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High Mortality and Significant Morbidity Burden among Preterm Infants in a Kenyan Tertiary NICU: A Retrospective Cohort Study

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ABSTRACT

Background: Preterm birth is the leading cause of neonatal mortality globally, with a disproportionate burden in low- and middle-income countries (LMICs). Despite advances in neonatal care, survival rates remain low in resource-limited settings. In Kenya, complications from prematurity account for a significant percentage of neonatal deaths. We investigated the management practices, associated complications, and short-term outcomes of preterm infants discharged from a major referral hospital Neonatal Intensive Care Unit (NICU) in Western Kenya.

Methods: We conducted a retrospective cohort study, reviewing the medical records of 340 preterm infants (<37 weeks gestation) admitted to the NICU at Tenwek Hospital between January 2022 and December 2024. Data on demographic characteristics, management strategies (Antenatal Corticosteroid [ACS] use, CPAP, enteral feeding initiation), major morbidities (sepsis, Necrotizing Enterocolitis [NEC], Chronic Lung Disease [CLD], Retinopathy of Prematurity [ROP]), and discharge outcomes (survival, death, complications) were extracted and analyzed using Statistical Package for the Social Sciences Version 30.

Results: Preterm infants accounted for 24.3% of all NICU admissions during the study period. The overall in-hospital mortality rate was substantial at 31.2% (106 infants). Mortality was significantly higher among extremely preterm infants (<28 weeks) at 85.7% and those with extremely low birth weight (<1000g) ($p < 0.001$). The most prevalent complications included clinical sepsis (100%), hyperbilirubinemia (72.4%), and hypothermia (62.1%). Complications strongly associated with mortality in multivariate analysis included culture-proven sepsis (AOR ≈ 3.5; $p<0.005$) and pulmonary hemorrhage (AOR ≈ 2.8; $p<0.012$). Adherence to key evidence-based interventions, such as timely administration prophylactic CPAP and a complete Antenatal Corticosteroid course was low (45.1%). Among the 23 survivors, short-term complications at discharge included anemia of prematurity (37.6%), Retinopathy of Prematurity (21.8%), and chronic lung disease (20.9%).

Conclusion: This study highlights the persistent, high burden of prematurity-related mortality and severe morbidity at this Kenyan referral hospital, comparable to the highest rates in East Africa. The findings underscore critical gaps in the timely and consistent application of key evidence-based interventions and the urgent need to strengthen neonatal care systems and infection control to improve short-term outcomes in this resource-limited setting.

1. Introduction

Global and Regional Context

Preterm birth (defined as delivery before 37 completed weeks of gestation) is the leading direct cause of neonatal mortality worldwide, accounting for approximately one million deaths annually (Perin et al., 2022; Ohuma et al., 2023; Bradley et al., 2025). The burden is disproportionately concentrated in low- and middle-income countries (LMICs), particularly in Sub-Saharan Africa, which carries the highest global prevalence and the lowest survival rates (Mabrouk et al., 2022). In Kenya, complications from prematurity account for a significant proportion of neonatal mortality, highlighting the challenge faced by regional health systems (Nabwera et al., 2021; Mwangi et al., 2022). While clinical guidelines emphasize specific interventions—including Antenatal Corticosteroid (ACS) administration, thermal protection, and Continuous Positive Airway Pressure (CPAP)—the effectiveness of these measures is often hindered by delayed presentation, inconsistent implementation, and resource limitations in tertiary care settings.

Despite the critical need, facility-specific data on the spectrum of complications and precise short-term outcomes in regional referral NICUs in Western Kenya are scarce. Understanding the locally prevalent morbidities, the effectiveness of current management protocols, and the primary predictors of mortality is essential for designing targeted, resource-appropriate quality improvement interventions.

Whie national data offers broad estimates, specific hospital-level data are essential for identifying local barriers to effective care and driving targeted quality improvement initiatives. Tertiary referral centers, such as Tenwek Hospital in Western Kenya, often manage the most critical and low-survival cases transferred from surrounding lower-level facilities. However, comprehensive local data regarding the management adherence, immediate morbidity profile, and short-term outcomes of this vulnerable population upon discharge are limited.

This study aimed to investigate the prevalence, management, associated health complications, and short-term outcomes of preterm infants admitted and subsequently discharged from the Neonatal Intensive Care Unit at Tenwek Hospital over a three-year period.

2. Methods

2.1 Study Design and Setting

This was a Retrospective Cohort Study conducted at the Neonatal Intensive Care Unit (NICU) of Tenwek Hospital in Bomet County, a major referral center serving over five million people in Western Kenya. The study period spanned January 2022 to December 2024.

2.2 Study Population and Sample

The study population included all preterm infants (gestational age <37 weeks) admitted to the NICU during the study period. Infants with major congenital anomalies that precluded life support and those with incomplete or missing critical data required for outcome analysis were excluded. A total of 340 eligible preterm infant records were reviewed and included in the final analysis. Gestational age was classified as: Extreme Preterm (<28 weeks), Very Preterm (28 to <32 weeks), and Moderate Preterm (32 to <37 weeks).

2.3 Data Collection and Variables

Data were extracted from the electronic and paper medical records. Key variables collected included:

- Demographics and Admission Data: Gestational age, birth weight, and admission temperature.
- Management: Antenatal Corticosteroid administration, use of prophylactic Continuous Positive Airway Pressure, timing of enteral feeding initiation.
- Morbidities: Incidence of clinical and culture-proven sepsis, Necrotizing Enterocolitis (NEC, ≥ Stage II), hypothermia, hyperbilirubinemia, respiratory distress syndrome, and pulmonary hemorrhage.
- Outcomes: Status at discharge (survival/death), length of hospital stay (LOS), and short-term morbidities at discharge (Anemia of Prematurity, Retinopathy of Prematurity, Chronic Lung Disease).

2.4 Data Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences version 30.0. Descriptive statistics (frequencies, percentages, means ± standard deviation) were used to summarize cohort characteristics and morbidity prevalence. Bivariate analysis (Chi-square test) was used to assess associations between categorical variables. Binary logistic regression was employed to identify independent predictors of in-hospital mortality. A p-value of <0.05 was considered statistically significant.

2.5 Ethical Considerations

Ethical approval for this study was obtained from the Ethical Review Committee of the Mount Kenya University and a necessary permit from both the National Commission for Science, Technology, and Innovation (NACOSTI), which regulates research in Kenya, and the local administrative clearance from Tenwek Hospital, the study's site. Confidentiality was maintained by anonymizing all patient data during the abstraction and analysis process.

3. Results

3.1 Cohort Characteristics and Prevalence

A total of 340 preterm infants were included in the cohort, representing 24.3% of all NICU admissions during the study period. The mean gestational age was 32.1 ± 2.4 weeks and the mean birth weight was 1780 ± 410 grams.

Table 1: Baseline Characteristics and Gestational Age Distribution

Variable	Category	Frequency (n)	Percentage (%)
Total Study Cohort		340	100.0%
Gestational Age (GA)	Mean SD (Weeks)	32.1±2.4	
	Extreme Preterm (<28 weeks)	35	10.3%

Variable	Category	Frequency (n)	Percentage (%)
	Very Preterm (28 to <32 weeks)	145	42.6%
	Moderate Preterm (32 to <37 weeks)	160	47.1%
Birth Weight (BW)	Mean SD (Grams)	1780±410	
	Extremely Low Birth Weight (<1000g)	30	8.8%
	Very Low Birth Weight (1000g to <1500g)	85	25.0%
	Low Birth Weight (1500g to <2500g)	225	66.2%

3.2 Management Interventions and Implementation

Adherence to critical evidence-based interventions was sub-optimal. Only 45.1% of the mothers received a complete course of antenatal corticosteroids (ACS). Furthermore, the initiation of enteral feeding was delayed beyond 48 hours in [Insert %] of infants, which was associated with an increased incidence of Necrotizing Enterocolitis (P<0.05).

Table 2: Management Interventions, Morbidity Profile, and Short-Term Outcomes

Variable	Category	Frequency (n)	Percentage (%)
Management Practices			
Complete Antenatal Corticosteroid Course	Yes	153	45.1%
Prophylactic CPAP in infants <32 weeks	Yes	85	33.3%
Delayed Enteral Feeding (>48 hours)	Yes	224	65.9 %
Major Complications (Any Time)			
Clinical Sepsis	Yes	340	100.0%
Culture-Proven Sepsis	Yes	15	4.4%
Hyperbilirubinemia (requiring phototherapy)	Yes	246	72.4%
Hypothermia (admission or recurrent)	Yes	211	62.1%
Necrotizing Enterocolitis (NEC, Stage II)	Yes	18	5.3%
Acute Kidney Injury	Yes	12	3.5%
Short-Term Outcomes (Survivors N=234)			
Anemia of Prematurity (at discharge)	Yes	88	37.6%
Retinopathy of Prematurity	Yes	51	21.8%
Chronic Lung Disease	Yes	49	20.9%

3.3 Morbidity Profile

Clinical sepsis was recorded in all 100.0% of the preterm infants. Culture-proven sepsis was confirmed in 4.4% of cases. Other highly prevalent morbidities included hyperbilirubinemia (72.4%) and hypothermia (admission or recurrent) (62.1%). Major morbidities such as NEC (≥ Stage II) occurred in 5.3% of the cohort.

3.4 Outcomes and Predictors of Mortality

The overall in-hospital mortality rate was 31.2% (106 deaths). Mortality rates varied dramatically by gestational age:

- Extreme Preterm (<28 weeks): 85.7%
- Very Preterm (28 to <32 weeks): 35.9%
- Moderate Preterm (32 to <37 weeks): 16.3%

Binary logistic regression revealed that the following variables were independent, significant predictors of mortality (adjusted odds ratio [AOR]):

- Gestational Age <32 Weeks: AOR = 4.1 ($P < 0.001$)
- Culture-proven Sepsis: AOR = 3.5 ($P = 0.005$)
- Pulmonary Hemorrhage**:** AOR = 2.8 ($P = 0.012$)

Table 3: Independent Predictors of In-Hospital Mortality (Binary Logistic Regression)

Predictor Variable	**Adjusted Odds Ratio (AOR)**	**95% Confidence Interval (CI)**	**p-value**
Gestational Age <32 Weeks vs. 32 Weeks)	4.1	0.028	< 0.001
Culture-proven Sepsis	3.5	0.020	< 0.001
Pulmonary Hemorrhage	2.8	7.342	< 0.001
Necrotizing Enterocolitis	2.4	0.226	0.227
Acute Kidney Injury	2.6	4.563	< 0.001

3.5 Short-Term Outcomes in Survivors

Among the 234 infants who survived to discharge, a high burden of short-term complications was noted: anemia of prematurity (37.6%), Retinopathy of Prematurity (21.8%), and Chronic Lung Disease (20.9%).

4. Discussion

The overall in-hospital mortality rate of 31.2% observed in our cohort at Tenwek Hospital highlights the severe challenges associated with preterm care in tertiary centers in Western Kenya. This figure is consistent with the high end of reported neonatal mortality rates across the East African region, suggesting a shared systemic burden. For example, studies from major referral hospitals in Uganda frequently report preterm mortality rates ranging between 25% and 35%, particularly among the very low birth weight categories (Abdallah et al., 2018; Nsubuga et al., 2024). Similarly, research from Tanzania, Muhimbili National Hospital shows comparable rates, often exceeding 30% for infants <1500g (Bulimba et al., 2022; Msonda et al., 2024). The staggering 85.7% mortality rate we recorded for extremely preterm infants (<28 weeks) underscores that survival for the smallest infants remains extremely precarious in settings constrained by limited ventilation, scarce surfactant, and inconsistent essential resources. This mortality profile confirms that the critical window for survival continues to widen significantly as one moves from high-income to resource-limited settings like those in Kenya, emphasizing the urgent need for investment in advanced neonatology services.

Our findings reveal a morbidity profile dominated by preventable conditions, pointing directly toward gaps in basic care and infection control. The nearly universal prevalence of clinical sepsis (100%) is concerningly high, reflecting a likely issue with local clinical coding practices, but also suggesting a high threshold for presumptive antibiotic use due to overwhelming infection risk. Our 4.4% rate of culture-proven sepsis, which emerged as a strong independent predictor of mortality (AOR ≈ 3.5), aligns with high infection rates reported in NICUs across Rwanda and other regional centers, where infection is a top cause of neonatal death (Cartledge et al., 2020; Niyoyita et al., 2024; Nzeyimana et al., 2024). Furthermore, the high rate of hypothermia (62.1%) underscores a failure in effective, consistent thermal care, a fundamental intervention. This contrasts sharply with global standards and suggests that even basic, inexpensive, life-saving protocols are facing implementation challenges due to high patient volumes, staffing shortages, or infrastructure limitations common in regional LMIC settings.

A key finding of our study is the sub-optimal adherence to critical, evidence-based interventions. The rate of only 45.1% for complete Antenatal Corticosteroid administration is significantly lower than targets set by the World Health Organization (WHO) and falls below rates reported in some improved regional programs. Low ACS utilization is a widely acknowledged challenge in East African NICUs, primarily attributed to late maternal presentation, emergency deliveries, or inconsistent hospital procurement and supply. Similarly, the delayed initiation of minimal enteral feeding contributed to adverse outcomes. These deficiencies highlight a system problem where life-saving guidelines are available but their consistent delivery is compromised, resulting in avoidable morbidity and mortality.

While mortality was high, a significant number of survivors were discharged with substantial morbidity, including ROP and CLD. The prevalence of 21.8% ROP requiring follow-up places a significant burden on scarce pediatric ophthalmology resources and signals a high risk for long-term visual impairment. The high rates of CLD also predict a complex, resource-intensive post-discharge course, emphasizing the need for robust follow-up and community-level support.

A key strength of this study is the large, contemporary sample size from a major referral center, providing a robust snapshot of current outcomes in a crucial regional setting. However, the retrospective design introduces potential bias due to reliance on medical record accuracy. The single-center nature of the data limits generalizability, and critically, the study focuses only on short-term outcomes at discharge, lacking long-term neurodevelopmental follow-up.

5. Conclusion

This study confirms that preterm infants admitted to this major Kenyan referral NICU face a high risk of death, comparable to the upper ranges reported across the East African sub-region. The high rates of mortality are inseparable from system-level failures, specifically concerning infection control and the timely delivery of Antenatal Corticosteroids and consistent thermal management. The significant burden of short-term complications in survivors further stresses the already limited follow-up capacity in the region. These findings emphasize the urgent need for strengthening neonatal care systems, improving the consistent application of evidence-based practices, and enhancing infection control to close the critical care gaps identified in this study.

Declarations

Ethics Approval and Consent to Participate: Ethical approval was obtained from the Institutional Review Board (IRB) of Mount Kenya University, a necessary permit obtained from the National Commission for Science, Technology, and Innovation (NACOSTI), and permission was granted by the administration of Tenwek Hospital. Due to the retrospective nature of the study, individual patient consent was waived.

Consent for Publication: Not applicable.

Availability of Data and Materials: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Authors' Contributions:

- GNO: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing – Original Draft.
- Dr. Godwil Munyekenye: Supervision, Validation, Writing – Review & Editing.
- Janerose Muriuki: Supervision, Validation, Writing – Review & Editing.

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