Outcomes at the Neonatal Intensive Care Unit, Eastern Regional Referral Hospital, Mongar Bhutan: a retrospective cohort study

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ABSTRACT

Background: Globally, 2.6 million neonates die every year, with more than one third of these deaths occurring within 24 hours of birth. Most neonatal deaths are preventable. The scaling up of Neonatal Intensive Care Unit services in developing countries have shown to improve survival rates. This study aimed to determine the mortality rate, and correlate the general and clinical characteristics with the outcomes of neonates admitted in the NICU at the Eastern Regional Referral Hospital, Mongar, Bhutan from the year 2015 to 2017. Methods: Demographic data, neonatal and maternal variables were extracted for all Neonatal Intensive Care Unit admissions from 2015 to 2017. Descriptive and analytical statistics were reported as frequencies, percentages, median, adjusted OR, 95% CI and p-values. Results: The mortality rate was 12.31%. Neonatal jaundice (49.55%), neonatal sepsis (41.74%), and prematurity (32.43%) were the three most common diagnoses. The mortality among neonates with low birth weight (<2500 grams) was 3.68 times (adjusted OR 3.68; 95% CI: 1.39-9.77) higher than the mortality among the normal birth weight neonates and mechanically ventilated neonates were 35.85 times (adjusted OR 35.85; 95% CI: 13.12-97.87) more at risk of dying than those without mechanical ventilation. The main causes of mortality were neonatal sepsis (34.15%), prematurity (29.27%) and birth asphyxia (21.95%). Conclusions: The mortality rate at the NICU, Eastern Regional Referral Hospital is 12.31%. The study recommends to establish intermediate phototherapy/Kangaroo Mother Care/special baby care unit in the hospital to improve the quality of new born care.

Keywords: Bhutan; Neonatal intensive care unit; Neonatal mortality; Outcomes.

INTRODUCTION

Globally around 2.6 million neonatal deaths are reported annually with more than one-third of these deaths occurring within 24 hours of birth1. Over the past two decades, substantial progress has been made in reducing neonatal mortality as well as deaths in children under-five2. However, this reduction has been unequal with 41% reduction in neonatal mortality and around 60% reduction in mortality rates among children 1-5 years3. Majority of these deaths occur in developing countries where accessibility to healthcare is low3. A large proportion of neonatal deaths are preventable, therefore, improvements in prenatal care, care during the time of birth and post-natal care are critical1. Accessibility to health services with well-trained health care professionals and adequately equipped health facilities are indispensable to improve the quality of neonatal care4. Thus, a comprehensive package of health services from pre-conception to the post-natal period is critical to reduce neonatal mortality. The scaling up of neonatal intensive care unit (NICU) services in developing countries has shown to improve survival rates5,6.

The Annual Health Bulletin 2018 of the Ministry of Health, Bhutan reports a declining prevalence of under-five mortality from 96.9 per 1000 live births in 1994 to 37.3 in 20177. Over half (56%) of these under-five deaths are neonatal death as reported by the National Health Survey of Bhutan 20128. Similarly, a study conducted to identify the determinants of infant mortality in Samdrup Jongkhar District of Bhutan reported that around one-third of the infant deaths were contributed by neonatal deaths9.

Bhutan has ratified the United Nations Sustainable Development Goals10 and one of the targets in maternal and child health is to end preventable deaths of new-borns and children
under-five years of age. By 2030, all countries aim to reduce neonatal mortality at least to as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births\(^1\). Thus, it is crucial to have reliable information on trends and causes of death in neonates as well as children under-five to assess programmatic needs, prioritize interventions, monitor progress and draw future plans\(^2\). However, no studies have been conducted in Bhutan to evaluate neonatal outcomes. Therefore, this study was conducted to evaluate the outcomes at NICU, ERRH, Mongar.

**METHODS**

**Study design**

This was a retrospective analytical cohort study. The medical records of neonates admitted from 01\(^{st}\) January 2015 - 31\(^{st}\) December 2017 at the NICU, ERRH, Mongar were retrieved and reviewed.

**Study settings and study period**

The Bhutanese health care system is based on the Primary Health Care model\(^3\). Health care services are provided through a network of out-reach clinics, Basic Health Units, District/General Hospitals, Regional Referral Hospitals and the National Referral Hospital\(^1\). The study site was a 150 bedded Eastern Regional Referral Hospital (ERRH) located in Mongar district and is a referral centre for six eastern districts of Bhutan.

In March 2014, the hospital established a level III NICU with six beds. At the time of study, the hospital had one gynaecologist and one paediatrician. There was no intermediate phototherapy/Kangaroo Mother Care/special baby care unit at the ERRH. Thus, neonates with varying severity of illness who could not be treated in the postnatal ward were directly admitted to the NICU.

**Data collection**

The data was collected and compiled from April to July, 2018. All the neonates admitted to the NICU from 01\(^{st}\) January 2015 - 31\(^{st}\) December 2017 were included in the study. Data was extracted from medical records, admission and discharge registers, birth registers and death certificates into structured pro-forma. There were 340 NICU admissions between 2015 and 2017 at ERRH as recorded in the NICU admission register. We could retrieve only 333 of the medical records and seven records could not be traced. There were three babies who were more than 28 days of age at the time of admission and were included in the study.

**Data management and analysis**

The gathered data were then double entered and validated in Epi-Data version 3.1. Data analysis was done in STATA 13.0. Descriptive statistics were presented as frequency, percentage, means and standard deviation. Bivariate analysis was done comparing outcomes (alive/dead) against general and clinical characteristics of neonate and mother. Those with \(p\leq0.1\) were analysed using logistic regression to estimate the adjusted odds ratio and 95% confidence interval considering \(p<0.05\) as statistically significant. In the final model for logistic regression, gestational age was dropped due to collinearity with birth weight with a variance inflation factor of 1.47.

**Ethical considerations**

The study was granted ethical approval by the Research Ethics Board of Health, Ministry of Health, Bhutan vide approval No. REBH/Approval/2018/016 dated 30\(^{th}\) March 2018. Furthermore, this study was also granted administrative approval by the Ministry of Health, Bhutan and the management of the Eastern Regional Referral Hospital, Mongar.

**RESULTS**

The current study found that the NICU had a mortality rate of 12.31%. A half (50.15%) of the admissions occurred within the first 24 hours of life. Over half of the admissions were males (53.75%), and close to two-thirds of them were born at term (62.54%). More than half of the neonates (57.66%) had a birth weight of 2,500 grams or more. Over 80% of the neonates had more than one clinical diagnosis during admission to the NICU. Mortality among neonates requiring mechanical ventilation was 51.47%.

Table 2 presents the number of clinical diagnoses upon admission, the most common diagnoses in decreasing frequency of occurrence, need for mechanical ventilation and the corresponding neonatal outcomes of each clinical characteristic. Over 80% of the neonates had more than one clinical diagnosis during admission to the NICU. Mortality among neonates requiring mechanical ventilation was 51.47%.

Table 3 lists key characteristics of the mothers compared to neonatal outcome. Maternal age ranged from 15 to 45, with 77.18% of mothers between 20 and 34 years old. One-fifth (20.12%) of the mothers had an illness during pregnancy.

Table 4 presents the primary causes of neonatal mortality at NICU, ERRH, Mongar. Neonatal sepsis was the leading primary cause of neonatal mortality.

Neonates with low birth weight were 3.68 times more likely to die as compared to normal birth weight neonates (adjusted OR 3.68; 95% CI: 1.39-9.77). Neonates requiring mechanical ventilation were 35.85 times (adjusted OR 35.85; 95% CI: 13.12-97.87) more likely to die as compared to neonate not needing mechanical ventilation as shown in Table 5. However, there were no statistically significant associations between maternal characteristics and neonatal deaths.
### Table 1. General characteristics of neonates admitted to NICU, ERRH (n=333)

| Characteristic | Total Admissions | Neonatal outcomes |
|----------------|------------------|--------------------|
|                | n | % | n | % | n | % | n | % |
| **Total**      | 333 | 100 | 284 | 85.29 | 8 | 2.40 | 41 | 12.31 |
| **Sex of the baby** | | | | | | | | |
| Male           | 179 | 53.75 | 149 | 83.24 | 5 | 2.79 | 25 | 13.97 |
| Female         | 154 | 46.25 | 135 | 87.66 | 3 | 1.95 | 16 | 10.39 |
| **Age at Admission** | | | | | | | | |
| < 24 Hours     | 167 | 50.15 | 131 | 78.44 | 4 | 2.40 | 32 | 19.16 |
| 1 to 7 Days    | 99 | 29.73 | 92 | 93.93 | 4 | 4.04 | 3 | 3.03 |
| > 7 Days       | 67 | 20.12 | 61 | 91.04 | 0 | 0.00 | 6 | 8.96 |
| **Gestational Age (n=331)** | | | | | | | | |
| < 28wks        | 5 | 1.51 | 1 | 20.00 | 0 | 0.00 | 4 | 80.00 |
| 28 to 31wks    | 34 | 10.27 | 22 | 64.71 | 0 | 0.00 | 12 | 35.29 |
| 32 to 36wks    | 85 | 25.68 | 73 | 85.88 | 4 | 4.71 | 8 | 9.41 |
| ≥ 37wks        | 207 | 62.54 | 180 | 91.15 | 4 | 1.93 | 17 | 8.21 |
| **Birth weight** | | | | | | | | |
| <1000 gm       | 9 | 2.70 | 3 | 33.33 | 0 | 0.00 | 6 | 66.67 |
| 1000 - 1499 gm | 26 | 7.81 | 16 | 61.54 | 0 | 0.00 | 10 | 38.46 |
| 1500 - 2499 gm | 105 | 31.53 | 90 | 85.71 | 3 | 2.86 | 12 | 11.43 |
| ≥2500 gm       | 192 | 57.66 | 175 | 91.15 | 5 | 2.60 | 12 | 6.25 |
| **APGAR score** | | | | | | | | |
| Normal (7-10)  | 269 | 86.50 | 238 | 88.48 | 5 | 1.86 | 26 | 9.67 |
| Intermediate risk (4-6) | 35 | 11.25 | 25 | 71.43 | 1 | 2.86 | 9 | 25.71 |
| High risk (0-3) | 7 | 2.25 | 2 | 28.57 | 0 | 0.00 | 5 | 71.43 |
| **Mode of Delivery** | | | | | | | | |
| Normal         | 217 | 65.17 | 185 | 85.25 | 6 | 2.76 | 26 | 11.98 |
| Elective LSCS  | 31 | 9.31 | 27 | 87.10 | 1 | 3.23 | 3 | 9.68 |
| Emergency LSCS | 76 | 22.82 | 64 | 84.21 | 1 | 1.32 | 11 | 14.47 |
| Assisted       | 9 | 2.70 | 8 | 88.89 | 0 | 0.00 | 1 | 11.11 |
| **Place of Birth** | | | | | | | | |
| ERRH, Monggar  | 203 | 60.96 | 177 | 87.19 | 2 | 0.99 | 24 | 11.82 |
| Other HF*      | 130 | 39.04 | 107 | 82.31 | 6 | 4.62 | 7 | 5.38 |

*HF: Health Facilities
Table 2. Clinical characteristics of neonates admitted to NICU, ERRH ($n=333$)

| Characteristic                       | Total | Neonatal outcomes |
|--------------------------------------|-------|-------------------|
|                                      | n     | Discharged | Referred | Dead |
|                                      | n     | %           | n        | %    | n    | % |
| No of Clinical Diagnosis             |       |            |          |      |      |   |
| 1                                    | 66    | 19.82      | 60       | 90.91| 3    | 4.55 |
| 2                                    | 109   | 32.73      | 97       | 88.99| 2    | 1.83 |
| 3                                    | 100   | 30.03      | 78       | 78.00| 2    | 2.00 |
| 4                                    | 37    | 11.12      | 32       | 86.49| 0    | 0.00 |
| 5                                    | 21    | 6.32       | 17       | 80.95| 1    | 4.76 |
| Neonatal Jaundice                    |       |            |          |      |      |   |
| Yes                                  | 165   | 49.55      | 159      | 96.36| 2    | 1.21 |
| No                                   | 168   | 50.45      | 125      | 74.40| 6    | 3.57 |
| Neonatal Sepsis                      |       |            |          |      |      |   |
| Yes                                  | 139   | 41.74      | 117      | 84.17| 2    | 1.44 |
| No                                   | 194   | 58.26      | 167      | 86.08| 6    | 3.09 |
| Prematurity                          |       |            |          |      |      |   |
| Yes                                  | 108   | 32.43      | 84       | 77.78| 3    | 2.78 |
| No                                   | 225   | 67.57      | 200      | 88.89| 5    | 2.22 |
| Respiratory Distress*                |       |            |          |      |      |   |
| Yes                                  | 105   | 31.53      | 80       | 76.19| 3    | 2.86 |
| No                                   | 228   | 68.47      | 204      | 89.47| 5    | 2.22 |
| Lactation Failure                    |       |            |          |      |      |   |
| Yes                                  | 72    | 21.62      | 69       | 95.83| 0    | 0.00 |
| No                                   | 261   | 78.38      | 215      | 82.38| 8    | 3.07 |
| Birth Asphyxia                       |       |            |          |      |      |   |
| Yes                                  | 57    | 17.12      | 40       | 70.18| 0    | 0.00 |
| No                                   | 276   | 82.88      | 244      | 88.41| 8    | 2.90 |
| Birth Defects                        |       |            |          |      |      |   |
| Yes                                  | 36    | 10.81      | 25       | 69.44| 6    | 16.67|
| No                                   | 297   | 89.19      | 259      | 87.21| 2    | 0.67 |
| Hypoglycemia                         |       |            |          |      |      |   |
| Yes                                  | 23    | 6.91       | 20       | 86.96| 0    | 0.00 |
| No                                   | 310   | 93.16      | 264      | 85.16| 8    | 2.58 |
| Ventilator Support                   |       |            |          |      |      |   |
| Yes                                  | 68    | 20.42      | 30       | 44.12| 3    | 4.41 |
| No                                   | 265   | 79.58      | 254      | 95.85| 5    | 1.89 |

*Respiratory Distress: Includes respiratory distress syndrome (RDS) as well as respiratory distress from other causes
### Table 3. Maternal characteristics of neonates admitted to NICU, ERRH (n=333)

| Characteristic                        | Total | Neonatal outcomes |
|---------------------------------------|-------|-------------------|
|                                       |       | Discharged | Referred | Dead |
|                                       | n     | %          | n        | %    | n       | %      |
| **Maternal age**                      |       |            |          |      |          |        |
| 15-19                                 | 30    | 9.01       | 26       | 86.67| 0        | 0.00   | 4       | 13.33 |
| 20-34                                 | 257   | 77.18      | 219      | 85.21| 6        | 2.33   | 33      | 12.84 |
| 35-45                                 | 44    | 13.21      | 37       | 84.09| 2        | 4.55   | 5       | 11.36 |
| Unknown                               | 2     | 0.01       | 2        | 100.00| 0        | 0.00   | 0       | 0.00  |
| **Maternal Illness**                  |       |            |          |      |          |        |
| Yes                                   | 67    | 20.12      | 52       | 77.61| 2        | 2.99   | 13      | 19.40 |
| No                                    | 266   | 79.88      | 232      | 87.22| 6        | 2.26   | 28      | 10.53 |
| **Prolonged/Premature Prolonged Rupture of Membrane** |       |            |          |      |          |        |
| Yes                                   | 27    | 8.11       | 20       | 74.07| 1        | 3.70   | 6       | 22.22 |
| No                                    | 279   | 83.78      | 241      | 86.38| 6        | 2.15   | 32      | 11.47 |
| No Record                             | 27    | 8.11       | 23       | 85.19| 1        | 3.70   | 3       | 11.11 |
| **Multiple Gestation**                |       |            |          |      |          |        |
| Yes                                   | 19    | 5.71       | 16       | 84.21| 0        | 0.00   | 3       | 15.79 |
| No                                    | 314   | 94.29      | 268      | 85.35| 8        | 2.55   | 38      | 12.10 |

### Table 4. Primary cause of neonatal mortality at NICU, ERRH (n=41)

| Cause of death    | Frequency (n) | Percentage (%) |
|-------------------|---------------|----------------|
| Neonatal Sepsis   | 14            | 34.15          |
| Prematurity       | 12            | 29.27          |
| Birth Asphyxia    | 9             | 21.95          |
| Birth Defect      | 3             | 7.32           |
| Other             | 3             | 7.32           |

### Table 5. Risk factors associated with neonatal mortality NICU, ERRH (n=333)

| Variables            | Adjusted OR | 95% CI      | p-value |
|----------------------|-------------|-------------|---------|
| **Birth weight**     |             |             |         |
| Normal birth weight  | Ref         |             |         |
| Low birth weight     | 3.68        | 1.39 - 9.77 | 0.009   |
| **Ventilator Support** |           |             |         |
| No                   | Ref         |             |         |
| Yes                  | 35.85       | 13.12 - 97.87 | 0.001   |
| **APGAR Score**      |             |             |         |
| Normal (Score 7-10)  | Ref         |             |         |
| Intermediate Risk (Score 4-6) | 0.97     | 0.31 - 3.02 | 0.962   |
| High risk (Score 0-3) | 15.04      | 1.59 - 41.97 | 0.018   |
DISCUSSION

The study found that the NICU, ERRH had a mortality rate of 12.31%. A study conducted in the NICU of Kiwoko Hospital, Uganda presented similar general characteristics as reported in this study but had a much higher mortality rate of 22.4%. Neonatal mortality rates range between 0.2 - 64.4% in developing countries and 4 - 46% in developed countries\(^5\). The lower mortality rate reported in this study could be because of flexible admission criteria at the NICU.

This study found that the most common diagnosis was neonatal jaundice (49.55%), followed by sepsis, prematurity, and respiratory distress while infection, prematurity and respiratory distress were the top three diagnoses reported in the Kiwoko Hospital study\(^5\). Although a high prevalence of neonatal jaundice has been reported in the Asian ethnic population\(^11\) the higher prevalence of neonatal jaundice reported in this study could probably be attributed to absence of a phototherapy unit in ERRH. Twenty-nine percent of the neonates received phototherapy in the Kiwoko Hospital study\(^5\).

The World Health Organization points out that the main causes of new born deaths are low birth-weight, prematurity, infections, birth asphyxia and birth trauma which accounts for around 80% of total new-born deaths\(^1\). A study of eight special care new-born units in eight different states of India reported asphyxia as the leading cause of death which accounted for 47% of neonatal deaths, followed by sepsis (22%), and low birth weight (17%)\(^9\). Our study found that over 85% of the total neonatal deaths were contributed by neonatal sepsis (34.15%), complications of prematurity (29.27%) and birth asphyxia (21.95%). This difference could be due to a greater proportion of Bhutanese mothers delivering in health facilities where resuscitation can be immediately performed when required.

Studies have shown that neonates born to mothers outside the age range 20 - 34 years have negative outcomes\(^4\). This trend was not observed in this study. A higher mortality rate in children with low birth weight has also been reported in cohort studies\(^8\). Adjusted analysis of the data suggests that neonates with low birth weight were 3.68 times more likely to die compared to infants with normal birth weight and new-borns kept on ventilator support were 35.85 times more likely to die compared to those who did not require ventilator support. This was a single hospital-based study and the findings cannot be generalized nationally. Inability to retrieve all 340 medical records was also a limitation in this study.

CONCLUSIONS

This study found that the neonatal mortality at the NICU, ERRH was 12.31%, with neonatal sepsis being the leading cause of death. Over half of the neonates kept on ventilator support could not survive and around 80% of the neonates had more than one clinical diagnosis during admission. Based on the findings of the study, one of the key recommendation is to establish intermediate phototherapy/KMC/special baby care unit in the hospital. A prospective study would generate useful evidences on survival opportunities and challenges for planning and facilitating policy decisions in the country.

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**AUTHORS CONTRIBUTION**

Following authors have made substantial contributions to the manuscript as under:

**TRS:** Concept, analysis of data, study design, manuscript drafting and critical reviews

**PE:** Concept, analysis of data, study design, manuscript drafting and revision

**HPP:** Concept, analysis of data, study design, manuscript drafting and revision

**PL:** Concept, analysis of data, study design, manuscript drafting and revision

**TD:** Concept, analysis of data, study design, manuscript drafting and revision

**TZ:** Concept, analysis of data, study design, manuscript drafting and revision

Authors agree to be accountable for all respects of the work in ensuring that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved.

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**CONFLICT OF INTEREST**

None

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