

Determinants of Length of Hospital Stay in Neonatal Intensive Care Unit Patients: An Observational Study from a Tertiary Care HospitalKrishna Parmar¹, Krutik Gamit¹^{1,2}Senior Resident, Department of Paediatrics, Shri M. P. Shah Government Medical College and G G Government Hospital, Jamnagar, Gujarat, India
(Previous affiliation: Junior Resident, Smt. NHL Medical College, Ahmedabad, Gujarat, India)

Received: 22-02-2026 / Revised: 23-03-2026 / Accepted: 28-04-2026

Corresponding Author: Krishna Parmar

Conflict of interest: Nil

Abstract:**Background:** The length of hospital stay (LoHS) in a neonatal intensive care unit (NICU) is an important surrogate marker of neonatal morbidity, clinical complexity, and resource utilization. Identifying the determinants of prolonged NICU stay is essential for improving care quality, planning resources, and reducing healthcare costs, particularly in resource-limited settings.**Objectives:** To identify the clinical, demographic, and perinatal determinants of length of hospital stay among neonates admitted to the NICU of a tertiary care hospital.**Methods:** This observational study was conducted over a period of 12 months at the NICU of a tertiary care teaching hospital in Gujarat. A total of 320 neonates meeting inclusion criteria were enrolled. Detailed perinatal, demographic, and clinical data were collected. Prolonged LoHS was defined as hospital stay beyond the 75th percentile of the study sample. Univariate and multivariate logistic regression analyses were used to identify independent determinants of prolonged LoHS.**Results:** The mean LoHS was 8.4 ± 6.2 days (range 1–52 days). Prolonged LoHS (>14 days) was observed in 28.4% of neonates. On multivariate analysis, significant independent determinants of prolonged LoHS included: low birth weight (LBW) (<2500 g) (aOR 3.21; 95% CI 1.87–5.51, p<0.001), prematurity (gestational age <37 weeks) (aOR 2.94; 95% CI 1.72–5.03, p<0.001), neonatal sepsis (aOR 4.12; 95% CI 2.30–7.38, p<0.001), respiratory distress syndrome (RDS) (aOR 2.68; 95% CI 1.41–5.09, p=0.003), requirement of mechanical ventilation (aOR 3.56; 95% CI 1.89–6.71, p<0.001), outborn status (aOR 1.89; 95% CI 1.12–3.19, p=0.017), and late initiation of enteral feeding (aOR 2.45; 95% CI 1.33–4.52, p=0.004).**Conclusions:** LBW, prematurity, neonatal sepsis, RDS, mechanical ventilation, outborn status, and delayed enteral feeding are the major determinants of prolonged NICU stay. Targeted interventions to prevent and promptly treat these conditions may substantially reduce NICU LOHS and improve resource utilization.**Keywords:** Neonatal Intensive Care Unit, Length of Stay, Determinants, Neonatal Sepsis, Low Birth Weight, Prematurity.**DOI:** 10.25258/ijcpr.18.5.41This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

The neonatal period — the first 28 days of life — is the most vulnerable phase of human existence, with the highest risk of morbidity and mortality concentrated in this window. [1] Neonatal intensive care units (NICUs) serve as the primary setting for the management of sick and high-risk newborns, providing advanced monitoring, respiratory support, nutrition, and pharmacotherapy. The length of hospital stay (LoHS) in the NICU is a composite outcome that reflects the biological complexity of the neonate's illness, the effectiveness of clinical management, and the efficiency of the healthcare system. [2]

Prolonged NICU stay is associated with multiple adverse consequences, including increased exposure to nosocomial infections, parental anxiety and bonding difficulties, higher healthcare expenditures, and bed unavailability for other critically ill neonates. [3] In tertiary care facilities in India, where NICUs are frequently stretched beyond capacity, understanding the determinants of LoHS is both a clinical and a public health priority. [4]

Several studies from high-income countries have established key predictors of prolonged NICU LoHS, including gestational age, birth weight, sepsis, respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), and

bronchopulmonary dysplasia. [5–7] A systematic review published in *Frontiers in Pediatrics* (2023) identified birth weight, gestational age, sepsis, NEC, bronchopulmonary dysplasia, and retinopathy of prematurity as the most critical risk factors for prolonged NICU LoHS. Similar findings have emerged from studies in low- and middle-income countries (LMICs), though contextual factors such as referral patterns, outborn status, and nutritional support practices may vary considerably. [8]

From Gujarat, studies on NICU morbidity and mortality patterns have reported that RDS, meconium aspiration syndrome (MAS), neonatal sepsis, hyperbilirubinemia, and hypoxic-ischemic encephalopathy (HIE) are the predominant causes of admission, and that low birth weight and prematurity drive higher mortality. However, data specifically examining determinants of LoHS from Gujarat remain limited, leaving a gap that prevents local policy formulation. [9]

The present study was therefore undertaken to determine the clinical, perinatal, and demographic predictors of LoHS among neonates admitted to the NICU of a tertiary care hospital in Gujarat, with the intent of generating locally applicable evidence to guide NICU resource planning and clinical quality improvement.

Methodology

Study Design and Setting: This was an observational study conducted in the NICU of a tertiary care teaching hospital in Gujarat over a period of 12 months (January 2024 to December 2024). The NICU is a Level III unit with 20 beds, providing full neonatal intensive care including mechanical ventilation, total parenteral nutrition (TPN), phototherapy, and surgical consultation.

Study Population: All neonates (age 0–28 days) admitted to the NICU during the study period were eligible for inclusion. Neonates who were admitted only for observation and discharged within 24 hours, those with major congenital anomalies incompatible with life, those who died within 48 hours of admission, and neonates who were transferred out to another facility were excluded from the study.

Sample Size: Based on a previous study reporting a mean NICU LoHS of 7 days with a standard deviation of 6.5 days, and assuming a 10% precision and 95% confidence interval, the minimum required sample size was calculated to be 300. Accounting for a 10% dropout/exclusion, a total of 320 neonates were enrolled. [10]

Data Collection: After obtaining written informed consent from parents/guardians and ethical clearance from the Institutional Ethics Committee, a pre-designed and pre-tested proforma was used to collect the following data:

- **Demographic data:** Date of birth, sex, birth weight, gestational age, inborn/outborn status
- **Maternal data:** Age, parity, mode of delivery, antenatal care, premature rupture of membranes (PROM), gestational diabetes, pregnancy-induced hypertension (PIH)
- **Neonatal clinical data:** Apgar score at 1 and 5 minutes, need for resuscitation at birth, primary diagnosis, co-morbidities, requirement for mechanical ventilation, CPAP, inotropes, TPN, blood transfusion, and phototherapy
- **Laboratory data:** Complete blood count (CBC), C-reactive protein (CRP), blood culture, serum bilirubin, blood gas analysis
- **Nutritional data:** Day of initiation of enteral feeding, day of achievement of full enteral feeds, type of feeding
- **Outcome:** LoHS in days, discharge status (recovered, against medical advice, death)

Definitions

- **Prolonged LoHS:** Defined as a hospital stay exceeding 14 days, consistent with the 75th percentile in the study sample. [11]
- **Low birth weight (LBW):** Birth weight <2500 g
- **Very low birth weight (VLBW):** Birth weight <1500 g
- **Preterm:** Gestational age <37 completed weeks
- **Neonatal sepsis:** Clinical signs of infection with positive blood culture, or clinical sepsis treated with antibiotics as per NNF India guidelines
- **RDS:** Diagnosis based on clinical features and chest X-ray findings (ground-glass opacity, air bronchograms) in a preterm neonate
- **Birth asphyxia/HIE:** As per standard Sarnat staging criteria

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0 and jamovi. Continuous variables were expressed as mean \pm standard deviation (SD) or median (interquartile range, IQR) as appropriate. Categorical variables were expressed as frequencies and percentages. Univariate analysis was performed using chi-square test and unpaired t-test. Variables with $p < 0.2$ on univariate analysis were included in a multivariate binary logistic regression model to identify independent predictors of prolonged LoHS (>14 days). Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were computed. A p -value of < 0.05 was considered statistically significant.

Results

Baseline Characteristics: A total of 320 neonates were enrolled during the study period. The male-to-female ratio was 1.4:1 (187 males, 133 females). Mean gestational age was 35.6 ± 3.1 weeks; 48.4% (n=155) were preterm (<37 weeks). Mean birth weight was $2,248 \pm 680$ g; 58.1% (n=186) were LBW (<2500 g) and 19.4% (n=62) were VLBW (<1500 g). A total of 201 (62.8%) neonates were inborn and 119 (37.2%) were outborn (referred from peripheral facilities). This pattern is consistent with data reported from Gujarat tertiary centers.

Morbidity Profile: The leading causes of NICU admission were neonatal sepsis (36.6%, n=117), followed by RDS (22.2%, n=71), birth asphyxia/HIE (16.3%, n=52), neonatal hyperbilirubinemia (12.5%, n=40), MAS (5.9%, n=19), and others (6.5%, n=21). This admission profile is consistent with data reported from other

tertiary NICUs in India, where neonatal sepsis, prematurity, and birth asphyxia dominate the admission spectrum.

Length of Hospital Stay: The mean LoHS was 8.4 ± 6.2 days (median 7 days, range 1–52 days). A total of 91 neonates (28.4%) had prolonged LoHS (>14 days). The mean hospital stay for neonatal sepsis cases was 14.3 ± 8.1 days compared to 5.0 ± 3.2 days in non-sepsis cases ($p < 0.001$), which is in concordance with published literature showing a nearly threefold increase in LoHS in sepsis neonates. Neonates on mechanical ventilation had a significantly higher mean LoHS (18.7 ± 9.3 days) compared to those not ventilated (6.1 ± 3.8 days, $p < 0.001$).

Univariate Analysis: The following variables were significantly associated with prolonged LoHS (>14 days) on univariate analysis:

Variable	Prolonged LOHS (n=91)	Normal LOHS (n=229)	p-value
Preterm (<37 wks)	76 (83.5%)	79 (34.5%)	<0.001
LBW (<2500 g)	72 (79.1%)	114 (49.8%)	<0.001
VLBW (<1500 g)	38 (41.8%)	24 (10.5%)	<0.001
Neonatal sepsis	64 (70.3%)	53 (23.1%)	<0.001
RDS	47 (51.6%)	24 (10.5%)	<0.001
Mechanical ventilation	49 (53.8%)	21 (9.2%)	<0.001
Outborn status	46 (50.5%)	73 (31.9%)	0.002
Late enteral feeding (>72 h)	58 (63.7%)	61 (26.6%)	<0.001
Positive blood culture	38 (41.8%)	19 (8.3%)	<0.001
PROM (>18 hours)	31 (34.1%)	42 (18.3%)	0.004

Multivariate Analysis: On multivariate binary logistic regression, the following variables emerged

as independent and statistically significant determinants of prolonged LoHS.

Determinant	aOR	95% CI	p-value
Neonatal sepsis	4.12	2.30–7.38	<0.001
Mechanical ventilation	3.56	1.89–6.71	<0.001
LBW (<2500 g)	3.21	1.87–5.51	<0.001
Prematurity (<37 weeks)	2.94	1.72–5.03	<0.001
Late enteral feeding	2.45	1.33–4.52	0.004
RDS	2.68	1.41–5.09	0.003
Outborn status	1.89	1.12–3.19	0.017

The Nagelkerke R^2 of the final model was 0.62, indicating that the model explained approximately 62% of the variance in prolonged LOHS. The Hosmer-Lemeshow goodness-of-fit test was non-significant ($p=0.43$), suggesting a good model fit.

Outcomes

Of the 320 enrolled neonates, 289 (90.3%) were discharged after recovery, 14 (4.4%) died, 11 (3.4%) left against medical advice (LAMA), and 6 (1.9%) were transferred. Mortality was significantly higher in the prolonged LoHS group (9/91, 9.9%) compared to the normal LoHS group (5/229, 2.2%, $p=0.009$).

Discussion

This prospective study from a tertiary NICU in Gujarat examined the determinants of length of hospital stay in 320 admitted neonates over one year. The mean LoHS of 8.4 days is comparable to findings from other Indian tertiary NICUs; Sahiledengle et al. reported a median LoHS of 7 days among NICU patients in their prospective study, and an Indian study reported a mean LoHS of 7 days across a large cohort of 3,902 neonates. [8]

Neonatal sepsis was the strongest independent predictor of prolonged LoHS (aOR 4.12), consistent with a study from a tertiary care hospital reporting a

mean stay of 29.0 ± 18.5 days in sepsis cases versus 5.0 ± 3.2 days in non-sepsis cases. Sepsis necessitates prolonged antibiotic courses, nutritional support, management of complications such as disseminated intravascular coagulation (DIC), and frequent invasive procedures, all of which prolong stay. Nosocomial infections, particularly common in VLBW neonates undergoing invasive procedures, further compound the LoHS burden. [12]

Prematurity and LBW were closely interlinked determinants, as expected. A study specifically examining very-low-birth-weight (VLBW) preterm neonates reported that gestational age, type of management, and presence of complications were the most significant predictors of LoHS, with a median stay of 24 days in that cohort. Among preterm neonates, physiologic immaturity of multiple organ systems — particularly the lungs, gastrointestinal tract, and immune system — mandates extended NICU care. Consistent with this, a systematic review in *Frontiers in Pediatrics* confirmed gestational age and birth weight as among the most critical determinants of NICU LoHS globally. [4]

Mechanical ventilation emerged as a highly significant predictor (aOR 3.56). Ventilated neonates are by definition critically ill and require more intensive monitoring, frequent blood gas analyses, sedation, and post-extubation respiratory support before discharge criteria can be achieved. This finding resonates with data from an Indian study where the use of mechanical ventilation and inotropes was independently associated with poor outcomes including prolonged stay. [13]

Respiratory distress syndrome independently prolonged LoHS (aOR 2.68). RDS predominantly affects preterm neonates and requires surfactant therapy, respiratory support, and careful fluid and nutritional management. The burden of RDS on NICU LoHS has been consistently documented in Indian tertiary centers, where RDS is among the top three causes of both admissions and mortality. [14]

Delayed enteral feeding initiation (beyond 72 hours) was an independent determinant of prolonged LoHS (aOR 2.45). This finding aligns with studies on VLBW infants that demonstrated associations between late feeding initiation and longer NICU stay. Trophic feeding, even in very small volumes, promotes gut maturation, reduces bacterial translocation, and shortens the duration of TPN dependency, all of which contribute to earlier discharge. A study on VLBW premature neonates reported that days to initiate trophic feeding and enteral intolerance were among the most important factors affecting NICU duration. [15]

Outborn status was independently associated with prolonged LoHS (aOR 1.89). Outborn neonates

often arrive after a delay, in a more deteriorated clinical state, having received variable initial management at peripheral facilities. This increased severity at admission translates to longer treatment duration. Additionally, outborn VLBW neonates are more likely to have received suboptimal thermal care and resuscitation, predisposing them to sepsis and metabolic complications. Data from Gujarat confirm that outborn neonates had significantly higher mortality rates compared to inborn neonates. [9]

Positive blood culture was significant on univariate analysis and corroborates the sepsis findings; confirmed bacteremia, requiring pathogen-directed prolonged antibiotic therapy, results in particularly extended stays. A Polish cohort demonstrated that infected neonates had LoHS twice that of uninfected neonates. Comparable findings in our population highlight that prevention of neonatal sepsis — through strict hand hygiene, aseptic technique for line insertion, early breast milk feeding, and antibiotic stewardship — is a key strategy to reduce LoHS. [4]

The proportion of neonates with prolonged LoHS (28.4%) is consistent with published literature. A large North Indian NICU study found 75th percentile LoHS to be 14 days in a Level III NICU cohort. Our study reaffirms that the determinants of prolonged LoHS are consistent across Indian settings, despite geographic and institutional differences, providing external validity to our findings. [11]

Limitations: This study was conducted at a single tertiary care center in Gujarat and may not represent community-level NICU data. The study enrolled neonates over one year, and seasonal variations in morbidity (e.g., increased sepsis in monsoon months) may have influenced results. Socioeconomic data and maternal education levels, which may independently affect LoHS through compliance and decision-making, were not fully analyzed. The definition of prolonged LoHS was based on the study sample's 75th percentile; future studies may use standardized cutoffs for comparability.

Conclusions

Neonatal sepsis, requirement of mechanical ventilation, low birth weight, prematurity, respiratory distress syndrome, late enteral feeding initiation, and outborn status are independent determinants of prolonged length of hospital stay in NICU patients at a tertiary care center in Gujarat. These findings have actionable implications: strengthening antenatal care to reduce preterm births and LBW, implementing robust infection control bundles to prevent sepsis, promoting early trophic feeding protocols, and improving pre-transport

stabilization of outborn neonates are priority interventions. Locally derived data such as these are critical to formulate context-specific NICU quality improvement programs in the Gujarat region.

References

1. Newborn mortality n.d. <https://www.who.int/news-room/fact-sheets/detail/newborn-mortality> (accessed April 21, 2026).
2. Schulman J. Studying determinants of length of hospital stay. *Journal of Perinatology* 2006;26:243–5. <https://doi.org/10.1038/SJ.JP.7211478>.
3. Albanese FB, Ventura D de S, Perroud MW, Nogueira de Souza R, Morau MV, Visacri MB, et al. Adverse events in the neonatal intensive care unit identified by triggers. *Front Pharmacol* 2025;16:1539687. <https://doi.org/10.3389/FPHAR.2025.1539687/FULL>.
4. Fu M, Song W, Yu G, Yu Y, Yang Q. Risk factors for length of NICU stay of newborns: A systematic review. *Front Pediatr* 2023;11:1121406. <https://doi.org/10.3389/FPED.2023.1121406/TEXT>.
5. Ismail L, Markowsky A, Adusei-Baah C, Gallizzi G, Hall M, Kalburgi S, et al. Variation in Length of Stay by Level of Neonatal Care Among Moderate and Late Preterm Infants. *Hosp Pediatr* 2024;14:37–44. <https://doi.org/10.1542/HPEDS.2023-007252>.
6. Wang K, Hussain W, Birge JR, Schreiber MD, Adelman D. A High-Fidelity Model to Predict Length-of-Stay in the Neonatal Intensive Care Unit (NICU). *INFORMS J Comput* 2021;34:183. <https://doi.org/10.1287/IJOC.2021.1062>.
7. Alhamawi NJ, Alharbi HA, Alqahtani MH, Sr. NJA, Alharbi H, Alqahtani M. Reasons and Factors Affecting the Neonatal Intensive Care Unit (NICU) Length of Stay of Full-Term Newborns: A Systematic Review. *Cureus* 2024;16. <https://doi.org/10.7759/CUREUS.73892>.
8. Sahiledengle B, Tekalegn Y, Zenbaba D, Woldeyohannes D, Teferu Z. Which Factors Predict Hospital Length-of-Stay for Children Admitted to the Neonatal Intensive Care Unit and Pediatric Ward? A Hospital-Based Prospective Study. *Glob Pediatr Health* 2020;7. <https://doi.org/10.1177/2333794X20968715;PAGE:STRING:ARTICLE/CHAPTER>.
9. Rohit M, Bhavesh M, Punitha KM. Study of the Morbidity and the Mortality Pattern in the Neonatal Intensive Care Unit at a Tertiary Care teaching Hospital in Gandhinagar District, Gujarat, India. *Journal of Research in Medical and Dental Science* | n.d.;3. <https://doi.org/10.5455/jrmds.20153311>.
10. P. K, S. KK, K. V. A study on the length of stay of neonates in neonatal intensive care unit in a referral hospital in India. *Int J Contemp Pediatrics* 2019;6:746–9. <https://doi.org/10.18203/2349-3291.IJCP20190723>.
11. Gavhane N, Agarwal R, Vallabhneni D, Resident J. Determinants of Length of Stay in The Neonatal Intensive Care Unit: A Clinical and Demographic Analysis in A Tertiary Care Centre 2025. <https://doi.org/10.21276/SSR-IIJLS.2025.11.4.29>.
12. Singh S, Vangala AR. Prevalence and Risk Factors of Neonatal Sepsis in a Tertiary Care Hospital. *Journal of Contemporary Clinical Practice* 2024;10:155–61. <https://doi.org/10.61336/JCCP/24-01-20>.
13. Paudel PK, Bhandari P, Kc N, Devkota B. Morbidity and Mortality Profile of Neonates Admitted in Neonatal Intensive Care Unit. *J Nepal Health Res Counc* 2024;21:373–9. <https://doi.org/10.33314/JNHRC.V21I3.4168>.
14. Nair AT. Morbidity and Mortality Profile of Newborns Admitted to the Neonatal Intensive Care Unit of a Tertiary Care Teaching Hospital of Assam. *Journal of Medical Science And Clinical Research* 2020;08. <https://doi.org/10.18535/JMSCR/V8I1.109>.
15. Niknajad A, Ghojzadeh M, Sattarzadeh N, Bashar Hashemi F, Dezhm Khoy Shahgholi F. Factors affecting the neonatal intensive care unit stay duration in very low birth weight premature infants. *J Caring Sci* 2012;1:85–92. <https://doi.org/10.5681/JCS.2012.013>.