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%). **Conclusion:** 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 birth[1]. Over the past two decades, substantial progress has been made in reducing neonatal mortality as well as deaths in children under-five[2]. However, this reduction has been unequal with 41% reduction in neonatal mortality and around 60% reduction in mortality rates among children 1-5 years[2].

Majority of these deaths occur in developing countries where accessibility to healthcare is low[3]. A large proportion of neonatal deaths are preventable, therefore, improvements in prenatal care, care during the time of birth and post-natal care are critical[1]. Accessibility to health services with well-trained health care professionals and adequately equipped health facilities are indispensable to improve the quality of neonatal care[4]. 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 rates[5,6].

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 2012[7]. Over half (56%) of these under-five deaths are neonatal death as reported by the National Health Survey of Bhutan 2012[8]. 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 deaths[9].

Bhutan has ratified the United Nations Sustainable Development Goals[10] and one of the targets in maternal and child health is to end preventable deaths of new-borns and children

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under-five years of age. By 2030, all countries aim to reduce neonatal mortality at least to as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1,000 live births[11]. 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[12]. 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 01st January 2015 - 31st 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[13]. 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[7]. 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 01st January 2015 - 31st 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 $p<0.1$ 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 30th 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. The respective outcomes of each of the general characteristics are presented in Table 1.

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 n	Total		Neonatal outcomes					
			Discharged		Referred		Dead	
	n	%	n	%	n	%	n	%
Total Admissions								
	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	89.86	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 n	Total		Neonatal outcomes					
			Discharged		Referred		Dead	
	n	%	n	%	n	%	n	%
No of Clinical Diagnosis								
1	66	19.82	60	90.91	3	4.55	3	4.55
2	109	32.73	97	88.99	2	1.83	10	9.17
3	100	30.03	78	78.00	2	2.00	20	20.00
4	37	11.12	32	86.49	0	0.00	5	13.51
5	21	6.32	17	80.95	1	4.76	3	14.29
Neonatal Jaundice								
Yes	165	49.55	159	96.36	2	1.21	4	2.42
No	168	50.45	125	74.40	6	3.57	37	22.02
Neonatal Sepsis								
Yes	139	41.74	117	84.17	2	1.44	20	14.39
No	194	58.26	167	86.08	6	3.09	21	10.82
Prematurity								
Yes	108	32.43	84	77.78	3	2.78	21	19.44
No	225	67.57	200	88.89	5	2.22	20	8.89
Respiratory Distress*								
Yes	105	31.53	80	76.19	3	2.86	22	20.95
No	228	68.47	204	89.47	5	2.22	19	8.33
Lactation Failure								
Yes	72	21.62	69	95.83	0	0.00	3	4.17
No	261	78.38	215	82.38	8	3.07	38	14.56
Birth Asphyxia								
Yes	57	17.12	40	70.18	0	0.00	17	29.82
No	276	82.88	244	88.41	8	2.90	24	8.70
Birth Defects								
Yes	36	10.81	25	69.44	6	16.67	5	13.89
No	297	89.19	259	87.21	2	0.67	36	12.12
Hypoglycemia								
Yes	23	6.91	20	86.96	0	0.00	3	13.04
No	310	93.16	264	85.16	8	2.58	38	12.26
Ventilator Support								
Yes	68	20.42	30	44.12	3	4.41	35	51.47
No	265	79.58	254	95.85	5	1.89	6	2.26

***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 n	Total		Neonatal outcomes					
			Discharged		Referred		Dead	
	n	%	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								
No	27	8.11	20	74.07	1	3.70	6	22.22
No Record	279	83.78	241	86.38	6	2.15	32	11.47
	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%[5]. Neonatal mortality rates range between 0.2 - 64.4% in developing countries and 4 - 46% in developed countries[14]. 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[15] 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[3]. 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%)[16]. 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[14,15]. 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[17]. 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.

CONCLUSION

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.

CONFLICT OF INTEREST

None

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