

# Current Status of NICUs in India: A Nationwide Survey and the Way Forward

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**Abstract** The number of Neonatal Intensive Care Units (NICUs) and Special Care Newborn Units (SCNUs) in the country has increased exponentially. However, their current status of functioning is not known. A structured questionnaire survey of 70 NICUs spread across the country was conducted to assess their infrastructure, staffing, equipment, patient profile and their involvement in research and training. Majority of the units were well staffed and led by neonatologists trained in India and abroad. All had facilities for mechanical ventilation and were equipped with sophisticated imported equipment. Yet, availability of in-house blood gas and X-ray, microbiology facility, invasive blood pressure monitoring and support of ophthalmologist was not universal. More than half had published papers in scientific journals and were having recognized training programs in neonatology. Though tremendous progress is visible since the last surveys, the number of NICUs is still grossly insufficient. The current and future gap in trained manpower is however daunting, and intensive efforts for expanding the in-service training programs and innovative approaches to training are required. There is an urgent need to improve the quality of care by launching collaborative quality improvement programs and mandatory periodic accreditation

managed by independent empowered organizations. The focus has to move forward from simply ‘survival till discharge’ to ‘intact complete life survival’. Simultaneously, the NICU care has to stay available and affordable for the masses.

**Keywords** India · Newborn · NICU · SCNU · Status · Survey

## Introduction

India is the largest contributor to the global births and neonatal deaths due to its second largest population base and a high neonatal mortality rate. Majority of these deaths occur in the 7.5 million low birth weight and 3.5 million preterm infants born annually. To improve neonatal survival, several programs have been initiated for better antenatal and intranatal care, and promote institutional deliveries [1]. A prerequisite to decrease mortality is the availability of Neonatal Intensive Care Units (NICUs) and Special Care Newborn Units (SCNUs) for care of sick infants. In the last 2 to 3 decades, the number of NICUs and SCNUs in the country has increased exponentially. This has been due to the impetus provided by and progress made by the National Neonatology Forum (NNF) and in recent years the Government's drive to have at least one SCNU in each district with the help of National Rural Health Mission (NRHM), UNICEF and other agencies. An increasing number of neonatologists trained through sub-specialty programs like Doctorate in Medicine (DM), Diplomate of National Board (DNB) and fellowships, and an easier availability of affordable neonatal care equipment have been the other catalysts for this growth [2].

Even though the number of NICUs and SCNUs has increased, their actual operational status is not clearly known. In absence of a system of mandatory registration and

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assessments by authorities, we have to rely on periodic surveys. The last surveys related to neonatal care in the country were conducted several years ago [3–6]. In this review, the authors describe the current status of NICUs in the country not only with respect to their infrastructure, staffing and equipment but also their functional aspects. Based on the findings of this survey, the authors also discuss the way forward.

## Material and Methods

A structured questionnaire was used to understand the current status of Indian NICUs. The authors did not know the exact number of NICUs or SCNUs in existence, as there is no centralized registry at the central or state level. For the same reason and also due to the fact that all units have a mixture of level II and level III beds, no attempts were made to distinguish between level II and III units. A list of NICUs/SCNUs in public and private sector was made based on the NNF directory, personal knowledge of the authors and further enquiries from the units known to them. Attempts were made to ensure coverage of all zones of the country. This survey does not include the 400 plus district SCNUs, which have been established by the NRHM or the UNICEF.

The questionnaire items were based partly on the NNF accreditation norms and partly on the consensus opinion of the writing group. The survey covered details of infrastructure, staff, equipment, support services, transport facilities, training, research and data. The questions were framed in such a way so as to also provide an idea of the quality of care. The participation in the survey was purely voluntary and the respondents were free to complete only parts of the survey, if they wished so. A fillable and savable Microsoft Word form was created so as to be returned *via* e-mail. It was pilot tested amongst 4 NICUs and the errors were rectified. The final survey questionnaire was e-mailed to 125 e-mail IDs. Three e-mail reminders were sent and phone calls made at 15 d intervals for a period of 2 mo.

## Results

Seventy (56 %) units responded to the survey request. Among the 70 units, 32 were in government sector and 38 in private sector. There were 25 medical colleges/institutions and 7 other hospitals, which comprised the respondents from the government sector. Amongst the private sector respondents, there were 3 medical colleges and 35 corporate/other hospitals. Overall, 26 (37 %) units were accredited by NNF and 7 (10 %) by National Accreditation Board for Hospitals (NABH). Amongst these 70 units, 16 admitted only outborns, 6 only inborns while 48 admitted both inborns and outborns. The number of outborn admissions was 68,200 as against

40,568 inborn admissions. Very low birth weight infants comprised 14.8 % of all the admissions (Table 1). There was a large variation in the survival rates, more so in the extremely low birth weight infants (Table 1).

Table 2 depicts the basic features of the respondents. The details of nursing staff and supporting manpower are shown in Table 3. All NICUs had full-time consultants, fellows/senior residents and house staff/junior residents. There were a total of 250 full-time consultants in the 70 units. Of them, 45 (18 %) had additional training from overseas NICUs and were working in 34 (49 %) units. At least one consultant with DM (Neonatology) qualification was working in 36 (52 %) units. Majority of units had a wide range of sophisticated equipment as shown in Table 4. Most units used open care systems and only half had incubators. All units had facilities for mechanical ventilation. However, invasive blood pressure (BP) monitoring, ophthalmology support, blood gas and in-house X-ray facilities were not available universally. Pulse oximeters were present in the delivery room in three-fourths of the units but air-oxygen blenders were available in only one-third. Except for open care systems, the other sophisticated equipment was predominantly imported. More than half to three-fourths of the units had the availability of support from other allied departments and sub-specialties (Table 5). Out of the 68 units which responded to this question, 56 (82 %) used formula milk in their NICUs. Only 6 (9 %) units had human milk banking facility. Parenteral Nutrition (PN) was being used by 44 units on regular basis and occasionally by another ten. PN was prepared by resident doctors and/or nurses in all except 1 unit where a nutritionist was involved. Table 6 shows the capacity for special training programs in neonatology. Written NICU protocols were present in 51 (73 %) units. Of them, 20 had locally written/adapted protocols, 20 used national protocols and 11 were using protocols of other institutions. Forty-one (59 %) units were involved in research activities and 33 (47 %) units had published 162 papers in national and international journals in the last 1 y.

Facilities for transport (71 % vs. 37 %), high frequency ventilation (82 % vs. 56 %) and inhaled Nitric Oxide (32 % vs. 22 %) were more commonly available in private sector NICUs

**Table 1** Patient profile of one year (for 70 units with 1,08,768 admissions)

Gestation/Birth weight	No. of admissions	Proportion of total admissions	Survival*		
			Median	IQR	Range
< 28 wk	3,127	2.9	44	18 to 60	0 to 100
28–32 wk	8,615	8.0	88	80 to 92	44 to 98
< 1,000 g	3,738	3.5	58	39 to 69	20 to 93
1,000–1,500 g	12,280	11.4	88	80 to 94	55 to 99

\*Gestation and weight wise break up is from 69 units. Only 23 units provided survival data. Infants who left against medical advice (LAMA) in poor medical condition have been included under deaths

**Table 2** Basic characteristics (n=70)

Characteristics	Values; n (%)
How old is the NICU (in years) (n=66)	
• < 1 y	0
• 1–3 y	10 (14.5)
• 4–5 y	7 (10)
• 6–10 y	12 (17.5)
• 11–20 y	19 (27.5)
• > 20 y	18 (26)
Location zone of the hospital	
• North	17 (24)
• South	23 (33)
• West	13 (19)
• East	7 (10)
• Central	10 (14)
Total beds	
• Up to 6 beds	1 (1.5)
• 7–12 beds	3 (4)
• 13–20 beds	10 (14.5)
• 21–40 beds	47 (68)
• > 40 beds	8 (12)
Level III beds (out of total 1926 beds)	713 (37)
Major ancillary areas	
• Side lab	39 (57)
• Milk expression room	54 (78)
• KMC room	37 (54)
• Counseling area	58 (84)
Attached obstetrics unit	49 (70)
Attached fetal medicine unit	25 (36)
NICU & DR on same floor (n=48)	28 (58)
DR to NICU transport mode (n=48)	
• KMC position	5 (10)
• Wrapped in non-KMC position	28 (58)
• Transport incubator	28 (58)
• Warming mattress	3 (6)

DR Delivery room; KMC Kangaroo mother care

as compared to government sector. Government sector NICUs were more likely to have an attached obstetric unit (88 % vs. 53 %) and larger number of beds.

## Discussion

This questionnaire survey of 70 government and private sector neonatal units across the country shows a tremendous progress in infrastructure and availability of equipment, trained manpower, supporting staff and services. There is a large pool of neonatologists with special training in neonatology from India and abroad. The availability of ventilation services at all surveyed centers reflects easier availability of equipment and

**Table 3** Nursing and support staff (n=69)

Characteristics	Value; n (%)
Nursing staff; median (range)	25 (6–120)
Experience of nurses in newborn care (out of 1,835 nurses)	
• < 1 y	439 (24)
• 1–3 y	550 (29)
• 4–5 y	356 (19)
• 6–10 y	289 (15)
• >10 y	239 (13)
Qualification of nurses (out of 1,835 nurses)	
• GNM/ANM	1,294 (71)
• BSc in Nursing	379 (21)
• MSc in Nursing	64 (3)
• No special qualification	98 (5)
Lactation support/counselor	38 (55)
Infection control specialist	50 (72)
Respiratory therapist	43 (62)
Pharmacist	30 (43)
Nutritionist	51 (74)
Physiotherapist	31 (45)
Occupational therapist	57 (83)
Biomedical engineer/technician	31 (45)
Quality control personnel	33 (48)
Social worker/counselor	16 (23)
Data entry operator	35 (51)

Nursing and support staff details were provided by 69/70 units

GNM General nursing & midwifery; ANM Auxiliary nursing & midwifery

Note: The supporting staff was not necessarily exclusive to NICU/SCNU and was often shared with the hospital

trained personnel. However, the absence of universal availability of blood gas facility, invasive BP monitors, microbiology laboratory support, in-house X-ray and ophthalmology support in centres who are ventilating is disconcerting. The higher number of out-born admissions than inborn could simply be due to the fact that some units did not have attached obstetric services but it also indicates infrequent *in-utero* transfers.

Surveys of neonatal units in the country conducted by NNF in 1987 revealed that only 3 or 4 centers met the standards of a level II neonatal unit and practically all the neonatal equipment were imported [3, 4]. Another survey of 37 units in 1994–95 showed that although 29 (78 %) were providing ventilation, 20 (54 %) were using PN and follow-up services were provided by 29 (78 %), overall, 10 centers could match the standards of level III neonatal care [5]. A survey of Indian made neonatal care equipment in 2005 revealed that though basic equipment of Indian make was well accepted, indigenous sophisticated equipment like ventilators or multichannel monitors were not considered reliable [6].

**Table 4** Details of equipments (n=68)

Equipment	Value; n (%)	Distribution of equipments		
		Only imported n (%)	Only indigenous n (%)	Both n (%)
Open care system	68 (100)	10 (15)	27 (40)	31 (45)
Incubators-single walled	28 (41)	19 (68)	7 (25)	2 (7)
Incubators-double walled	33 (49)	26 (79)	6 (18)	1 (3)
Conventional ventilators	68 (100)	60 (88)	3 (4)	5 (8)
High-freq. ventilators	49 (72)	46 (94)	1 (2)	2 (4)
Stand-alone CPAP	60 (88)	47 (78)	9 (15)	4 (7)
Inhaled NO	19 (28)	16 (84)	3 (16)	0
Invasive BP monitoring	43 (63)	36 (84)	6 (14)	1 (2)
Air-O <sub>2</sub> blender in DR	22 (32)	18 (82)	4 (18)	0
Pulse oximeter in DR	48 (71)	46 (96)	2 (4)	0
Therapeutic hypothermia	13 (19)	11 (85)	2 (15)	0
Blood gas machine	59 (87)	55 (93)	4 (7)	0
Portable X-ray facility	64 (94)	40 (63)	24 (37)	0
Portable ultrasonography	55 (81)	43 (78)	12 (22)	0
Portable echocardiography	43 (63)	34 (79)	9 (21)	0
Laminar flow hood	26 (38)	5 (19)	19 (73)	2 (8)
Cerebral function monitor	2 (3)	2 (100)	0	0
BERA/OAE (hand held or stand-alone)	34 (50)	32 (94)	2 (6)	0

All values indicate number of units having that specific equipment (%) unless specified otherwise. 68/70 units provided equipment details  
*CPAP* Continuous positive airway pressure; *BP* Blood pressure; *NO* Nitric oxide; *DR* Delivery room; *BERA* Brainstem evoked response audiometry; *OAE* Oto-acoustic emission

### The Way Forward

The number of level II and III beds in the country is still grossly insufficient and we can expect an increasing number of NICUs/SCNUs in both government and private sector. Although with the easier flow of funds, establishment of the infrastructure is now feasible, there is a huge gap in the availability of trained manpower especially nurses and supporting paramedical and specialist staff. Hence, more number of training facilities, in-service programs and innovative approaches utilizing the internet and mobile technologies are required [7]. The training programs, curricula and facilities need to be standardized to ensure quality and uniformity. Apart from the initial induction training, the SCNUs need continuous hand-holding, support and supervision. This task should be undertaken by the neighboring medical colleges who should proactively fulfill their mandate of outreach education. However, the medical colleges themselves need to be urgently supported and upgraded to help them discharge their responsibility.

India is a huge country and there are wide variations in the neonatal mortality rate, causes of neonatal deaths, existing facilities, socio-demographic profile and topography. There cannot be a 'one size fits all' solution. District or even block

level planning is required. District Coordination Committees for perinatal-neonatal care, comprising of all stakeholders, should be allowed to prioritize neonatal care for their area according to the needs and existing facilities as well as to audit the quality and coverage of care [1]. To ensure high quality and safe care in the NICUs, the accreditation process needs to be handled by an empowered agency and should be based on not only physical inspection but also audit of data. The accreditation should be made mandatory and time-barred to be renewed periodically. Though part of the huge variation in survival rates of very low and extremely low birth weight infants observed in this survey could be because of variations in policies regarding caring for such infants, it offers great opportunities for collaborative improvement. Although survival rates of sick preterm infants have improved over the years, there are major concerns about long-term morbidities and quality of survival [1, 8, 9]. The time is ripe for setting-up national and regional collaborative for benchmarking, to learn from each other and continuous quality improvement. National Neonatal-Perinatal Database (NNPD) has already laid the foundations for this type of activity [8] and a large pool of highly skilled, experienced and trained neonatologists working in well-equipped units form a perfect backdrop to launch this exercise. The focus of the units has to move forward from

**Table 5** Supporting services (n=70)

Services available	N (%)
Pediatric/Neonatal surgery	48 (69)
Pediatric/Neonatal cardiology	47 (67)
Pediatric/Neonatal neurology	54 (77)
Ophthalmology	45 (64)
Hearing screening	61 (87)
Pediatric radiology	55 (79)
Developmental pediatrician	36 (51)
Child psychology	39 (56)
Autopsy services (Pathology)	25 (36)
Blood culture (Medical microbiology)	59 (84)
Availability of blood bank facilities (Intra-hospital)	41 (59)
• Pediatric component bag	39 (56)
• CMV screen of blood units	23 (33)
• Ultra-filtration	27 (39)
• Irradiation	14 (20)
CT scan	49 (70)
MRI	39 (56)
Transport facilities available	39 (56)
• Dedicated ambulance	25 (36)
• Transport ventilator	22 (31)
Accompanying personnel for transport (n=39)	
• Neonatologist	12 (31)
• Pediatrician	20 (51)
• Paramedical	7 (18)
Human Milk Bank	6 (9)

CMV Cytomegalovirus; CT Computerized tomography; MRI Magnetic resonance imaging

simply ‘survival till discharge’ to ‘intact survival’ into productive adulthood. Neonatologists alone cannot achieve this. They have to become leaders of, and develop multi-disciplinary teams who meticulously look after the multitude of needs of the fragile neonate. This requires engagement, encouragement and special training of nurses, nutritionists, lactation counselors, pharmacists, respiratory therapists, physiotherapists, occupational therapists *etc.* as well as collaboration and cooperation with experts in ophthalmology, audiology, radiology, infection control and microbiology, cardiology, genetics and surgery. In addition, the neonatal care has to become family-centric. NICUs have to involve and support the families for the benefit of the neonate. Mother is not only the source of priceless breast milk but can also take over many of the basic nursing tasks helping to alleviate the shortage of nursing personnel to some extent [Mohpal UC, Bhakoo ON. Evaluation of mother’s role in the care of low birth weight babies. Thesis submitted for MD (Pediatrics), Postgraduate Institute of Medical education and Research, Chandigarh 1990]. As per this survey, very few units have a human milk

**Table 6** Special training programs in neonatology and capacity

Course	No. of institutions offering	No. of seats offered per year
DM -Neonatology	7	19
DNB - Neonatology	9	21
IAP Fellowship	20	49
NNF Fellowship	14	30
Nursing Fellowship/Diploma	6	20

At least 1 training program was offered by 50 % of the respondents  
DM Doctorate in medicine; DNB Diplomate of National Board of examinations; IAP Indian Academy of Pediatrics; NNF National Neonatology Forum

bank and formula feeds are used in most of the units. Use of human milk not only reduces mortality and infections but also protects the preterm infant from dreaded morbidities like necrotizing enterocolitis. Special efforts are required to ensure maintenance of expressed breast milk supply in mothers of sick and preterm infants and creating human milk banks to provide safe donor milk. Other important areas needing urgent attention are healthcare associated infections, multidrug resistant organisms and antibiotic stewardship.

#### Regionalization of Care and Transport

The need and efficient functioning of regionalized neonatal care in Indian scenario has been debated [10]. A recent review synthesized the evidence on facility based newborn care and identified regionalization to play a key role in advancing newborn care practices [11]. However, this cannot occur in isolation from the overall health care system and implementation of the concept requires a strong political will and leadership. Regionalization is also intricately linked to an efficient newborn emergency transportsystem [12]. As can be seen from the results of the survey, sick neonates are being transported but this is poorly organized, of variable quality and available to a very small proportion. A significant improvement is also required in *in-utero* transfers.

#### Costs of Care

The establishment and running costs of SCNU and NICU are high but highly subsidized in the government set-up [13–15]. With international and national focus on the care of the mother and newborn, the flow of funds is no longer a limiting factor and even private sector has found it profitable. However, for the majority of the population, the cost of care is unaffordable. In government hospitals, though the charges are highly subsidized or free, the family still bears huge out-of-pocket expense on purchasing medicines, disposables, their own stay

and loss of wages. This leads to inconsistencies and compromises in care, frequent episodes of parents taking their infants LAMA (left against medical advice) and transfers from private to government hospitals in the critical stage. It is highly unlikely that the government will be able to bear and sustain all the expenses required for the optimum treatment of all sick newborns and alternative models of financing like health insurance need to be implemented.

### Research

The causes of neonatal mortality in our country are different from that in the developed world and continue to be related to sepsis, perinatal asphyxia, low birth weight and prematurity. The national training curricula and research should focus on these issues. An assessment of neonatal research published in major Indian journals in 2004 found that that only 12 % studies pertained to neonates and less than 20 % were of national interest [16]. Most studies so far have been from single centers and small to medium in scale with little possibility of impacting policy or practice change. There have been sporadic multi-site high quality researches that have had not only national, but global impact [2]. There is a need for multiple centers to form groups to pursue same research question with similar protocols and come out with cost-effective multisite studies of sufficient sample size to answer important questions of national relevance [17].

The limitations of the present survey with regards to generalizability to the total situation in the country should be kept in mind. As indicated above, since there is no registration process or a comprehensive list of NICUs and SCNUs in the country, the investigators could approach only the units about which they or their peer group had the knowledge or those listed in the NNF directory. Also, the situation in the district SCNUs was not assessed in this survey. These units have been established as per the toolkit developed by UNICEF and are likely to have similar and adequate infrastructure for a basic level II unit [13]. However, there are issues related to the availability of adequately trained manpower and the quality of functioning and care [18]. The authors did not try to distinguish level III from level II units in the absence of a uniform accreditation policy. In our country, most units run a mix of level II and III beds and the authors let the surveyed units categorize their own beds. In this survey, 37 (53 %) units had no accreditation even though they may have easily fulfilled the criteria. This is likely to be due to lack of any mandatory clause or benefits in getting accredited. In addition, the NABH has a higher fee structure and accredits the whole hospital and not an individual specialty service. NNF has recently revised the norms for accreditation of level I, II and III units [19]. However, medical insurance and medical tourism prompts many hospitals to seek accreditation elsewhere from specialized national and international organizations.

### Conclusions

The dramatic increase in the number of well-equipped NICUs all across the country due to an increasing focus on neonatal health, leadership by well-trained neonatologists and easy availability of good quality equipment is contrasted by a huge deficiency of well-trained nurses and allied paramedical personnel. Investments and innovations are required to develop this important cadre of neonatal service providers to improve the quality of care. The time is opportune to implement mandatory accreditation, quality improvement and collaborative and country specific multi-site researches. All of this has to be achieved while maintaining universal availability and affordability of neonatal care.

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