A Step toward Healthy Newborn: An Assessment of 2 Years’ Admission Pattern and Treatment Outcomes of Neonates Admitted in Special Newborn Care Units of Gujarat

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Abstract

Context: Facility Based Newborn Care (FBNC) is a key strategy to improve child survival, especially in newborn care where neonatal mortality rate (NMR) is stagnant in declining. Gujarat has achieved considerable amount of reduction in child deaths, but neonatal health requires attention. The study was aimed to assess the admission pattern of Special Newborn Care Units (SNCUs) which supports decision-making.

Settings and Design: A cross-sectional descriptive analysis was done from secondary data of the SNCU reports on the aspects of admission patterns, morbidity, and mortality pattern. The reports had been analyzed on various critical variables. Results: In 2015–2016, Gujarat has operationalized forty SNCUs by saturating each district with at least one SNCU. The study found near proportions of (53%) inborn – (47%) outborn admission and 44% admission of female. Out of 69,662 admissions, 67% were discharged, 16% died, 10% leaving against medical advice, and 7% referred to higher centers. Major reasons for admission were respiratory distress syndrome (RDS) (22%) and infection (21%). Similar pattern in mortality found as final diagnosis of deaths was RDS (23%) and infection (21%). The proportion of neonatal deaths in outborn was high compared to inborn. Conclusion: Strengthening of FBNC is essential to address neonatal mortality. NMR is of prime focus because the health interventions needed to tackle NMR differ from those needed for infant mortality rate and under-five mortality rate. This accentuates the need for focused attention on facility- and community-based child health interventions along with quality maternal health services and robust referral mechanisms to all delivery points.

Keywords: Facility based newborn care, maternal and child health, neonatal mortality rate, newborn health, special newborn care units

Introduction

A healthy start to life is vital in establishing the foundation of healthy community, state, and nation. Recent progress over polio and other areas of health made considerable decline in under-five-aged children deaths, but neonatal deaths are lagged behind on the front.[1] The newborn deaths are now in greater proportions of global child deaths than in 1990. Over the period, newborn has become a different category of vulnerable population, and it seems far to achieve child survival if priorities are not set.[2,3] The Lancet Series 2005 has been important in drawing attentions to the interventions that accelerate efforts for neonatal survival in developing countries.[4] RMNCH + A strategy emphasizes on continuum of care community to facility to community and life cycle approach. There are several interventions at level of households, community, and facility which help to reduce neonatal morbidity and mortality.

Globally, neonatal deaths now constitute 44% of all deaths in children younger than 5 years.[5] Simple interventions aimed at these main causes have been tested and found to be effective in reducing the neonatal mortality.[6,7] Estimates have suggested that more than 70% of neonatal mortality is preventable with these existing evidence-based practices, but coverage of these interventions is low and uneven in geographic areas with highest burden of mortality.[8] Still, specific efforts are required to understand the effectiveness of these interventions.

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in context of local barriers of service coverage. This also needs adequate demand generation in the community, socioeconomic upliftment, and effective creation of infrastructure to provide quality care to most vulnerable population of the earth.

In India, neonatal mortality contributes almost two-thirds of the infant deaths and half of the under-five deaths. Furthermore, neonatal mortality rate (NMR) of Gujarat accounts for 58% of total under-five-aged children mortality. Gujarat has achieved child mortality rate of 45/1000 live births, infant mortality rate of 35/1000 live births, and 26/1000 live births NMR. Wide geographical variations in mortality rates were also a concern for Gujarat state. Gujarat has witnessed significant reduction in infant and neonatal mortality, and over the period, 35% reduction was seen in NMR. In this context, Facility Based Newborn Care (FBNC) at various levels performs critical role to strengthen care of sick, premature, and low birth weight newborn. Gujarat has come long way in achieving the Millennium Development Goals for health with priority to the mothers and children in providing available resources up to the root levels. Minimal or absence of data provides in-depth knowledge and views on newborn morbidity and mortality in larger proportions. Hence, the current study was aimed to assess the pattern of neonates’ admission from Special Newborn Care Units (SNCUs) of a tertiary level hospitals and medical college attached hospitals. It was conducted to provide data of newborn morbidity and mortality for health planners and care providers with analysis of critical variables.

**Materials and Methods**

FBNC is composed of three-tier structure, namely, Newborn Care Corners at all delivery points for essential newborn care, Newborn Stabilization Units (NBSUs) at secondary care, and SNCUs at tertiary care facilities. The SNCUs are advanced newborn care centers located in tertiary care hospitals, district hospitals, and medical colleges. These SNCUs have radiant warmers, phototherapy units, and advance life support care machines if required. In Gujarat, tertiary care hospitals provide all maternal health services including newborn care support to those who are admitted within the hospitals, i.e., inborn and those who are referred from peripheral health facilities, i.e., outborn. These SNCUs are financially supported by Gujarat State Health and Family Welfare Department and National Health Mission.

**Study design and settings**

A cross-sectional descriptive study was conducted based on secondary data collected from SNCUs of Gujarat. The study includes all Government-supported SNCUs which are in medical college attached hospitals, district hospitals, and trust hospitals. In Gujarat, there were 37 designated SNCUs during the year April 2014–March 2015 and 40 designated SNCUs during April 2015–March 2016.

**Study population**

Newborns and neonates admitted in SNCUs were considered as study participants. These were categorized into two sections as inborn, who have delivered in same facility and outborn, who have referred to the facility from peripheral health facilities.

**Study period**

April 2014 to March 2016 was the study period and aggregated yearly data were taken for the study.

**Data collection**

The source of information was SNCU monthly reports generated from admitted neonates (Indoor cases only). In SNCUs, neonates are referred from MCH level facilities 1-2, private health facilities and from community by direct contact admission or by frontline health workers: Accredited Social Health Activist, Auxiliary Nurse Midwife, or Multi-Purpose Worker. Accredited Social Health Activist, Auxiliary Nurse Midwife, or Multi-Purpose Worker. The primary data have been recorded in predefined registers and case sheets of SNCUs filled up by pediatricians and staff nurses. Inclusion Criteria include all babies who had ≤28 days of life (neonates) admitted in SNCUs. Exclusion Criteria include babies who had life of more than 28 days (postneonates) and neonates who were not admitted in SNCUs. The SNCU monthly report is predefined format from Ministry of Health and Family Welfare, Government of India, which includes data on admission information, reasons of admission, course of admission, and mortality reasons (if any) with treatment outcomes. It also includes information on gender, birth weights, gestation age, and duration of stay. Ethical permission was sought from the concerned authority of State Health and Family Welfare Department, Government of Gujarat. The aggregated data of SNCU reports were analyzed and due efforts were made to conceal identity of hospitals and patients.

**Limitation of analysis**

Detailed information of each neonates had not been collected. The aggregated data of indicators was taken into the study. Only Government-supported SNCUs were studied, as system to collect private hospitals’ data is not in place. The follow-up on discharged, leaving against medical advice (LAMA), and referred neonates were not done during the study.

**Data analysis**

Statistical analysis was done analyzing the percentages, proportions, and Chi-square using Statistical Package for the Social Sciences (SPSS) version 17 (SPSS-Inc., IBM, USA). After analysis, the efforts were made to share the analysis with concerned SNCU in charge to take corrective actions in consultation with State officials.

**Results**

**Overview of Special Newborn Care Units in Gujarat**

Gujarat has population of sixty million as per census 2011 with 57.4% rural and 42.6% urban population; located in 33 districts, 8 corporations across the State. Gujarat has achieved considerable growth in operationalization of SNCUs by saturating each district with at least one SNCU. The numbers of SNCU have been increased from 24 (2013) to 40 (2016).
Neonatal characteristics of Special Newborn Care Unit admission

During the study period, there were 69,662 neonates admitted in SNCUs across the State, and out of which, 36,994 (52%) were inborn and 32,668 (47%) were outborn admissions. Out of total admissions, 56% were males and 44% were females with ratio of 1.27:1.

Birth weight and gestation age characteristics

The progress of management and prognosis are different for each neonate based on their birth weight and gestational age. Study showed birth weight of admitted neonates were more than 2500 g (37%), 1500–2499 g (37%), 1000–1499 g (21%), and <1000 g (5%). The neonates had gestational age of <34 weeks (18%), 34 weeks to 37 weeks (30%), and more than 37 weeks (52%). These categories of neonates are critical on survival to reach the health facility also after birth.

Morbidity profile of admitted neonates

The neonates were admitted in SNCU through in-facility transfer and from referrals to SNCUs either from the community or from the lower health facility centers; Primary Health Centres, Community Health Centres, subdistrict hospitals, few district hospitals, and private hospitals. The study revealed that major criteria for admission were respiratory distress syndrome (RDS) (22%) along with infection (21%). Rest of the reasons were jaundice (17%), meconium aspiration syndrome (14%), perinatal asphyxia as moderate or severe birth asphyxia/hypoxic-ischemic encephalopathy (12%), and other causes of respiratory distress (6%) which involve transient tachypnea, congenital pneumonia, and aspiration pneumonia. Morbidity due to congenital malformation, hypoglycemia, and hypothermia were observed in lesser percentage (3%).

Outcome of the admitted neonates

The outcome was categorized into four sections as successfully discharged, referred to higher centers, LAMA, and died. The analysis showed that 46,681 (67%) neonates were successfully discharged, 4877 (7%) were referred to higher centers, 6,968 (10%) were left against medical advice, and 11,136 (16%) were died during the study period. The analysis found that every second neonates was about to discharge successfully during the course of management. The study had not explored the reasons behind the LAMA and referred to higher centers: district hospitals to medical colleges as a limitation.

Mortality profile of neonates

Final diagnosis on causes of death were RDS (22%), infection (21%), and followed by perinatal asphyxia, prematurity, meconium aspiration syndrome, and major congenital malformation [Table 1]. It was found that neonates admitted with low birth weight had less chances of survival. Study identified that the difference between weight at birth and mortality of newborn had significant association ($P < 0.0001$). Table 2 shows that chances of mortality were more in neonates with lower birth weight. Here, alive neonates were considered those who were discharged alive, LAMA, and referred to higher centers. Study found that death rate among outborn neonates (58%) was higher than death rate of inborn (42%) admissions. There was statistically significant association between the survival of inborn and outborn neonates admitted in SNCUs ($P < 0.001$). This analysis has been done by excluding the neonates who had been referred and LAMA.

**Discussion**

In Gujarat, SNCUs have been increased in numbers by creation of infrastructure in district hospitals and medical colleges, but reduction in child morbidity and mortality depends on availability of wide range of interventions. Among them, facility-based interventions are high impact intervention, especially in India. The three-tier structure of FBNC prevents major preventable deaths of newborn, and maximum reduction in child mortality can be met if it links with community-based interventions. Improvement of newborn health aimed at comprehensive continuum of care from facility to community with context-specific investments.[4]

Demographic profile of SNCU admissions showed high male:female ratio in admissions which requires in-depth community-based observations to identify gender-specific issues. These findings were similar to previous studies of National-Neonatal-Perinatal Database, Rakholia et al. and

| Table 1: Mortality profile of neonates admitted in special newborn care units during 2014-2016 ($n=11,136$) |
|---------------------------------------------------------------|
| Mortality profile | Inborn deaths, $n$ (%) | Outborn deaths, $n$ (%) | Total deaths, $n$ (%) |
|-------------------|------------------------|-------------------------|---------------------|
| RDS               | 1074 (23)              | 1513 (23)               | 2587 (23)           |
| MAS               | 599 (13)               | 924 (14)                | 1523 (14)           |
| Perinatal asphyxia| 724 (16)               | 1003 (15)               | 1727 (16)           |
| Sepsis/pneumonia/meningitis | 800 (17) | 1514 (23) | 2314 (21) |
| Major congenital malformation | 313 (7) | 329 (5) | 642 (6) |
| Prematurity       | 899 (19)               | 970 (15)                | 1869 (17)           |
| Others$^a$        | 223 (5)                | 251 (4)                 | 474 (4)             |
| Total             | 4632 (100)             | 6504 (100)              | 11,136 (100)        |

$^a$Hemorrhagic disease of newborn, neonatal tetanus, suspected inborn error of metabolism, tetanus, unknown. RDS: Respiratory distress syndrome, MAS: Meconium aspiration syndrome

| Table 2: Association of mortality pattern by birth weight for special newborn care units admission ($n=69,662$) |
|---------------------------------------------------------------|
| Birth weight (g) | Dead (%) | Alive (%) | Total (%) | Difference |
|------------------|----------|-----------|-----------|------------|
| ≥2500            | 2631 (10) | 22,933 (90) | 25,564 (37) | $\chi^2=5478.4$, degree of freedom=3, $P<0.0001$ |
| 1500-2499        | 3635 (14) | 22,478 (86) | 26,111 (37) |
| 1000-1499        | 2913 (20) | 11,740 (80) | 14,653 (21) |
| ≤1000            | 1959 (59) | 1375 (41)  | 3334 (5)   |
| Total            | 11,136 (16) | 58,526 (84) | 69,662 (100) |
other rural India studies.\[11-14\] During the study, the outborn admissions were less in number compared to inborn admissions. The low outborn admission directs the need to strengthen referral system with community-based interventions. The demand generation is another key area where gender bias and equity are major concerns.

In the present study, RDS (22%), infections (21%), and perinatal asphyxia (12%) were the major causes of neonatal admissions. The pattern of morbidity is different in developed countries as major causes were admissions due to extreme prematurity, asphyxia, and congenital malformations.\[15,16\] Table 3 shows that causes and mortality rate were similar to other studies where findings are in concordance with present study findings. This study found lower rate of neonatal mortality (16%) compared to other studies conducted in India but the rate appears higher while comparing with developed countries where health facilities have better equipped infrastructure and higher doctor-patient ratio. Here, high mortality in outborn admission needs specific attentions on programmatic delay factors. While analyzing treatment outcome, it was observed that referral rate was high among admissions. The reason could be that SNCUs of district hospitals used to refer neonates to hospitals attached with medical colleges for advanced treatment. The rate of LAMA was similar to or near to other studies.

Universal implementation of antenatal corticosteroids in preterm labor and use of injection gentamycin along with syrup amoxicillin in infection will prevent the respiratory distress and infections among most of neonates. In Gujarat, there could be several possibilities for higher rate in outborn deaths as follows:

- Lack of demand generation in community for timely treatment of neonates. Equity issues have to be dealt to ensure that girl children receive attention
- Poor doctor–patient and nurse–patient ratio in health facilities in hard to reach and hilly areas. Private sector is not equipped for provision of proper care in these areas
- Lack of trained staff for management of small and critical neonates; low number of first referral units equipped to manage high-risk pregnancy and established NBSUs
- Poor referral linkage between communities to facility for neonates; difficulty in transport for very severe low birth weight babies.

**Recommendations**

Based on the present study, the following recommendations can be taken into consideration:

- Strong implementation framework of community- and facility-based interventions is essential in support with robust referral system. Use of IT enable monitoring software such as Mother Child Tracking System and SNCU Online Software can play vital role for linkages and monitoring of health programs
- Comprehensive human resource policy with inbuilt structure of capacity building and supportive supervision. Involvement of private sectors for the promotion of high-impact interventions
- A detailed community-based study can support to identify the gaps in demand generation and program implementation framework
- To summarize, meaningful actions have been taken to reduce neonatal morbidity and mortality, but still, state

| Regions | Gujarat | National | North India, Ballabhgarh | Uttarakhund | World in general | Rural Bangladesh | Nepal | Sudan | Canada |
|---------|---------|----------|--------------------------|------------|-----------------|-----------------|-------|-------|--------|
| Causes of mortality | Present study (April 2014 to March 2016) | National neonatal perinatal database (2002-2003)\[12\] | Kumar et al., 2002\[17\] | Rakholia et al., 2014\[13\] | Lawn et al., 2014\[16\] | Chowdhury et al., 2005\[14\] | Shrestha and Karki, 2012\[19\] | Elhaasen et al., 2010\[20\] | Simpson et al., 2018\[21\] |
| RDS | 23% | - | - | 17.3% | - | - | 42% | - | - |
| Sepsis/pneumonia/meningitis | 21% | 36% | 9% | 21.6% | 26% | 32% | - | 24.8% | 8%-14% |
| Prematurity | 17% | 26.5% | 41% | 25.7% | 28% | 30% | 53% | 25.7% | 67% |
| Perinatal asphyxia | 16% | 10% | 38% | 19.6% | 23% | 26% | - | 10.7% | 10% |
| MAS | 14% | - | - | 9.45% | - | - | - | - | - |
| Congenital anomalies | 6% | 7.8% | - | 4.73% | - | - | - | - | - |
| Others | 4% | - | - | 2.03% | 7% | - | - | - | - |
| Rate of mortality | 16% deaths | 2.5% intramural deaths | 8% mortality | 20.53% death, 8.3% LAMA, 4.3% referred | 6% | - | - | - | - |
| LAMA referred | 16.9% extra | 18.2% referral | 67% | Its study world survey | - | 26.6% deaths of inborn neonates | 7% | 11% deaths | 7.7% LAMA |

RDS: Respiratory distress syndrome, MAS: Meconium aspiration syndrome, LAMA: Leave against medical advice
has to ensure the strong implementation of available strategies. Scaling up neonatal health interventions, securing financial infrastructure, rational deployment of skilled human resources, strong policy support for free entitlements, and continuous monitoring framework are some of the steps in the direction to have a healthy child for future.

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Conflicts of interest
There are no conflicts of interest.

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