Scaling up of Facility-Based Neonatal Care—A District Health System Experience

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Summary

With proportion of neonatal mortality increasing within under-five deaths, innovative approaches and stronger health systems are needed in neonatal care. We present data of a scaled-up neonatal facility in a District Government Headquarters hospital in Southern India. The special care neonatal unit (SCNU) was a community propelled, public private partnership worked out on the principles of private funding of public institutions and effective budgeting of the public health care system. In the first phase the unit was optimized over 3 years with non-governmental organizations (NGO) and government support from a basic nursery to a SCNU. The unit was operational through fixed maintenance budget from government and mobilized funds from NGOs and beneficiaries. Community health workers were motivated for effective utilization. In the second phase the unit's performance was studied and statistically analyzed in two time frames before and 5 years into the upgradation process. Neonatal admissions from the district increased by 14.65%. Hospital stillbirth, early neonatal and perinatal mortality rates showed significant decline ($p < 0.05$). There was a 48.59% (CI: 25.46–77.80) increase in antenatal referrals from community health centers. Caesarian sections for neonatal parameters that affect obstetric decisions showed percent changes of 163.25 (CI: 31.18–430.45) and 73.4 (CI: 14.15–164.39) for prematurity and low birth weight (LBW), respectively. Significant decline in case fatality rates for LBW, sepsis and birth asphyxia ($p < 0.001$) were observed. The district perinatal mortality rate showed a decline. Within the purview of financial constraints of the public health system, private funding, public–private cooperation and effective budgeting may become significant. Motivation of health workers and community to effectively utilize public health care services sets an evolutionary process of referral and vertical linkage of health care system.

Introduction

Worldwide, nearly four million neonatal deaths occur annually, accounting for 37% of all deaths in children <5 years of age [1]. Achievement of millennium development goal 4 (MDG) to reduce under-five mortality rate (U5MR) by two-thirds by the year 2015 is dependant on a substantial reduction in neonatal mortality [2]. India, a country which is home to the highest number of births in the world today, has a neonatal mortality rate (NMR) of 44/1000 live-births and accounts for one-third of all neonatal deaths in the world [3]. Significant gains in the NMR was achieved between 1970 and 1995 with decline in neonatal tetanus, increased skilled attendance at birth, institutional deliveries, and birth spacing. However, this reduction became stagnant between 1995 and 2000 and has also slowed the decline of other childhood mortality rates [3–5]. The neonatal mortality has gradually increased as a percentage of total U5MR because of a faster decline in post-neonatal mortality rate [5]. The scenario is similar in many of the developing countries [4, 6].

To achieve the MDG health goals the World Health Organization Health Report 2005 emphasizes

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on universal access of families to continuum of care requiring programmes to work together, build sustainable health systems and also extend and strengthen them. Systematic scaling up of neonatal care involves medium to long-term strategies with upgraded clinical-care services including increased deployment of midwives, improved obstetric care and clinical care of ill-neonates [7]. Hospital-based, clinical care facility neonatal units are classified into levels based on their functional capabilities: level I, basic newborn care units which is the minimum requirement for any facility providing inpatient maternity care; level II, special care nurseries providing care for the moderately ill and level III, neonatal intensive care unit (NICU) for the critically ill [8]. It is recognized that though scaling up of clinical care is a challenge; it is necessary if maximum effect and equity are to be achieved in neonatal health [7]. District health systems comprising primary health centers and first referral units with the district head quarters hospital deliver basic health services in developing countries and need to be targeted for delivering improved clinical care. Emphasis on primary care in the developing countries have had the unintended consequence of neglecting hospitals, a critical part of the referral chain [9]. The newborn is not counted as a 'bed' separate from the mother and hence infrastructure and resources are often not budgeted with newborns in mind. The enormous financial burden on the households limits the families from 'health seeking'—for a 'tiny' neonate. In this context, we present our data of an upgraded neonatal care facility in the public sector in a district head quarters hospital and its impact within the hospital and the district overall.

Material and Methods

The work was done in two phases in the Government District Headquarters Maternity Hospital situated in the coastal city of Mangalore in Dakshina Kannada district of Karnataka state in Southern India. Established in 1848, this hospital caters to nearly one-fifth of the deliveries in the district and is the referral hospital for 78 community and peripheral health centers. The first phase involved the upgradation and maintenance of the existing basic neonatal nursery of the hospital to a special care neonatal unit (SCNU) with level II facilities by voluntary initiation. In the second phase the impact of these upgraded facilities within the hospital and community were studied.

The neonatal health services were scaled-up over a period of 3 years beginning in 1998 with contributions as funds and equipments worth 13 900 pounds mobilized from local philanthropists and non-governmental organizations (NGOs). The state government provided equipments worth 56 000 pounds over a period. Neonatal resuscitation by a two member trained medical team was made available for all deliveries. Special care was extended to neonates with low birth weight (LBW) below 2000 gram including preterms with clinical instability, birth asphyxia with Apgar <6, sepsis, seizures, hyperbilirubinemia, meconium aspiration syndrome (MAS) and surgical conditions. The unit was operational through fixed maintenance budget allocated by government in 1970 with no additional burden, which contributed to 60% of the operational cost. Regular contributions amounting to an approximate 2500 pounds per annum were streamlined from various NGOs and 'a voluntary donation at exit' by the beneficiaries was also successful. These contributions accounted for 30 and 10% of the operational costs, respectively. The health workers of the district were made aware of the upgraded facilities by arranging group visits to the unit and conducting seminars and group discussions.

To study the performance of this upgraded facility the trends in admission and outcome were studied and statistically analyzed between two time frames 1998 and 2004, 5 years into the process of upgradation. The sources data include district vital statistics from the District Health Office and hospital medical records. The district and hospital data have been compiled manually. The data on antenatal services, referrals, neonatal admissions and deaths in the two time frames, 1998 and 2004 were compared for statistical significance using Arcus-Prostat. Absolute differences between the time frames were derived for the calculated data. The relative changes and the 95% confidence intervals (CI) were derived to assess the impact of establishment. The hospital mortality statistics were expressed as ratio of deaths per 1000 live births restricted to fetuses and infants weighing 1000 g or more as recommended for international comparisons [6]. The antenatal referral pattern was calculated in relation to SCNU admissions. Caesarian sections were analyzed for neonatal parameters that might have affected the decision. Neonatal admissions were analyzed for the various mortality indices. The referred cases were subjected to calculations separately. The rates were tested for significance using *Z*-test of proportions. Wherever the number of neonatal admissions was used as numerator χ^2 test was applied. A p-value <0.05 was considered statistically significant. District vital statistics are presented as a graph of two-year averages to avoid the undue influence of random annual fluctuations.

Results

The impact of the unit on the neonatal outcome is presented in the tables. Significant gains were seen in the hospital mortality rates in the two time frames as

TABLE 1
Demography of hospital admissions and mortality pattern in the 2 reference years

Data	1998	2004	Absolute change	Percent change (95% CI)
Antenatal services	3543	4508	3.94	145.6 (96.16 to 207.69)
Live births	3282	4786		
1001–1500 g	108	156	0.06	1.92 (−22.82 to 24.8)
1501–2000 g	185	375	2.11	37.46 (16.13 to 63.22)
2001–2500 g	872	1077	−4.26	−16.13 (−9.36 to −22.38)
>2500 g	2117	3178	1.24	1.93 (−1.32 to 5.34)
Maternal mortality	8	4	−0.16	−66.05 (−89.11 to 5.85)
Still births	147	170	−0.96	−21.47 (−2.54 to −36.71)
Neonatal admissions	418	1384		
Inborn (total)	300	1142	10.74	14.65 (8.11 to 22.47)
Level II	–	883	–	
Referrals	118	242	−10.74	−38.98 (−25.9 to −49.51)
Early neonatal deaths	100	120		
Inborn (of live births)	69	70	0.64	−30.43 (−3.4 to −49.88)
Referrals	31	50	−5.61	−21.35 (−46.33 to 16.69)
Total neonatal deaths	120	162		
Inborn (of live births)	83	102	−0.62	−8.97 (−23.03 to 8.14)
Referrals	37	60	6.20	20.12 (−13.51 to 68.72)
Hospital mortality rates (per 1000 live births)			*Z*	*p*-value
Maternal mortality rate	2.44	0.84	1.83	0.07
Stillbirth rate	44.79	35.52	2.11	0.04
Early neonatal mortality rate	21.02	14.63	2.17	0.03
Perinatal mortality rate	65.81	50.15	2.99	0.003
Neonatal mortality rate	25.29	21.31	1.17	0.24

the unit evolved (Table 1). An increase in the number of booked cases show the changed 'health seeking' behavior of the community for safe motherhood and neonatal survival (Table 1). There was an absolute increase in the number of antenatal referrals from the peripheral health centers showing the awareness of high risk screening in pregnancies and '*in utero*' transfer of neonates amongst the health workers (Table 2). Higher number of caesarian sections for maturity less than 36 completed weeks and birth weights between 1501 and 2000 g demonstrated the confidence of the obstetricians in the neonatal unit (Table 3). Significant reversal in the morbidity pattern of admissions into the SCNU amongst the inborns was seen (Table 4). The case-fatality rate (CFR) declined significantly for LBW < 2000 g (including preterm), sepsis and MAS. The unit was cost-effective considering the probable number of lives saved (Table 4) and the segment of the population it catered to. With available data, the perinatal mortality rate of the district showed a decline, largely due to decrease in the stillbirths (Fig. 1). The childhood mortality rates in the district in the time frame have shown minimal variations probably because the mortality rates in the district in 1998 were much lower than the national average.

Discussion

Childbirth is a natural or physiological process. A neonate is at risk when the physiology is immature as in preterm or there is failure of adaptation *in utero* or at birth. Majority of the neonates need only essential newborn care (ENC) at birth achievable at home or in the primary care units. Community-based programmes facilitate the physiological process and promote positive health in the immediate newborn period. These programmes implemented over past few decades have saved many lives in both developing and developed countries [10–14]. Promotion of evolving physiology (breast feeding, thermoregulation), protection from sepsis and prevention of complications may suffice for the 'asymptomatic' neonate. However, few neonates slip into the 'symptomatic' group subsequently leading to mortality and morbidity and these neonates require special care. It is estimated that an approximate 15–20% of neonates will require special care and 3–5% intensive care. This proportion of newborn requiring special care or 'back-up' is underestimated while the need for advanced technology for tertiary care is overestimated [6].

Neonatal programmes in the developing world have tended to focus on ENC by birth attendants. But community-based maternal and neonatal services

TABLE 2
Referral pattern of pregnant women from community health centers to the district hospital in relation to admission into special care neonatal unit

Referrals of pregnant women from community health centers	1998		2004		Absolute change	Percent change (95% CI)
	Number	Relation to nursery admissions, % $n=300$	Number	Relation to level II admissions, % $n=883$		
Total	99	33.0	433	49.04	16.04	48.59 (25.46–77.80)
Antenatal	76	25.33	367	41.56	16.23	64.06 (33.83–103.2)
Intrapartum	23	7.67	66	7.48	−0.19	−2.51 (−37.7–53.81)
Referral in relation to gestation age						
<28 weeks	8	2.67	95	10.76	8.09	303.45 (102.69–712.01)
28–32 weeks	13	4.33	85	9.63	5.30	122.14 (−27.49–291.05)
>32 weeks	55	18.30	187	16.40	2.85	15.52 (−11.39–51.93)
Reasons for referral						
Maternal medical	11	3.67	105	11.89	8.22	224.31 (79.50–492.35)
Obstetric	80	26.67	322	36.47	9.80	36.75 (11.79–68.89)
Macerated still birth	8	–	6	–	–	–

TABLE 3
Trends in Caesarian sections in relation to gestational maturity and birth weight

Neonatal parameter	Caesarian sections		Absolute change	Percent change (95% CI)
	1998, $n=638$	2004, $n=1131$		
Gestational maturity preterm	9	42	2.30	163.25 (31.18–430.45)
Birth weight <1000 g	0	1	–	–
1001−1500 g	3	13	0.68	144.44 (−24.84–697.76)
1501−2000 g	27	83	3.11	73.4 (14.15–164.39)
2001−2500 g	76	145	0.9	7.63 (−16.84–39.68)

TABLE 4
Trends in admissions and cause-specific neonatal mortality in the two time frames, and Case Fatality Rate (CFR) with extrapolation to prevented deaths

Disease morbidity	Inborn		*p*	Referrals		*p*	CFR		*p*	Expected deaths without upgradation	Prevented deaths
	1998 $n=300$ (%)	2004 $n=883$ (%)		1998 $n=118$ (%)	2004 $n=242$ (%)		1998 n (%)	2004 n (%)			
LBW <2000 g including preterm	42 (14.0)	248 (28.09)	<0.0001	14 (11.86)	92 (38.02)	<0.0001	15 (26.79)	31 (9.12)	<0.0001	91	60
Sepsis	100 (33.33)	130 (14.72)	<0.0001	27 (22.88)	10 (4.13)	<0.0001	40 (31.50)	22 (15.71)	<0.01	44	22
Birth asphyxia	60 (20.0)	100 (11.33)	<0.001	27 (22.88)	27 (11.16)	< 0.01	25 (28.74)	26 (20.47)	Not significant	37	11
MAS	32 (10.67)	110 (12.46)	Not significant	11 (9.32)	18 (7.44)	Not significant	25 (58.14)	19 (14.84)	<0.0001	74	55
Surgical	12 (4.0)	36 (4.08)	Not significant	9 (7.63)	17 (7.02)	Not significant	10 (47.61)	20 (37.74)	Not significant	25	5

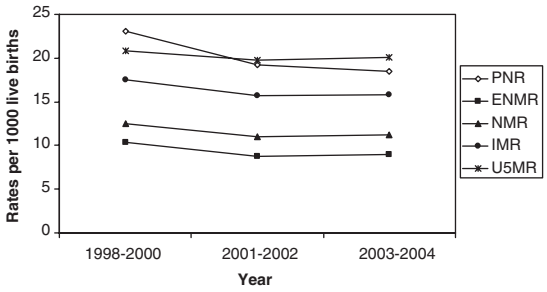

FIG. 1. Trends in mortality rates of study district. PNR, perinatal mortality rate; ENMR, early neonatal mortality rate; NMR, neonatal mortality rate; IMR, infant mortality rate; U5MR, under-five mortality rate.

alone can achieve only 18–37% reduction in neonatal deaths [15]. Community-based strategies need to be linked with health systems. There are considerable demands on the health care system to expand and upgrade facilities especially so in neonatal services where technological support has become key to the survival of preterm and LBW. Unfortunately, specialized neonatal care has become synonymous with level III intensive care and there has been no stress on developing level II special care neonatal units especially in the district health system. In India, the cost of running a level II care is given a weightage of 1:5.5 in comparison with NICU care [16]. At present SCNUs are available only in few district hospitals and more importantly there is no vertical linkage of neonatal services. Establishment of referral SCNUs in the district health system becomes critical in a mortality setting of NMR between 30 and 45, if further decline is to be achieved.

The improvement in the health care facility was initiated after analysis of the existing situation and assessment of the local needs. Utilization of available funds contributed by the local community and NGOs was carried out in stages with initial stress on providing physical facilities. The equipments provided by the government and other agencies were effectively used avoiding wasteful budgeting. The running of the unit was with NGO and community support and planned effective budgeting. Thus our model was a community propelled, public private partnership worked out on the principles of private funding of public institutions and effective budgeting of the public health care system. Our results show that with availability of quality services in the public sector, the health workers will be motivated to effectively utilize maternal and neonatal services and the community will also respond positively. Higher rates of survival of 'at risk' neonates will have positive impact on optimizing obstetric services. If interventional centers are operational optimally, the information carried onto the peripheral health care providers itself sets an evolutionary process of referral and vertical linkage of health care system.

Conclusion

Neonatal mortality rate has emerged as an important determinant of childhood mortality rates. India being the major contributor to global mortality rates urgently needs to develop functioning neonatal health care services in the form of clinical care facilities in the district health systems parallel to community programmes. Clinical care facilities are costlier and require better human resource management. But given their greater impact in morbidity and mortality reduction they are more cost-effective and need to be addressed early in programme development. Government is the central player and improved services and access to government facilities need to be a major thrust area for the policy makers. Greater participation of motivated professionals with expertise, and involvement of the community in planning and meeting their own health care needs is important.

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