

Patterns and Outcomes of Neonatal Admissions to the Neonatal Intensive Care Unit at Omdurman Maternity Hospital, Sudan: A Descriptive Cross-Sectional Study

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Abstract

Background: Neonatal morbidity and mortality remain critical public health challenges in low- and middle-income countries. Neonatal Intensive Care Units (NICUs) play an essential role in improving neonatal survival. Understanding admission patterns and clinical outcomes is vital for clinical auditing, resource allocation, and optimizing perinatal care protocols. **Objective:** To evaluate the patterns, clinical indications, maternal-neonatal determinants, and outcomes of neonates admitted to the NICU at Omdurman Maternity Hospital, Sudan. **Methods:** A hospital-based descriptive analytical cross-sectional study was conducted between October 20 and December 20, 2025. A consecutive sample of 50 neonates admitted to the NICU was enrolled. Maternal, neonatal, clinical, and therapeutic data were extracted retrospectively from medical records using a structured data collection instrument. Statistical analyses were performed using SPSS version 27.0, applying descriptive metrics and Chi-square / Fisher's exact tests to examine associations between delivery mode and clinical outcomes. **Results:** Most mothers were aged 25–30 years (46.0%), with 86.0% attending antenatal care. Emergency cesarean section was the primary mode of delivery (52.0%). Preterm neonates (<37 weeks) accounted for 60.0% of admissions, and low birth weight (<2500 g) constituted 84.0% (LBW: 44.0%, VLBW: 32.0%, ELBW: 8.0%). Neonatal resuscitation at birth was required in 72.0% of cases. The predominant indication for admission was respiratory distress syndrome (RDS) (74.0%), followed by suspected neonatal sepsis (18.0%). During hospitalization, acquired sepsis occurred in 28.0%, and 50.0% had a hospital stay exceeding 7 days. Overall in-hospital mortality was 2.0% (n=1), with 56.0% discharged either fully recovered or clinically improved. Mode of delivery was significantly associated with hospital-acquired sepsis ($p = 0.002$), but not with length of stay ($p = 0.233$) or final disposition ($p = 0.367$). **Conclusion:** Prematurity, low birth weight, and RDS represent the primary burden of NICU admissions in this setting. Enhancing intrapartum monitoring, universal access to continuous positive airway pressure (CPAP), and rigorous infection prevention programs are crucial to improving neonatal outcomes in resource-limited tertiary centers.

Keywords: Neonatal Intensive Care Unit; Prematurity; Respiratory Distress Syndrome; Neonatal Morbidity; Sudan; Cross-Sectional Study.

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1. INTRODUCTION

Neonatal health is a major determinant of child survival and a fundamental indicator of global healthcare quality. Despite international efforts aligned with Sustainable Development Goal 3 (SDG 3.2)—which targets reducing neonatal mortality to at least as low as 12 per 1,000 live births by 2030—newborn morbidity and mortality remain disproportionately high in sub-Saharan Africa and resource-constrained environments.

Neonatal Intensive Care Units (NICUs) serve as specialized tertiary hubs designed to manage high-risk newborns, particularly preterm infants, those with low birth weight (LBW), severe birth asphyxia, and neonatal sepsis. In Sudan, healthcare facilities face unique infrastructural and socioeconomic challenges that directly impact perinatal workflows, maternal follow-up, and the availability of advanced respiratory modalities such as non-invasive continuous positive airway pressure (CPAP) and mechanical ventilation.

Omdurman Maternity Hospital is the largest specialized maternity and neonatal referral center in Sudan. Characterizing the clinical patterns of admission, underlying maternal risk factors, therapeutic requirements, and outcomes in this high-volume tertiary center is essential to generating baseline data for quality improvement, policy revision, and clinical training. This study was undertaken to evaluate the admission patterns, therapeutic interventions, and clinical outcomes among neonates admitted to the NICU of Omdurman Maternity Hospital in 2025.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A hospital-based descriptive and analytical cross-sectional study was conducted at the Neonatal Intensive Care Unit of Omdurman Maternity Hospital, Khartoum State, Sudan. The unit operates with a 22-bed/incubator capacity, 6 phototherapy units, radiant warmers, CPAP machines, and basic resuscitation and monitoring infrastructure, serving as a tertiary clinical and academic training center.

2.2 Study Population and Sampling

The target population comprised all neonates admitted to the NICU during the study period from October 20, 2025, to December 20, 2025. A consecutive sampling approach was utilized. Inclusion criteria encompassed all admitted neonates regardless of gestational age, birth weight, or sex. Exclusion criteria included neonates with incomplete medical records and those discharged against medical advice (DAMA) prior to establishing a diagnosis or completing initial management.

2.3 Data Collection Instrument

Data were abstracted retrospectively from verified institutional admission registers and structured inpatient medical records. The extraction tool covered four domains:

- **Maternal and Obstetric Profile:** Maternal age, chronic illnesses, gestational infections, micronutrient supplementation, smoking exposure, parity, previous miscarriage or preterm birth, pregnancy plurality, antenatal care (ANC) attendance, pregnancy complications, labor complications, and delivery mode.
- **Neonatal Baseline Characteristics:** Gestational age category (preterm <37 weeks vs. term 37–41 weeks), birth weight classification (Normal $\geq$ 2500 g, Low Birth Weight 1500–2499 g, Very Low Birth Weight 1000–1499 g, Extremely Low Birth Weight <1000 g), gender, need for delivery room resuscitation, and presence of birth asphyxia.
- **Admission Indications and Clinical Interventions:** Primary respiratory and non-respiratory admission diagnoses, congenital anomalies, surgical status, respiratory

modalities administered (oxygen, CPAP), feeding methods, antimicrobial regimens (empirical vs. targeted), phototherapy, and vital sign status.

- **In-Hospital Morbidity and Clinical Outcomes:** Length of NICU stay (<3 days, 3–7 days, >7 days), occurrence of acquired complications (e.g., hospital-acquired sepsis, hyperbilirubinemia, metabolic derangements), and final clinical disposition at the conclusion of inpatient care.

2.4 Statistical Analysis

Data were compiled, coded, and analyzed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY). Categorical variables were presented as absolute frequencies (n) and percentages (%). Bivariate cross-tabulations were conducted to evaluate associations between mode of delivery and neonatal outcomes (length of stay, final outcome, and acquired morbidities). Statistical significance was assessed using the Chi-square test and Fisher's exact test where cell counts were sparse (cell counts < 5). A two-sided p-value of < 0.05 was considered statistically significant.

2.5 Ethical Considerations

Ethical approval was granted by the Institutional Ethics Committee of Omdurman Maternity Hospital and the Ministry of Health, Khartoum. Strict data confidentiality was maintained by de-identifying records, omitting patient names and medical record numbers, and utilizing the dataset strictly for academic and clinical research purposes.

3. RESULTS

3.1 Maternal and Obstetric Characteristics

A total of 50 neonates and their respective mothers were evaluated. As detailed in Table 1, the modal maternal age group was 25–30 years (46.0%). Chronic medical conditions were documented in 18.0% of mothers (hypertension: 12.0%; diabetes: 4.0%; asthma: 2.0%), while 82.0% had no chronic illnesses. Active pregnancy-associated infections included urinary tract infections (24.0%), malaria (20.0%), and dengue fever (8.0%).

Antenatal micronutrient supplementation was high, with 34.0% receiving combined folic acid, calcium, and vitaferral, and 24.0% receiving a four-agent regimen including vitamin D. Antenatal care (ANC) attendance was 86.0%. Premature rupture of membranes (PROM) was the most frequent antepartum complication (24.0%). Emergency cesarean section was the predominant delivery mode (52.0%), followed by spontaneous vaginal delivery (32.0%) and elective cesarean section (16.0%). Labor complications were documented in 34.0% of deliveries (obstructed labor: 18.0%; prolonged labor: 12.0%; malpresentation: 4.0%).

Table 1: Maternal demographic and obstetric profile (N = 50)

Maternal / Obstetric Variable	Frequency (n)	Percentage (%)
Maternal Age (years)		
18–24	13	26.0%
25–30	23	46.0%
31–40	13	26.0%
41–50	1	2.0%
Chronic Medical Illness		
None	41	82.0%
Hypertension	6	12.0%
Diabetes Mellitus	2	4.0%
Asthma	1	2.0%
Antenatal Care (ANC) Attendance		
Attended ANC	43	86.0%
No ANC	7	14.0%
Mode of Delivery		
Emergency Cesarean Section	26	52.0%
Spontaneous Vaginal Delivery	16	32.0%
Elective Cesarean Section	8	16.0%

3.2 Neonatal Demographics and Clinical Characteristics

Of the 50 admitted neonates, 56.0% were male and 44.0% were female (Table 2). Preterm infants (<37 weeks) constituted 60.0% of admissions. Categorization by birth weight revealed that 44.0% were LBW (1500–2499 g), 32.0% were VLBW (1000–1499 g), 8.0% were

ELBW (<1000 g), and only 16.0% had normal birth weight (≥ 2500 g). Resuscitation at birth was required in 72.0% of cases, primarily via oxygen administration (68.0%) and CPAP (10.0%). Clinical evidence of birth asphyxia was documented in 42.0% of admitted neonates.

Table 2: Baseline neonatal demographics and clinical characteristics (N = 50)

Neonatal Characteristic	Frequency (n)	Percentage (%)
Gestational Age		
Preterm (<37 weeks)	30	60.0%
Term (37–41 weeks)	20	40.0%
Birth Weight Classification		
Normal (≥ 2500 g)	8	16.0%
Low Birth Weight (1500–2499 g)	22	44.0%
Very Low Birth Weight (1000–1499 g)	16	32.0%
Extremely Low Birth Weight (<1000 g)	4	8.0%
Delivery Room Resuscitation		
Required Resuscitation	36	72.0%
No Resuscitation Required	14	28.0%
Documented Birth Asphyxia		
Present	21	42.0%
Absent	29	58.0%

3.3 Admission Indications, Clinical Interventions, and Length of Stay

Respiratory pathology was the primary driver of admission, headed by RDS in 74.0% (n=37), transient tachypnea of the newborn (TTN) in 4.0%, meconium aspiration syndrome (MAS) in 2.0%, and neonatal pneumonia in 2.0% (Table 3). Suspected early-onset sepsis was noted in 14.0% and late-onset sepsis in 4.0% at admission. Congenital anomalies were identified in 10.0% of patients (CNS: 8.0%; cardiac: 2.0%). No patient presented with a surgical pathology requiring immediate operative intervention.

Therapeutically, oxygen support in the NICU was provided to 90.0% of neonates, and CPAP to 8.0%. Nutritional support included intravenous fluids (58.0%), direct breastfeeding (24.0%), and enteral tube feeding (18.0%). Empirical antibiotic therapy was initiated in 80.0%, while 20.0% received targeted therapy. Phototherapy was administered in 30.0% of cases. Length of stay was prolonged, with 50.0% of neonates hospitalized for >7 days, 40.0% for 3–7 days, and 10.0% for <3 days.

Table 3: Clinical indications, respiratory support, and length of stay (N = 50)

Clinical Parameter	Frequency (n)	Percentage (%)
Primary Respiratory Condition		
Respiratory Distress Syndrome (RDS)	37	74.0%
Transient Tachypnea of Newborn (TTN)	2	4.0%
Meconium Aspiration Syndrome (MAS)	1	2.0%
Pneumonia	1	2.0%
Good Respiratory Status (No distress)	9	18.0%
NICU Respiratory Modality		
Oxygen Therapy	45	90.0%
Continuous Positive Airway Pressure (CPAP)	4	8.0%
No Respiratory Support Needed	1	2.0%
Length of NICU Stay		
< 3 days	5	10.0%
3–7 days	20	40.0%
> 7 days	25	50.0%

3.4 Outcomes and Cross-Tabulation Analysis

Regarding overall clinical outcomes, 34.0% (n=17) were discharged alive and well, 22.0% (n=11) showed clinical improvement, 16.0% (n=8) required minimal continuing support, 16.0% (n=8) required ongoing stabilization/resuscitation, 10.0% (n=5) experienced unresolved complications, and 2.0% (n=1) died during the hospital stay. Acquired sepsis during NICU stay was documented in 28.0% (n=14). Clinical disposition categories were evaluated based on the neonates' documented clinical status at the point of discharge or chart review closure.

Bivariate cross-tabulation (Table 4) demonstrated a statistically significant association between the mode of delivery and the occurrence of hospital-acquired sepsis ($p = 0.002$), with neonates born via cesarean delivery exhibiting higher rates of acquired infection. In contrast, no statistically significant associations were identified between mode of delivery and length of stay ($p = 0.233$) or final clinical disposition ($p = 0.367$).

Table 4: Bivariate association between mode of delivery and neonatal outcomes (N = 50)

*Statistically significant at $p < 0.05$ (Fisher's exact / Chi-square test). Note: Clinical disposition categories reflect recorded patient status at the conclusion of inpatient management / chart assessment

Clinical Parameter	Elective C-Section (n=8)	Emergency C-Section (n=26)	Vaginal Delivery (n=16)	Total (N=50)	p-value
Length of Stay					0.233
< 3 days	2	2	1	5	
3–7 days	1	10	9	20	
> 7 days	5	14	6	25	
Hospital-Acquired Sepsis					0.002*
Acquired Sepsis	6	7	1	14	
None	2	19	15	36	
Clinical Disposition / Outcome Status					0.367
Alive and Well	3	7	7	17	
Improved	2	5	4	11	
Needs Minimal Support	2	2	4	8	
Requires Resuscitation / Support	0	7	1	8	
Unresolved Complications	1	4	0	5	
Death	0	1	0	1	

4. DISCUSSION

This study outlines the spectrum of admissions and clinical outcomes in a primary tertiary neonatal unit in Sudan. The high prevalence of preterm admissions (60.0%) and low birth weight (84.0% combined) underscores the persistent burden of prematurity in this population. While 86.0% of mothers attended ANC, the high incidence of preterm delivery and intrapartum

complications suggests potential gaps in the depth of high-risk screening, timing of referrals, or universal administration of antenatal corticosteroids.

Respiratory Distress Syndrome (RDS) emerged as the single most common indication for NICU admission (74.0%), aligning with broader epidemiological evidence identifying surfactant

deficiency and prematurity as major contributors to neonatal morbidity in sub-Saharan Africa. The heavy reliance on basic oxygen therapy (90.0%) relative to non-invasive CPAP (8.0%) illustrates the resource limitations present in the clinical setting. Expanding early non-invasive respiratory support has been demonstrated to reduce progression to severe respiratory failure and shorten duration of stay.

The rate of emergency cesarean delivery (52.0%) and delivery room resuscitation (72.0%) reflects a high-risk referral case mix. Many mothers presented with antepartum complications such as PROM (24.0%) or intrapartum obstruction (18.0%). Mode of delivery demonstrated a statistically significant association with hospital-acquired sepsis ($p = 0.002$), with neonates delivered via operative routes experiencing higher infection rates, possibly secondary to prolonged rupture of membranes, emergency surgical conditions, or prolonged invasive device exposure.

The observed in-hospital mortality rate in this cohort was 2.0% ($n=1$), with 56.0% achieving favorable recovery upon discharge. While this survival figure demonstrates the efficacy of core supportive measures—including early thermal care, empirical antimicrobials, and fluid management—it must be interpreted within the context of study limitations. The sample size ($N=50$) over a two-month period and the exclusion of incomplete records or early transfers against medical advice may select for a subset of stabilized inpatients. Furthermore, half of the neonates required prolonged hospitalization (>7 days), illustrating the substantial resource utilization required to achieve clinical stabilization.

Limitations

The primary limitations of this study include the single-center descriptive cross-sectional design, a modest sample size ($N=50$), and potential selection bias resulting from the retrospective extraction of available completed records. Specifically, the notably low observed mortality rate (2.0%) may reflect survival bias inherent to retrospective audits of complete inpatient charts, as neonates with early acute demise prior to formal admission documentation or those discharged against medical advice (DAMA) were not captured. Additionally, diagnostic validation for neonatal sepsis relied primarily on clinical criteria and empirical protocols rather than universal blood-culture confirmation due to local laboratory resource constraints.

5. CONCLUSION AND RECOMMENDATIONS

Prematurity, low birth weight, and respiratory distress syndrome represent the primary contributors to NICU admissions at Omdurman Maternity Hospital. While immediate in-hospital survival was high, the substantial burden of prolonged stay and hospital-acquired sepsis underscores the need for targeted health system enhancements.

Based on these findings, the following clinical and policy measures are recommended:

- **Enhance Respiratory Infrastructure:** Scale up the availability of bubble CPAP devices and consumable interfaces to optimize non-invasive ventilatory support for neonates with RDS.
- **Strengthen Perinatal and ANC Quality:** Implement early detection protocols for high-risk pregnancies, timely administration of antenatal corticosteroids for anticipated preterm deliveries, and active intrapartum monitoring.
- **Infection Prevention and Control (IPC):** Enforce strict aseptic bundles, hand hygiene protocols, and targeted antibiotic stewardship programs to mitigate hospital-acquired neonatal sepsis.
- **Continuous Staff Training:** Conduct regular simulation-based training in Neonatal Resuscitation Program (NRP) standards and evidence-based neonatal nursing care.

DECLARATIONS

Ethical Approval and Consent to Participate:

Ethical approval was obtained from the Institutional Ethics Committee of Omdurman Maternity Hospital and the Ministry of Health, Khartoum, Sudan. In accordance with institutional research guidelines for retrospective cross-sectional record audits, individual informed consent was waived as all data were de-identified and analyzed anonymously.

Consent for Publication: Not applicable (no individual patient identifiable details, images, or personal data are included).

Availability of Data and Materials:

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable academic request.

Competing Interests: The authors declare that they have no competing or financial interests.

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Authors' Contributions:

KMM conceptualized the study framework and supervised the research. NMAE contributed to study design, data verification, and manuscript revision. SAOA conducted data collection, statistical analyses, and manuscript drafting and finalization. All authors read and approved the final manuscript.

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