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Original Research Article

A study to evaluate the functioning of Special Care Newborn Unit (SNCU) established at a District Hospital

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Abstract

The Neonatal mortality rate in India is high and stagnant. Special Care Newborn Units (SCNUs) have been set up to provide quality level II newborn-care services in several district hospitals to meet this challenge. The units are located in some districts where the burden of neonatal deaths is high, and access to special newborn care is poor. A cross-sectional survey was conducted to assess the availability of human resources, equipment, and quality care. Descriptive statistics were used for analyzing the inputs (resources) and outcomes (morbidity and mortality). The rate of mortality among admitted neonates was taken as the key outcome variable to assess the performance of the units. Chi-square test was used for analyzing the trend of case-fatality rate over a period of first year of operationalization of SNCU as the base. The Average Neonatal Mortality Rate reduced from 1.29% before the start of SNCU in 2012 to 0.845% after 1 year of start of SNCU in Rajouri district during 2013-14 study periods. Proportional mortality due to sepsis and low birth weight (LBW) declined significantly over a period of one year (LBW <2.5 kg). The major reasons for admission and the major causes of deaths were birth asphyxia, sepsis, and LBW/prematurity. Repair and maintenance of equipment were a major concern. It is possible to set up and manage quality SCNUs and improve the survival of newborns with LBW and sepsis in developing countries, although several challenges relating to human resources, maintenance of equipment, and maintenance of asepsis remain.

Keywords: Cross-sectional studies, Neonatal mortality, Newborn care, Evaluation, Case Fatality Rate, Chi-square test, Correlation coefficient, Morbidity, Mortality, Feasibility, Prematurity, Asphyxia, Asepsis, Immunization, Ventilator, Operationalization, Equipment, Referral.

1. Introduction

Every year, four million newborn babies die in the first month of life—99% in low and middle-income countries. India carries the single largest share (around 25-30%) of neonatal deaths in the world with Neonatal mortality rate of 32/1000 live births. Neonatal deaths constitute two-thirds of infant deaths in India; 45% of the deaths occur within the first two days of life while 75% deaths occur within first week of life [1]

The neonatal mortality rate is defined as number of neonatal deaths per 1000 live births [6]. Across the globe neonatal mortality rates range from 5 per 1000 in developed countries to 50 per 1000 in the least developed countries; early neonatal mortality represents about 75% of neonatal mortality. [6]

Globally, neonatal mortality accounts for more than one-third of deaths of children aged less than five years [4]. (a) Infection accounts for one-fourth of total neonatal deaths. About 99% of these neonatal deaths take place in low- and middle-income countries. (b) Bacterial infection is a significant cause of neonatal and early childhood admissions to hospitals and probably of morbidity in the community but its burden is unclear. (c) Identification and treatment of newborns with infection are weak in many developing countries. (d) Detailed studies on

the etiology and antibiotic resistance profile of neonatal septicemia in rural India are uncommon. [4]

Good laboratory facilities, especially blood culture, are frequently unavailable in the rural healthcare setting, resulting in the non-availability of relevant data on culture-proven neonatal sepsis. [4]

Description of Newborn Care Facilities at Different Levels: [2]

(1) **Special Care Newborn Unit:** SNCU is a neonatal unit in the vicinity of Labor room that provides care to all sick newborns except for those requiring assisted ventilation or major surgery. [2]

(2) **Neonatal Stabilization Unit:** The neonatal stabilization unit is a facility within or in close proximity of the maternity ward where most sick & low birth-weight newborns can be taken care of. All First Referral Units (FRUs) need to have a Neonatal Stabilization Unit in addition to a Newborn Care Corner. [2]

(3) **Newborn Care Corner:** This is a space within the delivery room where immediate care is provided to all newborns. This area is mandatory for all health facilities where deliveries take place. [2]

SNCU at District Hospital is expected to provide following services: [2]

i. Care at Birth including resuscitation of asphyxiated newborns.
ii. Managing Sick newborns except those requiring mechanical ventilation & major surgical interventions.
iii. Post-natal Care
iv. Follow-up of high risk newborns
v. Referral Services
vi. Immunization Services.

As a general rule, for all the deliveries occurring within a health facility, 3 beds for every 1000 Intramural deliveries may be dedicated to Newborn care unit. It accounts to Intramural deliveries occurring within District Hospital. [2]

Additionally, for Newborns delivered outside the hospital i.e. Extramural are being brought to hospital for Special care, an extra allowance of 30% of estimated beds should be considered.

For example, if a Hospital conducts 3000 deliveries per year, the number of beds required would be:

For Intramural --- 3/1000 x 3000 = 9 beds

For Extramural ---- 30% of 9 = 3 beds

Total Beds required = 12

Universally, units providing Special care should have a minimum of 8 beds & maximum of 16 beds.

These SNCU units are essentially equipped with radiant warmers, phototherapy units, oxygen concentrators, pulse Oximeter, and intravenous infusion pumps, enough to treat and take care of babies with birth asphyxia, jaundice, sepsis, and LBW.[1] These units cater to both Intramural and Extramural sick neonates. The recommended nurse: bed ratio is 1:1.2 while the doctor: bed ratio should be 1:4. It has been estimated that around 15-20% of all newborns require level II care in rural settings. [1]

Table 1: Newborn care facilities at different health care levels

S. No.	Health facility	All newborns at birth	Sick newborn
1	Primary Health Care	Newborn Care Corner in Labour Room	Prompt Referral
2	Community Health Care/First Referral Unit	Newborn Care Corner in Labour Room & in Operation Theatres(OT)	Neonatal Stabilization Unit
3	District Hospital	Newborn Care Corner in Labour Room & in Operation Theatre(OT)	Special Care Newborn Unit.

These units reflect the capability to provide increasingly complex care, reflected in appropriate personnel, equipment, and organization. [2]

Three levels of neonatal care are envisaged. [5] Newborn-care corners are established at every level to provide essential care at birth, including resuscitation. Level I care includes referral of sick newborns from Primary Health Centre (PHCs) to higher Centre and care at neonatal Stabilization Units (NSUs) in the first referral units. Care in the NSUs includes stabilization of sick newborns and care of low birth weight (LBW) babies not requiring intensive care. Level I care includes functioning of Special Care Newborn Units (SCNUs) at the district hospital level. These units are equipped to handle newborns other than those who need ventilator support and surgical care. The level III units are the neonatal intensive care units. [5]

Neonatal intensive care is regarded as one of the most expensive components of pediatric health care [7]. This makes it important to gain insights into the cost of facility-based newborn care. In the event when India goes on the path of universal health care, level II neonatal care would comprise 0.8% of India's health care spending. Thus it does not impose too much fiscal pressure. However, the resources would need to be used judiciously for the babies who actually require neonatal intensive care. [7]

The best indicators available to us about the risk status of the births at each unit were the birth weight distribution and whether the birth was singleton or multiple. [10] We considered two alternative measures for birth weight distribution: the proportion of total births at the unit

weighing less than 2501 g (low weight births) and the proportion of total births weighing less than 1501 g (very low weight births). [10]

While until recently there has been little evidence of feasibility and effectiveness of level II newborn care in rural settings, recent experiences have shown that a rural district hospital can provide level II newborn care. It was demonstrated that strengthening of secondary-level care can lead to significant reduction in mortality among admitted newborns and was further estimated to lead to reduction in neonatal mortality of the entire district [1]. The Average Neonatal Mortality rate (NMR) among admitted newborns reduced to 0.845% from existing 1.29% in the first year after SCNU became functional. [1]

1.1 Objective: A study to evaluate the functioning of Special Care Newborn Unit (SNCU) established at a District Hospital.

2. Methodology

The evaluation was carried out in 10 Bedded SNCU unit of a District Hospital at Rajouri in Jammu & Kashmir State of India over a 12-month period. w.e.f. 1st July 2013 to 31stJune 2014.

Based on an extensive literature review, different components of evaluation were identified. For assessment, standards laid out by the National Neonatology Forum for accreditation of level II units in India and those adapted for the SCNUs were adopted. Quantitative information was gathered on the resource inputs provided and available within the unit and performance of the unit in terms of the neonatal mortality and morbidity indicators.

Information was collected from the Retrospective study of the monthly reports of the SCNUs from the records i.e. Admission registers and Discharge registers were reviewed. The research team visited the SNCU unit to gather the information and triangulate the data with personal observations and interaction with the unit staff.

Data of SNCU were collected from January to December 2012 before the start of SNCU unit and comparable data during the study period of July 2013 to June 2014 after the start of SNCU unit. Information was collected on the following parameters: number of admissions; availability of human resources (doctors and nurses); adequacy and availability of essential equipment, such as radiant warmers, phototherapy units, weighing machines, oxygen concentrators, generator, and air conditioners and their functional status; availability and adequacy of beds; maintenance of asepsis; and morbidity profile and mortality rate among the admitted newborns. The performance of SNCU unit was assessed using Case-Fatality rate (CFR). i.e. proportion of deaths among babies admitted to the SCNU as the outcome variable. Data of the first year were taken as the baseline for SNCU unit. The factors assessed were: bed: doctor ratio, bed: nurse ratio, average duration of stay, bed occupancy rate, and asepsis score for each unit. The asepsis score was a composite score ascertained from the following factors after giving appropriate weights: 24-hour running water, presence of an elbow-operated wash basin, availability of soap, practice of hand washing before entering the SCNU, practice of hand washing after touching every baby, practice of wearing gowns in the SCNU, practice of wearing slippers in the SCNU, and practice of wearing mask and caps in the SCNU. The parameters included in the indicators were based on the observations made by the research team at the time of visit.

3. Results

3.1 Performance of SNCU: [1]

The performance was based on the analysis of Inputs (in terms of infrastructure, human resources, and equipment) and Output (in terms of the average duration of stay, bed occupancy rate, and aseptic measures). The CFR was the key outcome variable that correlated with the input and output variables. [1]

3.1.1 Inputs: [1]

1) Infrastructure:

SCNU was unique in its layout and suffered from its own space constraints, making it difficult to adhere to the norms. SNCU unit was close to the Labor room with a designated space for breastfeeding. There are recommendations that at least 50 sq. ft. per bed should be available for baby care and another 50 sq. ft. per bed for ancillary space. SNCU unit under study is 10 bedded.

2) Human Resources:

Table 2: Human Resources

S. No.	Designation	Number of posts
1	Incharge paediatrician	1
2	Consultant paediatrician	3
3	Medical officers	3
4	Staff nurses	5
5	Laboratory technicians	2
6	Sanitary attendants	1

SNCU unit had less number of nurses than the recommended nurse: bed ratio of 1:1.2, and One In charge Pediatrician doctor was posted exclusively for the SCNU. Three Consultants had to manage outdoor/indoor patients and had to attend to pediatric emergency duties, in addition to managing the SCNUs. Most staff members including 5 Staff Nurses & 2 Lab. Technicians had been imparted practical training, although the duration of training varied from one day to 15 days. There was no formal refresher training.

3) Equipments

SCNU had most of the essential equipment. However, once the equipment had a crash, the repair was

often delayed. The breakdown time varied from one week to over six months for essential equipment across the units. At the time of the survey, Annual Maintenance Contract (AMC) was made for essential equipment, such as baby warmers and phototherapy units. However, whether or not the unit had an AMC did not seem to influence the breakdown time.

Other basic physical facilities relating to newborn care, such as cord-tie, cord-cutter, and infant-weighing scale were available at most facilities. Supply of clean towels was meager, and the practice of wrapping the neonates in clothes brought by the mother or other attendants was common. [9]

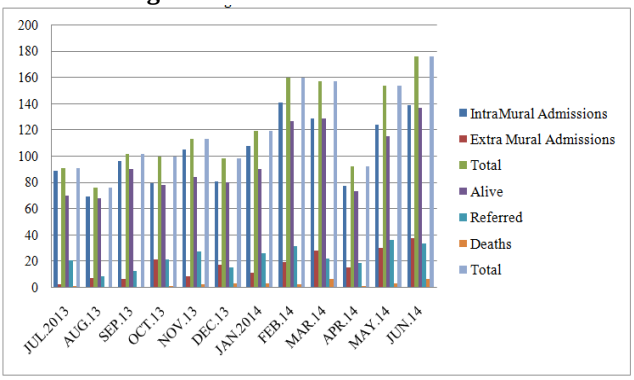
The hospitals were assessed for availability and functioning of equipment needed to provide essential newborn care as well as equipment to treat sick infants, like feeding-tubes, IV infusion sets, and phototherapy units. [9]

Table 3: List of Equipments

S.No	Equipments	Count
1	Radiant warmer	10
2	Phototherapy unit	10
3	Resuscitator	5
4	Oxygen concentrator	5
5	Laryngoscope set	3
6	Suction pump	5
7	Infusion pump	10
8	Portable Cardiac monitor	1
9	Transport incubator	1
10	ECG Unit	1
11	Pulse Oximeter	9
12	Sphygmomanometer	5
13	Stethoscope	3
14	Centrifuge Hematocrit	1
15	Microscope	1
16	Refrigerator	1
17	Bilirubin meter	1
18	Glucometer	4
19	Weighing machine	2
20	Portable X-ray machine	1
21	Digital thermometer	10
22	Examination light	1
23	Surgical instrument tray	1
24	Dressing/Kidney tray	5
25	Measuring tape	1
26	Steam Autoclave	1
27	Sterilization drum	5
28	Infant meter	3
29	Blood transfusion set	5
30	Endotracheal tubes	50
31	Nasal prongs	62
32	Oxygen cylinders	5
33	Sterile cord cutting equipment	1
34	Laundry washer	2
35	Air cleaner	2
36	Flow meter	2
37	Umbilical cord clips	20
38	Oxygen hood	10

3.1.2 Output:[1]

Figure 1: Annual work done of SNCU



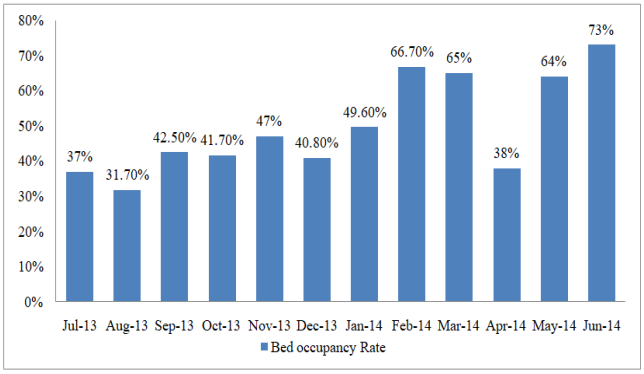
1) Average length of stay:

The average duration of stay ranged from 2 days to 8 days (Median 4 days).

2) Bed occupancy rate

These parameters were dependent to a large extent on the admission load, numbers of beds, demand for empty beds, and profiles of babies admitted to the SCNUs. High bed occupancy resulted in sharing of beds by 2-3 babies in some instances. The bed occupancy rate also indicated the burden on the nurses since each baby requiring admission in the SCNU would need special attention. The average duration of stay in the surveyed unit ranged from 2 days to 8 days (Median 4 days).

Figure 2: Bed occupancy rate:

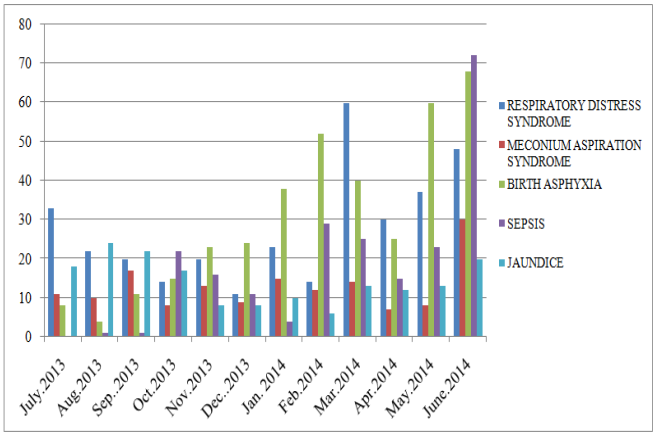


3) Aseptic practices:

The asepsis score was a composite score ascertained from the following factors after giving appropriate weights: 24-hour running water, presence of an elbow-operated wash basin, availability of soap, practice of hand washing before entering the SCNU, practice of hand washing after touching every baby, practice of wearing gowns in the SCNU, practice of wearing slippers in the SCNU, and practice of wearing mask and caps in the SCNU. The parameters included in the indicators were based on the observations made by the research team at the time of visit.

4) Monthly morbidity profile

Figure 3: Monthly morbidity profile



5) Referral rate

Figure 4: Referral rate

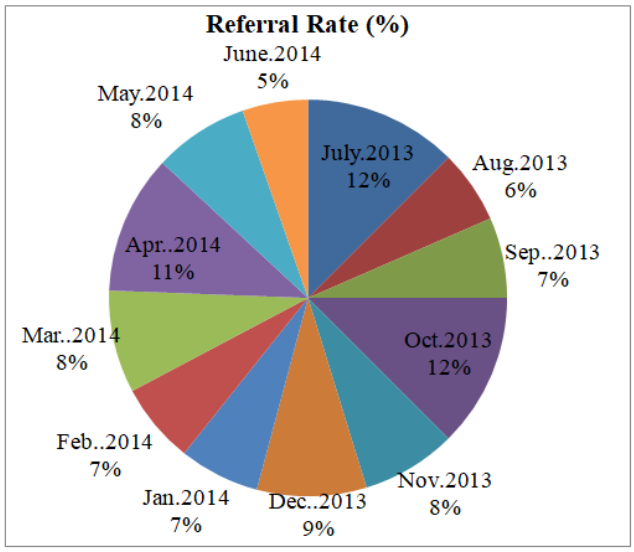


Figure 5: Performance of district hospital before S.N.C.U.

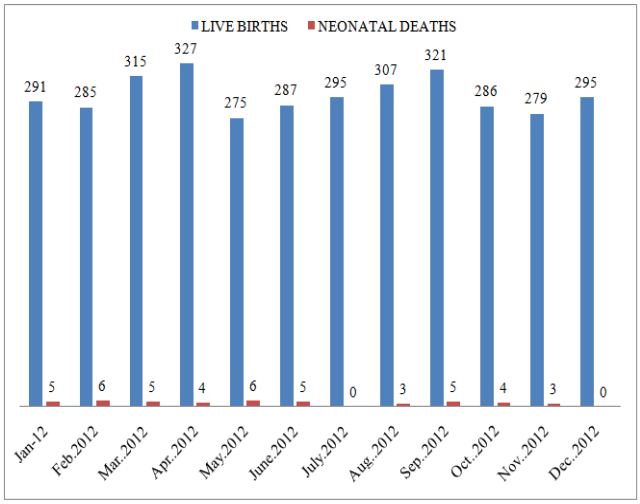
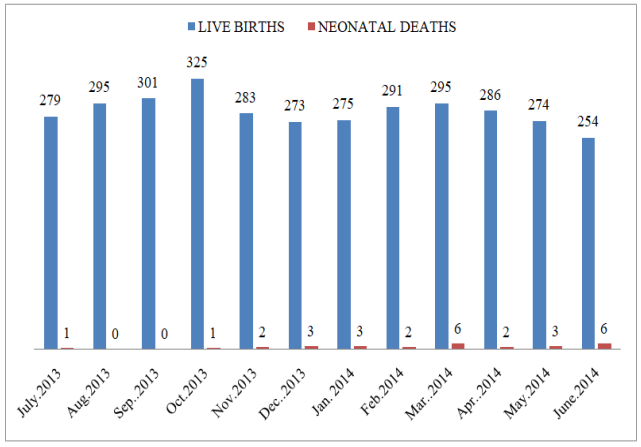


Figure 6: Performance of district hospital after S.N.C.U.



Thus the average neonatal mortality rate before starting S.N.C.U was found to be: - 1.29 % (in the period of January to December 2012)

While the same after starting S.N.C.U. dropped to 0.845 %

4. Discussion

The results of the assessment of the SNCU unit suggest that quality level II newborn care can be provided at the district level within the public-health system. According to the estimates, about 10-15% of all newborns have a complication requiring level II care. In the present study, the proportion was highly skewed. It was less in units where strict admission criteria were in place or where people preferred to visit private doctors. The number of beds was less than what was required. While the number of deliveries taking place in the hospital where the unit is located forms the basis; a number of other parameters, such as average duration of stay, proportion of babies requiring special care, proportion of out born babies, and proportion of LBW infants form the determining factors.

Table 6: Case fatality rate (CFR)

S.No.	Diagnosis	Average C.F.R. / Year
1	Respiratory distress syndrome	0.8%
2	Meconium aspiration syndrome	0.6%
3	Birth asphyxia	5.97%
4	Sepsis	1.8%
5	Jaundice	nil

The rule of thumb method based on the guidelines of the National Neonatology Forum considers only the proportion of babies requiring special care and the average duration of stay. The admission policy of a unit is also a key indicator that can influence the performance. There was overdependence on the SCNU, and in many instances, babies were kept for mere observation due to social pressure. Also, currently, the SNCU unit had largely inborn admissions, thus considerably leaving a large proportion of

sick newborns delivered outside the facilities. If one estimates the numbers of newborns in the district who would require level II care, the numbers of special care beds required would be much larger, indicating a huge unmet needs for special newborn care.

The admission overload was a concern in SNCU unit. It must be considered here that the number of beds is a crucial parameter because human resources, equipment, and admission load finally depend on the number of beds. Given the fact that the number of deliveries had increased in SNCU unit and the bed occupancy rate exceeded 100%, the number of beds for each unit needs to be revaluated. An increased admission overload also gives rise to sharing of beds often by 2-3 babies which poses a risk. Chances of acquiring infection increases manifold with sharing of beds. [1]

The maintenance of SNCU equipment was a major challenge in most districts. The equipment-providing companies had their offices at the state level or sometimes these were not there in every state. Service engineers at the state level generally prepared their roster for their round to attend the complaints but they preferred to plan their route map in a way that the districts falling on a particular route got covered all together, or they had a tendency to wait for the adequate number of complaints from districts on a particular route. This made economic sense to the equipment-providing company but it actually delayed in attending to complaints as by the time the turn of the particular SCNU came in the roster, it had already been quite late. This is a critical issue, and the situation would worsen in near future as the equipment would near their shelf-lives, and the frequency of breakdown would further increase. [1]

A composite score ascertained from the following factors after giving appropriate weights: (a)24-hourrunning water, (b) presence of an elbow-operated wash basin, [5] (c) availability of soap, (d) practice of hand washing before entering the SCNU, (e) practice of hand washing after touching every baby, (f) practice of wearing gowns in the SCNU, (g) practice of wearing slippers in the SCNU, and (h) practice of wearing mask and caps in the SCNU. The parameters included in the indicators were based on the observations made by the research team at the time of visit [5].

The duration of stay in the intensive care units is well-dependent on birth weight. [5] The average duration of stay in an SCNU is usually 5-7 days. The average duration of stay for preterm babies or very LBW babies is usually long, and the proportion of LBW babies affects the average duration of stay. It varied between two and 15 days in our assessment. The average stays of patients varied from 26days to 32-33 weeks &to seven days at term, according to a study in New Zealand on level II and III units. In California, the average hospital stay for LBW infants ranged from 6.2 days to 68.1 days whereas the average hospital stay for infants who weighed >2,500 g at birth was 2.3 days. Infants who weighed >1,249 g had progressively shorter hospital stay [5].

5. Limitations

Although the study was one of the initial ones to give an evidence of feasibility of operating these district-level SNCU units, yet it has its own limitations. The information collected was based on secondary data routinely obtained by the SNCU unit triangulated by personal observations. Reporting of morbidities and mortalities is a concern owing to lack of uniform case definitions used. Much of the outcomes could have been related to birth weight and inborn/out born status but this could not be analyzed because of absence of case-based data. Moreover, data were made available till January 2013 from the date of Inauguration of SNCU at District Hospital. These were compared with data of previous year 2012 which may not be very appropriate due to seasonal variations. Although we attempted to find out the possible factors that could be associated with the CFR, it was difficult to come to a meaningful conclusion due to the small sample-size. Despite these limitations, the assessment gives an insight into the potential challenges that might not have been captured during the routine monitoring.

6. Conclusion

The SCNUs are a critical investment to curb the neonatal mortality rate in India. Not only these are difficult to establish but it is equally important to maintain their performance. Initial results in the form of reduction in the CFRs are encouraging but there are challenges that need to be looked into before it is scaled up. Having an adequate number of personnel, right policies to facilitate timely repair of equipment, provision of an adequate number of beds, and imparting skills to maintain asepsis are the key recommendations that will circumvent the existing challenges. Replicating such a technically-intensive model, which involves a great deal of coordination and support of various agencies and the acceptability of the implementing authorities and health personnel, is a herculean task. It is pertinent to learn from the experiences, for us to establish the success of this model in diverse settings. It is hoped that lessons learnt from this assessment would assist in scaling up of such SNCU units with quality of newborn care facilities in other similar settings.

7. Recommendations

1) Regionalized systems of perinatal care are recommended to ensure that each newborn infant is delivered and cared for in a facility appropriate for his or her health care needs and to facilitate the achievement of optimal outcomes. [3]
2) The functional capabilities of facilities that provide inpatient care for newborn infants should be classified uniformly, as follows: [8]

- Level I (basic): a hospital nursery organized with the personnel and equipment to perform neonatal resuscitation, evaluate and provide postnatal care of healthy newborn infants, stabilize and provide care for infants born at 35 to 37 weeks' gestation who remain physiologically stable, and stabilize newborn infants born at less than 35 weeks' gestational age or ill until transfer to a facility that can provide the appropriate level of neonatal care. [8]
- Level II (specialty): a hospital special care nursery organized with the personnel and equipment to provide care to infants born at more than 32 weeks' gestation and weighing more than 1500 g who have physiologic immaturity such as apnea of prematurity, inability to maintain body temperature, or inability to take oral feedings; who are moderately ill with problems that are expected to resolve rapidly and are not anticipated to need subspecialty services on an urgent basis; or who are convalescing from intensive care. Level II care is subdivided into 2 categories that are differentiated by those that do not (level IIA) or do (level IIB) have the capability to provide mechanical ventilation for brief durations (less than 24 hours) or continuous positive airway pressure. [8]
- Level III (subspecialty): a hospital NICU organized with personnel and equipment to provide continuous life support and comprehensive care for extremely high-risk newborn infants and those with complex and critical illness. Level III is subdivided into 3 levels differentiated by the capability to provide advanced medical and surgical care. [8]

Ethics: Written informed consent was taken from all healthcare providers, and performance was assessed maintaining confidentiality. The ethical approval was obtained from Medical Superintendent of District Hospital where the study was conducted.

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