

## Research Article

# The cost and effective analysis of health care management of very low birth weight babies in rural areas of West Bengal, India

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### ABSTRACT

**Background:** Low birth weight (LBW) is prevalent in low-income countries. Level II neonatal intensive care at SCNUs is cost intensive. Rational use of SCNU services by targeting its utilization for the VLBW neonates and maintenance of community based newborn care is required. Even though the economic evaluation of interventions to reduce this burden is essential to guide health care policy making for low resource setting, data on low cost outcome study associated with LBW in Indian setup are scarce.

**Methods:** This study aims to estimate the costs to the health system in the management of LBW in rural setting where affordability of parents for healthcare facility comparatively less. The cost of management was cut off by minimum investigations, more supervision by working health care personnel's. A prospective observational study was conducted to see outcome of estimate the costs to the health system in the management of LBW or VLBW babies.

**Results:** The mortality and survival rate among the evaluated LBW under this low cost health care setting was 6.66% and 86.6% respectively.

**Conclusions:** Results of this unique cost and effectiveness evaluation of LBW healthcare management in a low resource setting are very relevant in Indian context where healthcare facility is almost out of reach and affordability in majority rural populations. These results are of relevance for similar settings and should serve to promote interventions aimed at improving maternal care in rural settings. Further larger research is required on cost effectiveness of level II neonatal intensive care.

**Keywords:** Health care cost, LBW, Economic evaluation, Infant deaths

### INTRODUCTION

LBW, defined by the World Health Organization (WHO) as weight at birth of less than 2.5 kg irrespective of gestational age, has adverse consequences on infant survival and physical and cognitive development.<sup>1</sup> Very low birth weight (VLBW) babies, defined as weighing 1.5 kg or less at birth, have a high risk of death and disease during the first year of life.<sup>2</sup> The incidence of very low birth weight (VLBW) babies has remained same

from 1970 to 2013 as data evaluation by data bank.<sup>3</sup> The overall incidence of VLBW babies in European studies range from 1.4 to 2% from the year 1970 to 2013. On further analysis it was found that in white non-Hispanic population incidence was 1 to 1.2% that is slightly less than average while in black non-Hispanic population incidence of the same was 1.2 to 2.4% for the same period. In Asian, Indian was 0.8% to 1%, in Chinese population 0.8% to 1.4% and in Japanese population 1.4% to 1.5% during the same period. But in India exact data is not available as birth registration was not

compulsory. A small well designed study was conducted by Chaudhuri N and has documented incidence from 2004 to 2007 in Burdwan Medical College.<sup>4</sup> It was found that out of 63299 deliveries, overall incidence less than 1000 gram was 0.25% and between 1000 and 1500 grams were 0.45%, totalling 0.7% below 1500 grams. It is much less than reported in most other countries. Total delivery during the period in Burdwan district in West Bengal, India was 409613. As these include deliveries at home as well as in health care facilities, exact birth weight was not available for all. In Burdwan medical college all booked and referred cases are delivered and that may be the reason for such low incidence. The VLBW babies have 22% chance of death within first year of life.<sup>5</sup>

In low-income countries about 60% of all infant deaths are reported in LBW babies.<sup>6</sup> Most of these deaths occur during the neonatal period when the risk of death is six times higher than in high-income countries.<sup>7-9</sup> LBW has been associated with an increased risk of respiratory and diarrheal diseases impaired growth and mental development, and poor outcomes in young adulthood.<sup>10-15</sup> HIV infection, malaria, malnutrition, and anemia during pregnancy along with maternal younger age have been reported to be risk factors for LBW.<sup>16-18</sup>

The cause of VLBW is multifactorial like spontaneous preterm delivery, psychological stress, socio economic status, physical activity, drug abuse, smoking.<sup>16,19, 20</sup> Also implicated are complications like threatened abortion, premature rupture of membrane, cervical incompetence, multiple pregnancies, fetal abnormalities.<sup>21</sup> Biochemical and immunological factors are also important. There is extreme improvement in maternal health care services, still the incidence remained same because multiple factors are responsible for VLBW which are difficult to identify. In Burdwan district different causative factors are important like early marriage, early motherhood, poor antenatal check-up, strenuous physical work and delivery complications. The most of the social burden of VLBW babies is the cost for their survival and ultimate outcome.

The treatment cost of initial hospitalization as per California medicaid experience averaging 54900 dollars.<sup>22</sup> Average cost of babies weighing 500 to 749 grams was 157000 dollars.

The cost of Indian scenario is variable in different sectors like Government hospitals, NGO supported health care facilities and corporate hospitals. The cost varies from house to house. The Government hospitals give free treatment but have problems like overcrowding, non-availability because the hospitals are not within reach in emergency period because of long distance.

The present study was conducted to give health care with minimum expenditure. The cost of management was cut off by minimum investigations, more supervision by working health care personnels.

## METHODS

The present study was conducted from May 2013 to March 2015 in a tertiary care hospital, West Bengal, India after taking permission from institutional ethics committee. During 1 year and 9 months admitted patients with level IIB care as per NNF protocol was considered for low cost care setting with careful observation by health care providers. Parents were counseled regarding the low cost care management setting with careful observation. Written informed consent was sought from parents or legal guardian before including in the above study. Those who were not interested to participate in the study get the routine care facilities. During this period 30 babies were admitted and their data has been analysed. The patient was first seen by a postgraduate degree holder with good training in neonatology, and subsequently same doctor sees the patient regularly twice a day and also in emergency if arises. The management as outlined was carried out by the persons who are well trained and motivated for neonatal care. The importance was given more on clinical assessment, constant watch, counselling the family members, minimum antibiotics and minimum relevant investigations.

At the time of admission basic clinical parameters were assessed which include weight, body temperature, color, SaO<sub>2</sub>, respiratory rate (RR), blood sugar etc. and provisional diagnosis was made and treatment started. After the baby is stabilised gestation was assessed by modified Duvowitch criteria. Treatment includes parenteral fluid 5% or 10% dextrose water as maintenance and normal saline as bolus when needed. Phenobarbitone was used in case of convulsion. Thermoneutral environment was provided around 29<sup>0</sup>C. Antibiotics were started initially with cefotaxime and one aminoglycoside and subsequent change was made depending on clinical profile and investigations. Basic investigations done include Hb, TLC, DLC, peripheral smear for toxic granules, CRP, serum sodium, serum potassium, blood sugar, if clinically jaundice is detected then serum bilirubin.

After investigations if any evidence of infection is found, same antibiotic was continued for 48 hours and changed if there is no improvement. Fresh frozen plasma was given in case of coagulation profile abnormalities or evident coagulation disorders.

## RESULTS

Out of 30 babies 26 (86.6%) were transported for a distance of 25-45 kilometers by ambulance. One baby was transported for 10 and another 15 kilometers by ambulance and two babies were brought from a distance of 500 meters. All the outborn babies were well covered during transport and temperature was 97 to 98<sup>0</sup> F. Only one baby had temperature of 99<sup>0</sup> F. Majority (66.6%) of babies were admitted at 7 AM to 8 PM and 33.3% of

babies were admitted at odd hours of 8 PM to 12 midnight.

Out of 30 babies 17 (56.6%) received oxygen by mask and 7 (23.3%) received oxygen by mask and IV fluids during transport. Six babies (19.98 %) did not receive any oxygen or IV fluids. Though the babies were provided with oxygen, or oxygen with IV fluids but none were well maintained during the transport period.

Out of 30 babies 2 (6.66%) were extremely low birth weight (ELBW), 6 (19.98%) were very low birth weight (VLBW) and 2 (6.66%) had jaundice (Table 1). Two babies developed neonatal necrotising enterocolitis (NNEC), Two babies had respiratory distress syndrome (RDS). Four babies had hypoxic ischemic encephalopathy (HIE) and one each babies developed hemorrhagic disease of newborn (HDN), Meconium aspiration syndrome (MAS) and sepsis respectively.

**Table 1: Weight of the babies.**

Weight	No. of babies	Percentage
<1000 gm	2 (1)	( 3.33% )
1001-1100 gm	4	( 13.32% )
1101-1200 gm	1	( 3.33% )
1201-1300 gm	7 LAMA - 1	( 23.31% )
1301-1400 gm	4	( 13.32% )
1401-1500 gm	12 (2) LAMA - 1	( 36.63% )

No of babies in bracket indicate death. Among three babies died one was 750 gm and other two 1.5 kg. Survival rate was 83.33%.

**Table 2: Gestation of the babies in weeks.**

Gestation age (weeks)	No. of babies	Percentage
28	2 (1)	(6.66%)
29	1	(3.33%)
30	4	(13.32%)
31	3	(9.99%)
32	3	(9.99%)
33		
34	5 (2)	(16.65%)
35	4	(13.32%)
36	8	(26.64%)
37		
38		

No of babies in bracket indicate death. Among three babies died by gestation one was 28 weeks and other two 34 weeks.

Out of 30 babies 2 died and 2 left health facility against medical advice whose future is not known. So mortality rate was 6.66% and survival rate was 86.6%. Each of three babies those died travelled a distance of 45 kilometres or more. The first baby with birth weight of 750 gm travelled a distance of 45 kilometres with fluid support only and died within 7 hours. The second baby -

mother first referred from primary health centre to sub divisional hospital and mother had prolonged labor. Baby suffered from HIE III and died within 17 hours. The third baby having respiratory distress syndrome and product of vaginal delivery survived for 67 hours had similar conditions of long travel of 45 kilometers with O<sub>2</sub> support. The second and third babies could have been saved if they had effective management at birth. They got transferred 8 hours after birth.

**Table 3: HR, SaO<sub>2</sub> and RR of babies.**

Heart rate	Saturation			
	84%	84% -92%	92% - 96%	>96%
<120 (%)	2 6.66%	11 36.63%	1 3.33%	1 3.33%
>120 (%)	3 9.99%	7 23.31%	3 9.99%	2 6.66%

No of babies with HR less than 120 saO<sub>2</sub> less than 84% in 2 babies and more than 84% = 13; No of babies with HR more than 120 saO<sub>2</sub> less than 84% in 3 babies and more than 84% =12.

LAMA 1 baby – outcome was not known as the baby was referred to higher centre for pediatric surgery after developing NNEC. LAMA 2 babies was improving but parents took to higher center due to unknown reasons.

Average hemoglobin level was 14±0.875 gm / decileter, total leukocyte count varied between 10400 - 13800, Polymorph count was 38% - 44% and toxic granules were present in 2 babies. Platelets varied between 1.2 to 2.7 lakhs/ dl. C–reactive protein was positive in two babies those who have got toxic granules. Serum sodium was variable between 132 - 140 meqv / litre and in one baby it was 127 meqv / L who was lethergic also. Serum potassium varied between 3.7 to 5.8 meqv / Litre and one baby had 3.2 meqv/ Litre, the same baby who had hyponatremia. Blood sugar varied from 55 to 124 mg/ decileter, one baby having 39 mg / dl. Serum calcium varied between 8.1 to 9.2 mg /dl. Serum bilirubin was high in 3 babies within a range of 11.7 to 17.9 mg/dl who needed phototherapy. These were baseline investigations at the time of admission. Two babies during stay developed necrotising enterocolitis who became septic and CRP positive.

**Table 4: Duration of hospital stay.**

Breakup of duration			
Neonatal unit (days)	Kangaroo mother care (KMC) in ward	Total	% (percentage)
<3 days	2 days	<5 days	4 (13.32%)
3-5 days	2 days	5-7 days	10 (33.33%)
5-7 days	3 days	8-10 days	6 (19.98%)
7-11 days	4 days	11-15 days	7 (23.33%)
>10 days	5 days	>15 days	3 (9.99%)

## DISCUSSION

A cost and effectiveness analysis (an observational study) was conducted for last 1 year and nine months in a tertiary care hospital, West Bengal, India for the care of very low birth weight babies (VLBW). The main idea was to provide care with minimum cost so that majority people can afford.

Preterm birth and being small for gestational ages (SGA), which are the reasons for low-birth-weight (LBW), are also important indirect causes of neonatal deaths. LBW contributes to 60% to 80% of all neonatal deaths. The global prevalence of LBW is 15.5%, which amounts to about 20 million LBW infants born each year, 96.5% of them in developing countries.<sup>23</sup>

"Kangaroo mother care (KMC)" is a method of care of preterm infants weighing less than 2 kg. It includes exclusive and frequent breastfeeding in addition to skin-to-skin contact and support for the mother-infant dyad, and has been shown to reduce mortality in hospital-based studies in low- and middle-income countries.<sup>23</sup>

Now all the corporate houses charge more than lakhs. The babies are also subjected to number of investigations irrespective of clinical status and superfluous instrumental approach and increased dependence on instrumental support. Curative care in India is highly skewed towards private sector.<sup>24</sup> More than 80% outpatient care and nearly 60% in-patient care is sourced from private providers.<sup>24</sup> Given the fact that neonatal care is cost-intensive, it imposes significant economic burden on households pushing them into poverty.

The cost of SCNU care holds important fiscal implications, especially in view of Government of India's recently launched janani shishu suraksha karyakram (JSSK), a scheme for provision of free delivery services and treatment for sick newborn till 30 days of birth in public hospitals.<sup>25</sup> In view of this, it is important to assess the cost effectiveness of SCNU care. High fiscal costs imply that the services need to be rationed carefully for the ones who need it most. We recommend careful implementation of selection criteria for admission to SCNUs. Currently, almost half of normal birth weight children were being admitted to SCNUs despite having clear cut admission guidelines. This is also corroborated by evidence from another study.<sup>26</sup>

The basic approach of the study is to train the staff with minimum academic qualification and motivation for involvement of the work. These staff are specially trained for care of LBW and VLBW babies and they are given responsibility of these babies and no other work so that they become dedicated newborn worker. They were trained to start IV line, care of IV line, early recognition of IV line infection, tube feeding, gastric aspiration and appreciation of tolerance of gastric feeding. They were

also trained on monitoring of clinical signs like look, activity, body temperature, pulse, capillary refill time, respiration count, detection of apnea etc. Baby clothes were changed daily or on immediately on soiling. Any person entering the nursery either doctor or staff should wash hands thoroughly before entering nursery and also after examining each patient.

Keep continuous eye on multichannel monitor when the babies are put in machine support and surveillance is more when babies are under radiant warmer and phototherapy. For all the babies the caretaker maintain chart of weight, temperature at least four times a day, urine output, stool color and frequency. The caretakers are more vigilant when the babies are under instrumental care like radiant warmer, phototherapy, CPAP etc. Those babies on anticonvulsants are much more prone to develop convulsion, apnea and aspiration, so the working personnel are more careful on these babies. Apart from all basic measures the staffs are given the responsibility of four babies from the day of admission till discharge so that there can assess the babies initially as well as during admission period. The nursery temperature was maintained at 29<sup>o</sup>c by continuous air conditioning. Insensible water loss was cut by plastic cover. In apnea of prematurity ventilation has not been used because of cost, chance of ventilation associated infection. Patients were kept on minimum time nasal CPAP with this innovative approach. The result was very gratifying. The minimum use of antibiotic led to less cost but better result.

The mother and family members were counselled at the time of admission. Concerned doctor met the family members after each visit and explained condition of the baby each time. The doctor family friendly atmosphere was created which makes a good bondage thus helps to establish confidence of family as well as avoidance of grievances. Mother or family members can see the baby through glass shield from outside and mother is specifically allowed to see and touch her baby two to three times a day after they are stabilized. So the family members can see their babies regularly as well as observe the care given by doctors and working personnel to their babies.

***With this level of care the present system has given the following achievements.***

1. Survival 86.6% and mortality rate 6.66%.
2. Nursing home stays average more in case those are coming from long distance with supportive measures.
3. Cost of management – average cost of nursing home is Rs 1000 and medicine cost Rs 500 per day.
4. Good doctor family relationship – establishment of Doctor, worker and family friendly environment which combat all the grievances.

### Recommendations

1. This type of set up can be made where minimum health care facility is available.
2. Sensitization of doctor working in grass root level regarding; (a) stabilization of the patient; (b) maintenance of on-going care during transport; (c) way of giving oxygen and intravenous fluids.
3. If these managements are provided then nursing home or health care facility in rural setting stay will decrease 3 to 4 days, which will be more cost effective.
4. Distance and time of arrival is well correlated with outcome but in such small sample study it is seen that babies who come from less than 5 kilometres has stay of less than 5 days and those coming from distance have longer stay.
5. It has been well studied that odd time admission has higher mortality but in present study such result has not been observed due to meticulous care. But in larger set up efficiency of caregivers may be affected in odd hours.

### Limitations of present study and future implications

Our study had certain limitations.

1. Small sample size
2. It was a single centre study. Thus the results cannot be a representative of national data. Further large scale multi-centric studies should try to overcome these limitations.
3. Although it is important to conduct a full economic evaluation, we did not analyze the incremental costs of LBW/VLBW per DALY averted, as compared to routine care setting.
4. We do not report condition or disease specific unit cost of neonatal treatment at the low costing setup.

However, we have estimated the per bed-day cost, which takes account of the average length of stay, and given their average length of stay. Also we did not undertake a complete economic burden from a societal perspective as we did not account for indirect costs such as productivity losses and transportation costs.

But the results of this study highlight the need for low cost healthcare management to rural areas so that timely management can be provided to LBW or VLBW babies to decrease infant mortality in both rural and urban setting.

### CONCLUSION

Given the fact that neonatal care is cost-intensive, it imposes significant economic burden on households pushing them into poverty. High fiscal costs imply that the services need to be rationed carefully for the ones who need it most. With the availability of low cost medicines and consumables, ordering rational

investigations and better surveillance by health care providers can reduce total healthcare expenditure cost for patients beyond affordability with better outcome.

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