themes consistently emerge:

1. Predominance of Gram-negative organisms - *Klebsiella, Acinetobacter*, and *E. coli* are the leading causes of neonatal sepsis in India.
2. High antimicrobial resistance - Resistance to first-line agents (ampicillin, gentamicin) is widespread, with concerning levels of cephalosporin and carbapenem resistance also documented.
3. Determinants of mortality - Prematurity, very low birth weight, need for mechanical ventilation, and infection with multidrug-resistant organisms are key risk factors for poor outcomes.

2. Methodology

Study design: Retrospective observational study.
Study place: NICU, Government RSRM lying in hospital, Stanley Medical College, Chennai.
Study period: 1 month (01/08/2025 to 31/08/2025)
Sample size: All neonates with culture-positive sepsis admitted to the NICU from January 2024 to December 2024 will be included in the study

2.1 Inclusion Criteria

1. All neonates admitted to the NICU with positive blood culture reports during the study period.
2. Both inborn and out born babies with culture-positive sepsis.
3. Neonates with complete medical records available for review.

2.2 Exclusion Criteria

1. Neonates with clinical suspicion of sepsis but with negative blood cultures.
2. Culture reports considered contaminants (*e.g.*, single growth of skin flora without clinical correlation).
3. Incomplete or missing case records.
4. Neonates discharged or transferred before blood culture results were available.

This is a retrospective observational study conducted in the NICU, Government RSRM Lying-In Hospital, Stanley Medical College, Chennai, during January 2024 to December 2024. All neonates with culture-positive blood cultures and complete medical records are included, while those with negative cultures, contaminants, incomplete records, or transferred before results are excluded.

Data collected include sex, gestational age, birth weight, place of birth (inborn/outborn), maternal and neonatal risk factors, onset of sepsis (EOS ≤72

h, LOS >72 h), microbiological profile, antibiotic susceptibility, and outcomes.

Statistical analysis is performed using chi-square and Fisher's exact tests to compare organism distribution and mortality. A p-value < 0.05 is considered significant.

3. Results

Among the newborns with positive blood culture results, 57.4% were male, while 42.6% were female.

Thus, there is a male predominance in culture-positive blood infections in this population.

The ratio of male to female in this table is approximately 1.35:1 (*i.e.* for every ~1.35 males, there is 1 female).

In our study cohort, the majority of neonates with early onset sepsis were preterm (<37 weeks), accounting for nearly 80% of cases. Among them, the largest subgroup was late preterm infants (34-37 weeks; 26.5%), followed by those between 28-32 weeks (22.1%) and 32-34 weeks (19.1%). Extremely preterm infants (<28 weeks) comprised 11.8% of the study population.

More than 80% of the infants are in the low birth weight categories (< 2.5 kg). Specifically, 7% are extremely low birth weight (<1 kg), 35 % are very low birth weight (11.5 kg), and 38% weigh between

Table 1. Sex distribution in blood culture positive cases

Sex	Number of newborns
Male	39(57.4)
Female	29(42.6%)

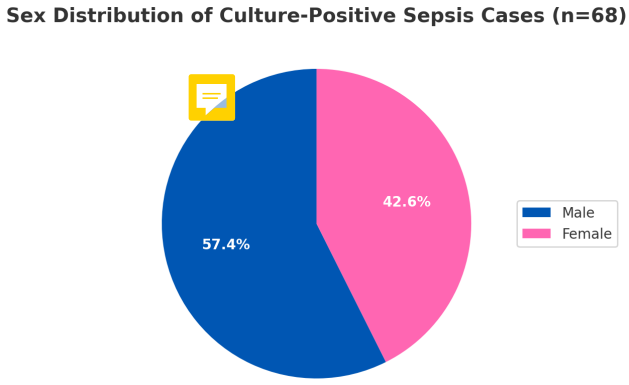

Figure 1. Sex distribution in blood culture positive cases.

Table 2. Distribution of gestational age

Gestational Age	Number of Newborns
<28 weeks	8 (11.8%)
28-32weeks	15 (22.1%)
32-34 weeks	13 (19.1%)
34-37weeks	18 (26.5%)
37-42 weeks	14 (20.6%)
> 42 weeks	Nil

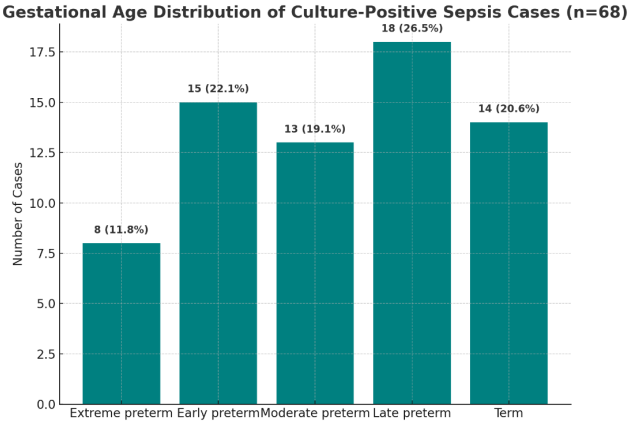

Figure 2. Distribution of gestational age.

Table 3. Distribution of birth weight in neonates with culture positive sepsis

Birth Weight	Number of Newborns
< 1 kg	5 (7%)
1-1.5 kg	24(35%)
1.5-2.5 kg	26(38%)
> 2.5 kg	13(19%)

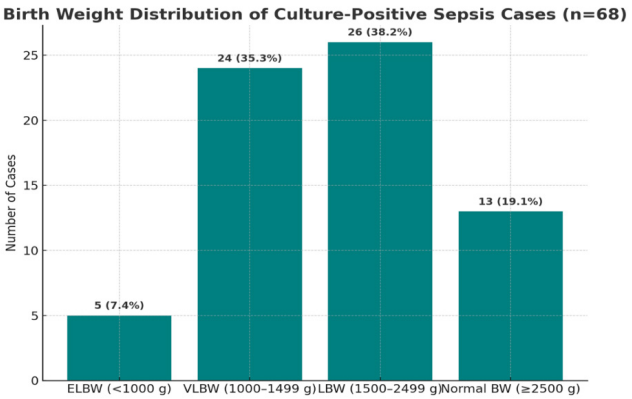

Figure 3. Distribution of birth weight in neonates with culture positive sepsis.

Table 4. Distirbution of neonates based on their place of birth

Place of Birth	Number of Newborns
Inborn	64 (94.1 %)
Outborn	4 (5.9 %)

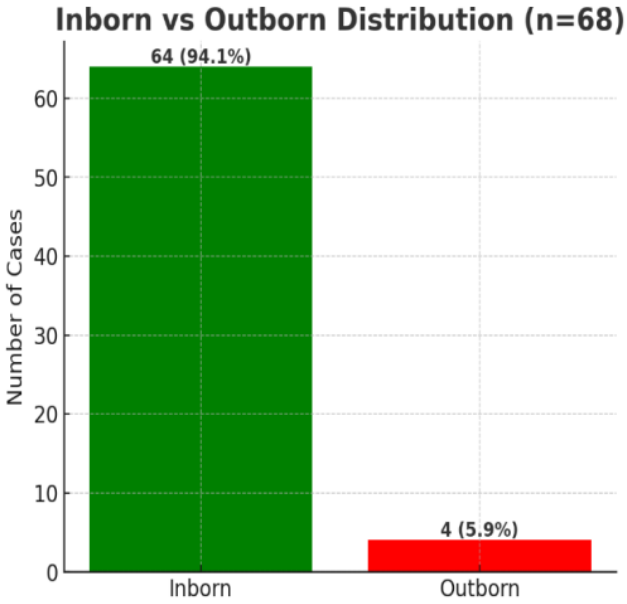

Figure 4. Distirbution of neonates based on their place of birth.

1.5–2.5 kg. Only 19% are >2.5 kg (normal birth weight or large).

This indicates a strong association between lower birth weight and blood culture positivity

This table shows the distribution of neonates based on their place of birth .94% of cases were inborn. Only 5.9 % were born outborn,

More than half of the neonates with sepsis were delivered by LSCS (55.9%), followed by normal vaginal delivery (41.2%) and forceps delivery (2.9%). The higher proportion of LSCS may reflect the overall delivery practices at the centre rather than a direct association with sepsis risk.

In the present study, PROM/PPROM was the most frequent maternal risk factor associated with early onset sepsis, being present in 13.2% of cases. This finding is consistent with previous studies, where rupture of membranes has been strongly linked with ascending intrauterine infections and increased neonatal vulnerability to sepsis. Birth asphyxia was present in 10% cases.

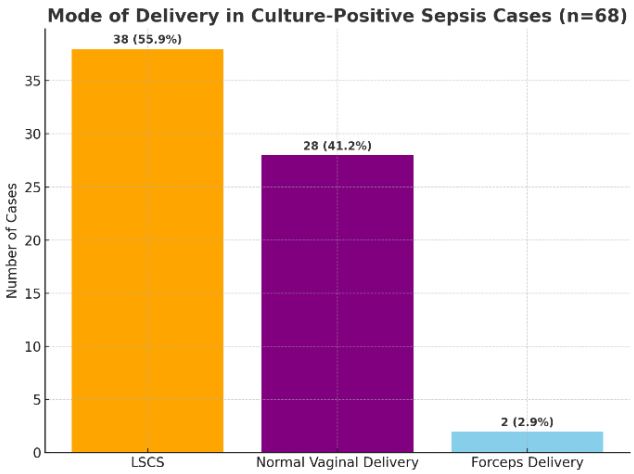

Figure 5. Distribution of mode of delivery in culture positive sepsis cases.

Table 5. Distribution of risk factors for early onset sepsis

Variables	Present n (%)	Absent n (%)
Maternal fever	2 (2.9)	66 (97.1)
PROM / PPROM	9 (13.2)	59 (86.8)
Birth asphyxia	7(10.3)	61 (89.7)
Foul smelling liquor	2 (2.9)	66 (97.1)
Prolonged ROM (>18 hrs)	2 (2.9)	66 (97.1)

Table 6. Distribution of risk factors for late-onset sepsis

Risk Factors	Frequency
Birth weight < 750 g	2 (2.9)
Presence of central venous catheters	14 (20.6)
Mechanical ventilation	19 (27.9)
Delayed enteral feeding	13 (19.1)
Patent Ductus Arteriosus (PDA)	6 (8.8)
Bronchopulmonary dysplasia	0 (0.0)
Necrotising Enterocolitis (NEC)	4 (5.9)

In our study, the most frequent late-onset sepsis risk factor was mechanical ventilation (27.9%), followed by central venous catheterisation (20.6%) and delayed enteral feeding (19.1%). These findings are consistent with earlier reports where invasive procedures and prolonged parenteral support were strongly associated with nosocomial infections in preterm and critically ill neonates. The results highlight the importance of strict infection-control practices and early initiation of enteral feeding to reduce LOS incidence.

Table 7. Distribution of symptoms at presentation

Presenting Symptoms	Number of Newborns	Percentage
Lethargy	37	54.4
Poor feeding	35	51.5
Respiratory distress	33	48.5
Seizures	13	19.1
Temperature instability	18	26.5
Apnea	11	16.2
Abdominal distension	9	13.2
Vomiting	7	10.3

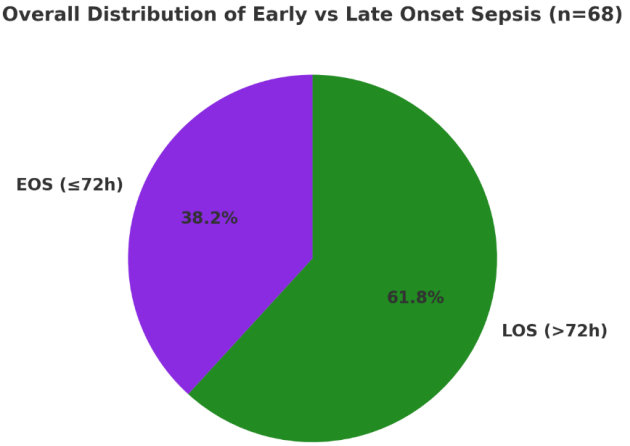

Figure 6. Proportion of EOS (≤72h) and LOS (>72h) in culture-positive cases.

Lethargy, poor feeding, and respiratory distress were the most frequent clinical features of neonatal sepsis in our study, consistent with findings from earlier reports. Temperature instability, seizures, and apnea were less common but usually reflected severe disease. The predominance of nonspecific signs highlights the diagnostic challenge of neonatal sepsis and the importance of prompt cultures and supportive investigations for timely management

This pie chart shows that, Late-Onset Sepsis (LOS) accounted for 61.8% of cases, whereas Early-Onset Sepsis (EOS) comprised 38.2%. The higher burden of LOS reflects the contribution of prematurity, prolonged hospitalization, and invasive interventions as major risk factors in neonatal sepsis.

In our study, the mean duration of hospital stay among neonates with culture-positive sepsis was 14.2 ± 6.5 days (range 5-37 days). Babies with early-onset sepsis had a comparatively shorter stay, with a mean of 11.6 ± 5.2 days, whereas those with late-onset sepsis required prolonged admission, averaging 15.8 ± 7.4 days. This trend reflects the higher burden of prematurity, invasive procedures, and multidrug-resistant infections in LOS

Table 8. Distribution of duration of hospital stay in neonates

Duration of Stay	EOS (n=26)	LOS (n=42)	Total (n=68)
≤7 days	6	5	11
8–14 days	10	14	24
15–21 days	7	11	18
>21 days	3	12	15

Table 9. Distribution of profile of microorganisms in blood culture

Microorganism	Number of cases (n)	Percentage (%)
S. haemolyticus	9	13.2
S. aureus	2	2.9
S. hominis	1	1.5
K. pneumoniae	15	22.1
E. coli	7	10.3
A. baumannii	11	16.2
E. faecalis	11	16.2
P. aeruginosa	1	1.5
Serratia marcescens	1	1.5
Enterobacter cloacae	2	2.9
Achromobacter xylosoxidans	2	2.9
Listeria monocytogenes	1	1.5
Candida parapsilosis	2	2.9
Salmonella typhi	2	2.9
Sphingomonas paucimobilis	1	1.5
Total	68	100

In our study, Gram-negative organisms predominated, with *K. pneumoniae* (22.1%) and *A. baumannii* (16.2%) being the most frequent isolates. *E. faecalis* and *S. haemolyticus* were the leading Gram-positive organisms, while fungal and rare bacterial pathogens were less common. Overall, Gram-negative bacilli were the principal causative agents of neonatal sepsis in this cohort.

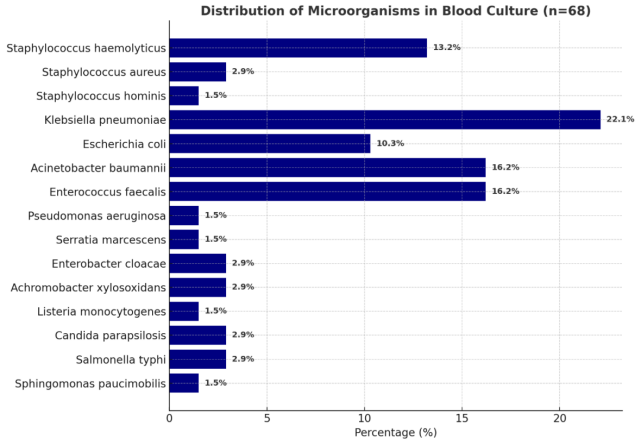

Figure 7. Distribution of profile of microorganisms in blood culture.

Table 10. Distribution of microorganism based on the onset of sepsis

Organism	Total (n)	EOS (n, %)	LOS (n, %)
S. haemolyticus	9	1 (1.5%)	8 (11.8%)
S. aureus	2	0 (0.0%)	2 (2.9%)
S. hominis	1	0 (0.0%)	1 (1.5%)
K. pneumoniae	15	10 (14.7%)	5 (7.4%)
E. coli	7	6 (8.8%)	1 (1.5%)
A. baumannii	11	2 (2.9%)	9 (13.2%)
E. faecalis	11	2 (2.9%)	9 (13.2%)
P. aeruginosa	1	0 (0.0%)	1 (1.5%)
S. marcescens	1	0 (0.0%)	1 (1.5%)
E. cloacae	2	1 (1.5%)	1 (1.5%)
A. xylosoxidans	2	0 (0.0%)	2 (2.9%)
L. monocytogenes	1	1 (1.5%)	0 (0.0%)
C. parapsilosis	2	1 (1.5%)	1 (1.5%)
S. typhi	2	2 (2.9%)	0 (0.0%)
S. paucimobilis	1	0 (0.0%)	1 (1.5%)
Total	68 (100%)	26 (38.2%)	42 (61.8%)

This study shows that Late-Onset Sepsis (LOS) was more common (61.8%) than Early-Onset Sepsis (EOS) (38.2%). The most frequent pathogen overall was *K. pneumoniae*, particularly in EOS, while *A. baumannii* and *E. faecalis* were more associated with LOS. *S. haemolyticus* also present mostly in LOS cases.

Escherichia coli were a leading cause of EOS, aligning with its role in vertical transmission. Rare pathogens like *Listeria monocytogenes* and *Salmonella typhi* were only found in EOS, while *Candida parapsilosis* occurred in both.

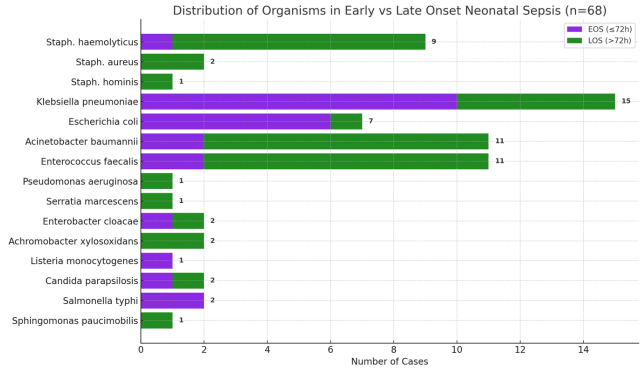

Figure 8. Distribution of microorganism based on the onset of sepsis.

Table 11. Statistical analysis for organisms based on the onset of sepsis

Organism	EOS (n)	LOS (n)	Odds Ratio	p-value
Escherichia coli	6	1	12.3	0.0106
Klebsiella pneumoniae	10	5	4.63	0.0157
Staphylococcus haemolyticus	1	8	0.17	0.1378
Acinetobacter baumannii	2	9	0.31	0.1839
Enterococcus faecalis	2	9	0.31	0.1839

These findings emphasize the need for targeted empirical treatment and strong infection control measures, especially for preventing hospital-acquired LOS.

The analysis shows that *E. coli* and *K. pneumoniae* were significantly more associated with early-onset sepsis (EOS). *E. coli* had the highest odds ratio (OR = 12.3, $p = 0.0106$), followed by *K. pneumoniae* (OR = 4.63, $p = 0.0157$), both showing statistically significant associations with EOS.

In contrast, *Staphylococcus haemolyticus*, *A. baumannii*, and *Enterococcus faecalis* were more common in Late-Onset Sepsis (LOS), but their associations were not statistically significant ($p > 0.05$). These trends suggest that Gram-negative bacteria, especially *E. coli* and *K. pneumoniae*, play a key role in EOS, while LOS tends to involve hospital-acquired pathogens.

Our study shows that most of the Gram-negative organisms were highly resistant to the commonly used first-line drugs. *K. pneumoniae* and *A. baumannii* had very poor response to ampicillin, gentamicin, and

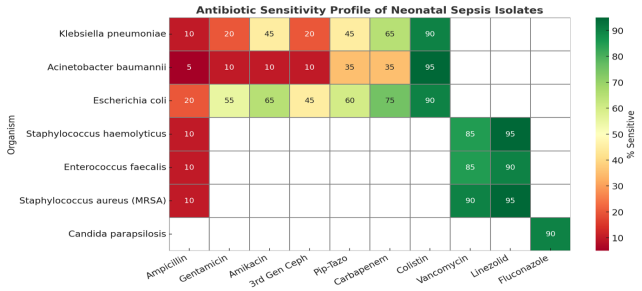

Figure 9. Antibiotic sensitivity profile of neonatal sepsis isolates.

third-generation cephalosporins, with only partial sensitivity to piperacillin-tazobactam. Better activity was seen with carbapenems and consistently high sensitivity to colistin, which remain the most reliable options for these resistant strains.

Escherichia coli was comparatively more susceptible, with moderate sensitivity to aminoglycosides and cephalosporins, and good activity of carbapenems and colistin.

Among the Gram-positive isolates, *S. haemolyticus* and *E. faecalis* were resistant to ampicillin but retained excellent sensitivity to vancomycin and linezolid. Similarly, MRSA isolates remained highly sensitive to these agents.

For fungal infections, *Candida parapsilosis* was uniformly sensitive to fluconazole, making it a suitable first-line option in our setting.

Overall, these results highlight the need to avoid routine use of first-line antibiotics in our NICU and to strengthen antibiotic stewardship, with carbapenems, colistin, vancomycin, and linezolid reserved for resistant infections

Out of 68 patients with sepsis, 83.8% survived, while 16.2% died, indicating a relatively high survival rate. However, the mortality rate of 16.2% remains clinically significant, reflecting the serious nature of sepsis, particularly in vulnerable populations such as neonates or critically ill patients.

This outcome emphasizes the importance of early diagnosis, appropriate antimicrobial therapy, and intensive supportive care to improve survival. Continued efforts in infection control and timely intervention are essential to further reduce sepsis-related mortality

In this study, organism-specific mortality analysis showed that Gram-negative organisms had higher case fatality rates, particularly *A. baumannii* (27.3%)

Table 12. Outcome of neonates with culture positive sepsis

Outcome	Number (n)	Percentage (%)
Survived	57	83.8
Expired	11	16.2
Total	68	100

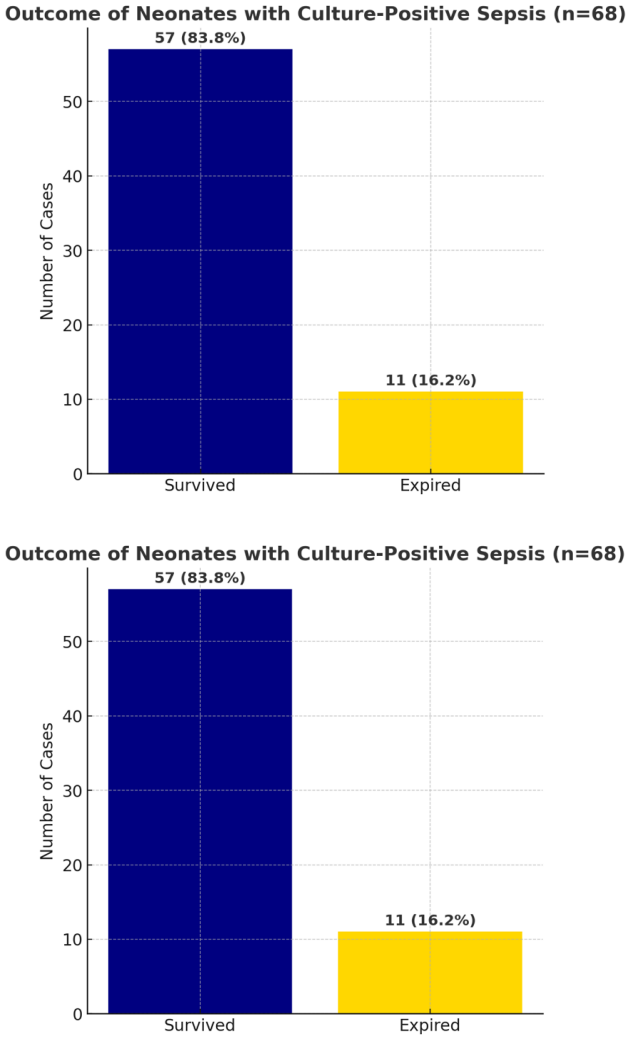

Figure 10. Outcome of neonates with culture positive sepsis.

and *K. pneumoniae* (20%). *P. aeruginosa* mortality was 100%, but this finding is not statistically significant due to the single case (OR = ∞, p = 0.25). Gram-positive organisms, such as *S. haemolyticus*, showed much lower mortality (11.1%), consistent with their low virulence profile, whereas *S. aureus* had higher lethality (50%). *C. parapsilosis* also carried a high mortality risk (50%).

Although none of these associations reached statistical significance (all p > 0.05), likely due to small

Table 13. Microbial profile and mortality risk in sepsis cases

Organism	Total Cases (n)	Deaths (n)	Mortality Rate (%)	Odds Ratio	p-value
S. haemolyticus	9	1	11.1%	0.61	1.000
K. pneumoniae	15	3	20.0%	1.41	0.696
A. baumannii	11	3	27.3%	2.30	0.367
E. coli	7	1	14.3%	0.85	1.000
S. aureus	2	1	50.0%	5.60	0.299
C. parapsilosis	2	1	50.0%	5.60	0.299
P. aeruginosa	1	1	100%	inf	0.250

subgroup sizes, the trend indicates that Gram-negative and fungal infections contribute disproportionately to mortality.

4. Discussion

This retrospective analysis of 68 neonates with culture-positive sepsis from our tertiary NICU shows that prematurity and low birth weight remain the dominant host-related risk factors. Males accounted for 57.4% of cases and nearly 80% were preterm, with late preterms (34-37 weeks; 26.5%) forming the largest subgroup. More than 80% of infants weighed <2.5 kg at presentation, underlining the vulnerability of small and immature infants to bloodstream infections.

Late-onset sepsis predominated (61.8% *vs* 38.2% EOS), reflecting the high burden of prolonged hospitalisation, invasive support, and neonatal comorbidities in our unit. Among maternal risk factors for EOS, PROM/PPROM was the most frequent (13.2%). For LOS, mechanical ventilation (27.9%), central venous catheterisation (20.6%), and delayed enteral feeding (19.1%) were the leading contributors, consistent with device-related and nosocomial infection pathways.

Gram-negative *bacilli* were the principal pathogens in this cohort. *K. pneumoniae* (22.1%) and *A. baumannii* (16.2%) were the most frequent isolates, while *E. faecalis* (16.2%) and *S. haemolyticus* (13.2%) were the leading Gram-positive organisms. *E. coli* and Klebsiella were significantly associated with EOS, supporting vertical/perinatal transmission, whereas *S. haemolyticus*, *Acinetobacter*, and *Enterococcus* were more frequent in LOS- findings consistent with other tertiary NICU reports from LMICs.

Antibiotic susceptibility patterns were concerning. Most Gram-negative isolates showed poor sensitivity to first-line agents such as ampicillin, gentamicin, and third-generation cephalosporins. Carbapenems and colistin retained the highest activity against resistant strains, while Gram-positives were uniformly susceptible to vancomycin and linezolid. *C. parapsilosis* remained fluconazole-sensitive. These results emphasise the declining usefulness of first-line antibiotics and the need for robust antibiotic stewardship supported by updated local antibiograms.

Clinically, lethargy, poor feeding, and respiratory distress were the commonest presenting features, while seizures, apnea, and abdominal distension marked severe illness. The overall mortality rate was 16.2%. Organism-specific outcomes showed that mortality was disproportionately higher in infections caused by multidrug-resistant Gram-negative organisms and fungi. Case fatality rates were 27.3% for *A. baumannii*, 20% for *K. pneumoniae*, and 50% for both *S. aureus* and *C. parapsilosis*. All *Pseudomonas* infections (though only one case) resulted in death. In contrast, *S. haemolyticus* had a relatively lower mortality of 11.1%. Although not statistically significant due to small subgroup sizes, these patterns highlight the critical role of resistant Gram-negatives and fungi in adverse outcomes.

Hospital stay was prolonged in LOS compared with EOS. The mean length of stay in the cohort was approximately 14 days, with EOS averaging 11-12 days and LOS around 16 days. This reflects the higher burden of prematurity, invasive procedures, and multidrug-resistant infections among LOS cases, and underscores the resource-intensive nature of managing neonatal sepsis.

5. Conclusion

1. Prematurity and low birth weights were the strongest risk factors for neonatal sepsis.

2. Late-onset sepsis was more common than early-onset sepsis in our cohort.
3. Gram-negative organisms such as *K. pneumoniae*, *A. baumannii* were the predominant pathogens.
4. High resistance to first-line antibiotics was observed; carbapenems and colistin remained effective for Gram-negatives, while vancomycin and linezolid were reliable for Gram-positives.
5. Mortality was higher in multidrug-resistant Gram-negative and fungal infections.
6. Strengthening infection-control practices, promoting early enteral feeding, and implementing antibiotic stewardship are critical to improving outcomes.

6. Limitations

1. Single-centre study, reducing generalisability to other settings
2. Modest sample size, limiting statistical power for subgroup mortality analysis

7. References

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