

# The Economic burden of Neonatal Intensive Care Unit Admission at a Community Hospital of Central Nepal

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## ABSTRACT

**Introduction:** Neonatal sepsis is the commonest cause of neonatal morbidity and mortality and remains a major public health problem especially in developing countries. It is one of the most common causes for admission to neonatal units. The objective of this study was to evaluate the cost of care of neonates admitted in Neonatal Intensive Care Unit. It also compared the cost of care of neonates with sepsis and those with non-sepsis along with the duration of hospital stay and its correlation.

**Method:** A hospital based prospective cross-sectional observational study was carried out over a period of one year. All the neonates admitted at NICU and fulfilling the inclusion criteria formed the study population. Total cost was calculated as the summation of direct and indirect cost. Normally distributed data was analyzed using the Student's t-test, non-normally distributed data using Mann-Whitney U test. P-value < 0.05 was taken to be statistically significant.

**Result:** Direct cost comprises more than two third of the cost. The median total cost of care of neonates admitted in NICU was USD 222.66 (Range 169.52-280.03). The cost for the ones with sepsis was USD 226.30 (Range 172.19-291.34) and 174.02 (Range 99.67-221.96) in non-sepsis. The mean duration of stay in NICU of the ones having sepsis was 6.6 days and 4.4 days in non-sepsis.

**Conclusion:** The median total cost of care of neonates admitted in NICU was USD 222.66 (Range 169.52-280.03). The duration of stay and the total cost of treatment with sepsis are higher than those with non-sepsis.

**Key words:** cost of care; financial burden; neonatal sepsis



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## INTRODUCTION

Neonatal sepsis is the commonest cause of neonatal morbidity and mortality in resource limited settings. It is a major public health problem especially in developing countries. It is the third leading cause of neonatal mortality, only behind prematurity and intrapartum related complications (or birth asphyxia). Among all deaths in children under five years, 2.5 million occurred in the first month of life and about one third died on the day they were born.<sup>1</sup> The incidence of neonatal mortality rate in 2016 was 21 deaths per thousand live births in our country.<sup>2</sup> Our target is to meet with one of the targets of Sustainable Development Goals, i.e., by 2030, end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least 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.<sup>3</sup>

Neonatal sepsis is one of the most common causes for admission to neonatal units. There is increased morbidity of neonatal sepsis despite considerable progress in hygiene, introduction of new antimicrobial agents and advanced measures for early diagnosis and treatment. The increased morbidity eventually prolongs the duration of hospital stay and increases the financial burden of the family. The Government of Nepal in Fiscal Year 2074/2075 (2017 A.D.) introduced the Free Newborn Care Provision in all government health facilities. It has set packages (O, A, B, C) for sick newborn case management. The health facilities are reimbursed for set packages of care: Packages O, A, B and C costing nothing, NPR 1,000 (USD 8.26), NPR 2,000 (USD 16.52) and NPR 5,000 (USD 41.33) respectively.<sup>4</sup> Health facility can claim as high as combination of A+B+C NPR 8000 (US D66.11), depending on medicines, diagnostic and treatment services provided. This is an important and commendable initiative taken by the Government, whereby, the basis for designating the amount is unclear. There have not been many studies conducted on the economic analysis of the admitted newborns. So, this study was being conducted to evaluate the cost of care of neonates admitted in Neonatal Intensive Care Unit (NICU) of a tertiary care institute. It also compared the cost

of care of neonates with sepsis and those with non-sepsis along with the duration of hospital stay and its correlation. This study will give an idea about the total out of pocket expenditure in treating the neonate in NICU and also will be a useful tool in facilitating the policy makers on allocating the budget for the management of sick newborns.

## METHODS

A hospital based prospective cross-sectional observational study was carried out at NICU of our hospital over a period of one year from September 2018 to August 2019 after taking ethical approval from Nepal Health Research Council (NHRC Reference number 515, 10/09/2018) and Institutional Review Committee of the hospital. It is a community level mission hospital with 150 bed facility that provides a full range of outpatient and inpatient multi-specialty services. It provides level III NICU care like incubator, supplemental oxygen, Continuous Positive Airway Pressure, Ventilator, intravenous antibiotics, phototherapy, and exchange transfusion. All the neonates admitted at NICU were included. Those who failed to give consent, opted out of treatment, had associated congenital surgical illness were excluded from the study. After brief introduction, both verbal and written informed consent were taken from the parents or accompanying caretaker.

Neonatal sepsis was defined by the presence of at least two clinical symptoms and at least two laboratory signs in the presence of or as a result of suspected or proven infection (positive culture, microscopy or polymerase chain reaction).<sup>5</sup>

Clinical signs:

- Modified body temperature: core temperature greater than 38.5 °C or less than 36 °C and/or temperature instability
- Cardiovascular instability: bradycardia {mean Heart Rate (HR) less than the 10th percentile for ages} or tachycardia (mean HR greater than 2 SD above normal for age) and/or rhythm instability, reduced urinary output (less than 1 ml/kg/h), hypotension (mean arterial pressure less than the 5th percentile for age), mottled skin, impaired peripheral perfusion

- Skin and subcutaneous lesions: petechial rash, sclerema
- Respiratory instability: apnoea episodes or tachypnea episodes {mean respiratory rate (RR) over 2 SD above normal for age} or increased oxygen requirements or requirement for ventilation support
- Gastrointestinal: feeding intolerance, poor sucking, abdominal distention
- Non-specific: irritability, lethargy and hypotonia

Laboratory signs:

- White blood cells (WBC) count:  $< 4,000 \times 10^9$  cells/micro Litre or  $> 20,000 \times 10^9$  cells/micro Litre
- Immature to total neutrophil ratio (I/T) greater than 0.2
- Platelet count  $< 100,000 \times 10^9$  cells/micro Litre
- C reactive protein (CRP)  $> 15$  mg/L or procalcitonin  $\geq 2$  ng/ml
- Glucose intolerance confirmed at least two times: hyperglycaemia (blood glucose  $> 180$  mg/dL or 10 mMol/L) or hypoglycaemia (blood glucose  $< 45$  mg/dL or 2.5 mMol/L)
- Metabolic acidosis: Base excess (BE)  $< -10$  mEq/L or serum lactate  $> 2$  mMol/L
- Proven Sepsis: A positive blood culture or PCR in the presence of clinical signs and symptoms of infection.<sup>6</sup>
- Probable Sepsis: Presence of signs and symptoms of infection and at least two abnormal laboratory results when blood culture is negative.<sup>6</sup>
- Possible Sepsis: Presence of clinical signs and symptoms of infection plus raised CRP when blood culture is negative.<sup>6</sup>

Cost of treatment was divided as direct cost and indirect cost. Direct cost included the cost of hospital bed charge (hospital charge), investigation charge and medicine charge. Bills paid by the parents/caretaker of the enrolled neonates were source of data for the direct cost, which were serially noted down. Indirect cost included productivity loss, travel cost and food cost. Productivity loss is the work time loss of the

parents/caretaker due to hospital stay for their child's illness. It was calculated as the product of missed work days and minimum daily wage in Nepal during 2018 i.e. NPR 517/day (USD 4.27).<sup>7</sup> Missed work days of parents were estimated by recorded length of hospital stay of their child. Total cost of care was summation of direct and indirect cost. All costs are expressed in USD with exchange rate of 1 USD = NPR 121.

A detailed history, physical examination, and other essential details were recorded in the standardised proforma. Useful data were entered in database for statistical analysis by using SPSS version 22. Percentage, proportions and contingency tables were used for description of the data. Normally distributed data was analysed using the Student's t-test, non-normally distributed data using Mann-Whitney U test. P-value less than 0.05 was taken to be statistically significant.

## RESULTS

There were total 98 admissions, out of which six denied the consent. So, a total of 92 participants were recruited from September 2018 to August 2019. Of the total, 56 (60.9%) were males and 36 (30.1%) were females. Most of the patients presented from inside the district [Inside the district 76 (82.6%) vs. outside the district 16 (17.4%)].

Amongst those included, 80 (87.0%) patients were found to have sepsis and 12 (13.0%) other than sepsis. The mean duration of stay in NICU of the ones having sepsis was 6.6 (range) days and those with non-sepsis were 4.4 (range) days with p-value of 0.027 which was statistically significant.

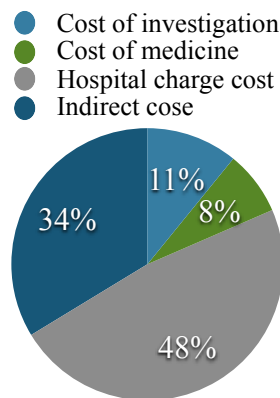
The different cost components of total cost is shown in Figure 1. The cost of treatment of the neonates admitted in NICU comprised of hospital charge cost, medicine cost, laboratory cost and indirect cost. Direct cost which includes hospital charge cost, medicine cost and investigation cost covers almost two third of the total cost where cost of hospital charge appears to be the largest component (47.99%).

The different cost of treatment of neonates with sepsis and non-sepsis is shown in table 2. The direct cost comprises the largest portion of the total

**Table 1.** Baseline characteristics of neonates admitted at NICU

Characteristics	Categories	Frequency	%
Age	Birth to 3 DOL	78	84.8
	> 3 DOL to $\geq$ 7 DOL	14	15.2
Gender	Male	56	60.9
	Female	36	39.1
Address	Within district	76	82.6
	Outside district	16	17.4
NICU stay	< 7 days	70	76.1
	$\geq$ 7-14 days	19	20.7
	$\geq$ 14-21 days	3	3.3
NICU stay Mean (SD)	6.34 (3.25)		
Birth	Single	88	95.7
	Multiple	4	4.3
Delivery mode	Spontaneous vaginal delivery	54	58.7
	Instrumental	2	2.2
	Caesarean Section	36	39.1
Birth weight	$\geq$ 2.5 kg	65	70.7
	1.5 -< 2.5 kg	24	26.1
	1 -< 1.5kg	3	3.3
Birth weight mean (SD)	2.71 (0.56)		
Diagnosis	Sepsis	80	87.0
	Non sepsis	12	13.0
Outcome	Complete recovery	87	94.6
	Mortality	5	5.4
Well baby	well baby	83	90.2
	with comorbidity	9	9.8
Income source	Agriculture	38	41.3
	Business	24	26.1
	Office	30	32.6

cost, i.e., USD 172.99 in the ones with sepsis and USD 108.74 in non-sepsis. The median (IQR) total cost for treatment of neonates admitted in NICU

**Figure 1.** Components of total cost of treatment

was USD 222.66. Among them the cost of care for the ones with sepsis was USD 226.30 and USD 174.02 in other than sepsis.

The association of duration of stay and the cost of care of the neonates admitted in NICU with the ones with sepsis and non-sepsis is shown in table 3. The duration of stay is nearly seven (6.6) days in neonates with sepsis. It is however lesser in those with non-sepsis. The length of stay strongly correlates with the total cost incurred. The total cost of care of neonates with sepsis is higher than those with non- sepsis with p value of 0.007 which is statistically significant.

## DISCUSSION

In this study among the enrolled neonates, 56 were males and 36 females. Other study done in Intensive and Intermediate Care Units of two hospitals in Greece from February 2004 to April 2004 also found out that out of 44 patients, 28 were males and 16 females.<sup>8</sup>

Around 80% of the children were from inside the district and 20% outside the district. This has an impact on the travel cost. In our study we found out that sepsis constituted the major part of the neonatal admission in intensive care unit. A study done by Geeta et al., in India and Sunny et al., in Nepal also found out that sepsis is one of the commonest reasons for the hospitalisation in intensive care unit.<sup>9,10</sup>

The mean duration of stay of neonates with sepsis in our study was six days. However, it was lesser in



**Table 2.** Cost of care of neonates with sepsis and non-sepsis

In Dollar	Sepsis		Non- sepsis	
	Mean	Median	Mean	Median
Laboratory cost	28.1415	23.6983	14.2803	15.062
Medicine cost	20.1759	15.7314	11.031	9.6901
Hospital charge cost	124.6817	99.1322	83.4332	79.9587
Direct cost	172.9992	136.9215	108.7445	112.1281
Indirect cost	89.0256	76.0331	50.4787	46.281
Grand total cost	262.0248	226.3017	159.2231	174.0289

those with non-sepsis. Similar finding was found in a study conducted in one of the NICUs. It showed the mean duration of stay of four days.<sup>9,11</sup>

The cost components of the total cost of care of neonates admitted in NICU in this study consisted of hospital charge cost, investigation cost, medicine cost and indirect cost. Indirect cost included the productivity loss of the caretaker/visitor involved during the treatment of his/her patient, food and travel cost amounted during the stay of hospital admission. The total expenditure of the caretaker depends on the type of health facility they are visiting. Private health facilities are more expensive than government or community hospital.<sup>12</sup> Because of variability in the policies of NICU of different hospital, input cost, and quality of care being offered there is the difference in the cost of care. The direct cost which included the hospital charge cost, medicine cost, and laboratory cost covered around two third of the total cost. Hospital charge cost was 47.99% of the total cost, followed by indirect cost of 33.79%. After the Hospital charge cost, the second out pocket expenditure goes for laboratory and medicine, i.e., USD 26.33 and USD 18.98 respectively. This is contradictory to the study done by Sunny et al in other government hospital of Nepal.<sup>10</sup> They found out the expenses of investigation to be USD 0.5 and USD 2.9 for medicine. This might be due to some free drug supply in the government hospital and limited

**Table 3.** Relation of duration of stay and cost of care in neonates with sepsis and non-sepsis

	Sepsis	Non-sepsis	p-value
Duration of stay Mean (SD) in days	6.625 (3.26615)	4.4167 (2.46644)	0.027 (T-test)
Grand total Cost median (IQR) USD	226.30 (168.47 -291.35)	174.03 (99.67-221.97)	0.007 (Mann Whitney-U test)
Direct cost median (IQR) USD	136.92 (107.16-202.5)	112.13 (65.60-153.15)	0.037 (Mann Whitney-U test)
Indirect cost median (IQR) USD	76.03 (60.12-111.57)	46.28 (24.70-82.54)	0.004 (Mann Whitney-U test)

laboratory facility. The median total cost of care of neonates was USD 222.66. For the neonates with sepsis it was found to be USD 226.30 and USD 174.02 for those with non-sepsis. A study conducted in private sector NICU at India had shown that the median total cost of care was USD 272.4 (range:64.9 – 3373.4).<sup>9</sup> The treatment cost of neonate has always been expensive. A study conducted in 2015 at Pokhara, Nepal found out that the Out Of Pocket (OOP) expenditure of neonatal health care was NRs. 4322 in general out-patient checkup and non-intensive care admission.<sup>12</sup> Similarly, the average cost of care per patient per day was estimated to be USD 198.7 in Chandigarh, India in a study done in 2003 and USD 117.9 in Delhi, India in 2010 in public sector NICUs.<sup>13</sup> This shows that the range of cost depends on the type of neonate admitted in NICU. The average cost per day in our NICU was USD 41, whereby, incases of sepsis it was USD 41 and in those with non -sepsis was USD 40.

As the focus shifts beyond 2015 to the post - Millennium Development Goal era, more recognition is being given to disability free survival, human capital, and sustainable development.<sup>14</sup> Higher disability risk is more likely with lower quality intensive care, or in the national start -up phase for provision of intensive care.<sup>15</sup> Hospitals might have invested on services and

facilities to increase the quality of NICU which increase the hospital charge cost. This might be true for our finding of hospital charge cost as well as it was the main bulk (47.99%) of the total cost paid by the caretaker.

The duration of hospitalisation of the neonates varies on the factors like birth weight, associated medical illnesses. If there is low birth weight, there will be prolonged stay along with the treatment intensity. In this study, the ones with low birth weight have prolonged stay. A study of NICU care in India in 2003 found out that the average total NICU cost to be USD3800, USD 2000 and USD 950 for ELBW, VLBW, and LBW neonates respectively.<sup>16</sup> The analysis of this study becomes evident that the NICU costs are high. The amount being allocated by the government for newborn care program provision is NRS 8000 (USD 66.11). There is a significant difference in between the allocation and the amount incurred. If it is addressed there can be a timely effective management of the sick newborns, thereby, reducing the economic burden for the unaffordable ones. Though our study was conducted in the community hospital of urban setting, it caters services mainly to the rural people. Even though we haven't taken account of wealth index of the patient

visiting this hospital, the amount incurred is high and it is problematic to all people as other study also shows that the wealth index is mostly a poor proxy for consumption expenditure.<sup>17</sup> Since it is a single hospital based study done on a small sample it may not be entirely the representative of whole neonatal population. Broad inclusion and exclusion criteria, exclusion of the input cost are the limitations of this study.

## CONCLUSIONS

The total cost of care of neonates admitted in NICU was USD 222.66 with per day cost of USD 41. The length of hospital stay and the cost of care of neonates with sepsis was more than those with non-sepsis. There is a huge gap in between the budget allocated by the government and the amount incurred. Further studies are warranted to guide the Government further in improving neonatal outcome and allocation of budget for NICUs.

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