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Regionalized perinatal care in developing countries

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Summary Neonatal–perinatal ill health and mortality are overwhelmingly a burden of the developing world. As many as 90% of births, 98% of fetal deaths and 98% of neonatal deaths occur in less developed countries. Regionalized perinatal services were introduced in developed countries when most neonatal mortality was confined to very-low-birthweight babies who required intensive perinatal care to survive. A large proportion of newborn morbidity and mortality in developing countries, however, continues to occur among full-term and moderate-sized low-birthweight neonates who can be managed well in the community and at small hospitals. The model of regionalized perinatal care as practiced in developed countries is, at present, neither affordable nor relevant to the needs of many developing countries. It is possible to achieve considerably lower neonatal mortality rates in resource-poor settings by implementing home-based newborn care delivered by community health workers, and by promoting institutional perinatal care at simple facilities provided by trained midwives.

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The challenge of newborn mortality in developing countries

Among the major child health challenges facing the world at the turn of the new millennium is the problem of exceedingly high neonatal mortality. The global burden of newborn deaths is estimated to be a gigantic 4 million per annum.¹ Only 2% of these deaths occur in developed countries, and the remaining 98% take place in developing countries. It translates into eight mothers losing their newborn infants every minute somewhere in the developing world. Countries in South Asia contribute nearly 1.5 million newborn deaths each year, with

Table 1 Burden of neonatal deaths (ca. 1999)¹

World/regions	Number of deaths in thousands (proportion of the global burden)
● Global	4035
● Less developed regions	3970 (98%)
South Asia ^a	1495 (37.0%)
Sub-Saharan Africa	857 (21.2%)
● More developed regions	65 (2%)
Europe	44 (1.09%)
Northern America	18 (0.45%)
Australia, New Zealand	1 (0.03%)

^a Includes India, Pakistan, Bangladesh, Nepal and Sri Lanka.

India accounting for over two-thirds of these. Sub-Saharan Africa experiences another 0.8 million newborn deaths annually (Table 1).

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Around 90% of births occur in developing countries.² The mean neonatal mortality rate (NMR) in the developing regions of the world is 34 per 1000 live births, which is seven times the rate prevalent in developed regions. The highest NMRs are estimated from western Africa (54 per 1000 live births) and South Central Asia (46 per 1000 live births).¹

It is estimated that there are 4 million fetal deaths each year globally, 98% of which take place in developing countries.² Perinatal conditions are the second leading cause of disability adjusted life years (DALYs) lost after lower respiratory infections, and account for 6.2% of global DALYs.³ Neonatal mortality constitutes 40% of the global mortality in under-5s⁴ and 60% infant mortality.⁵ Approximately two-thirds of all neonatal deaths in the developing world occur in the first week of life.²

The reasons for high neonatal mortality in developing countries are not difficult to find. Illiteracy, low income levels, high fertility and socio-cultural constraints create ideal conditions for the poor health and neglect of women. They suffer from deficiencies of micro- and macro-nutrients, encounter a host of infections (such as malaria, urinary tract infection, sexually transmitted diseases/HIV and other genital tract infections), undergo stress of excessive work, and are exposed to toxic substances (tobacco, alcohol, drugs etc.). These factors predispose them to fetal loss, low birth weight and neonatal deaths.

The obstetric complications of pregnant women in developing countries remain undetected and untreated because access to care is dismal. Half of them do not even receive tetanus vaccinations.¹ Consequently, 289 000 neonates suffer from tetanus in developing countries annually, of whom 215 000 die.⁶ Only 40% of women have the luxury of delivering their babies at facilities, and the remaining two-thirds give birth in a corner of their homes.⁷ Just over 50% of deliveries in developing countries are attended by skilled birth attendants.⁵ The rest, a staggering 50 million, are in the hands of unskilled birth attendants, family members or no one at all.¹ As a result, a sizeable proportion of newborn infants suffer birth asphyxia and injuries. The immediate environment of the infants at and after birth is often unhygienic, exposing them to the risk of septicaemia, pneumonia and diarrhoea. When the neonates fall sick or are simply too small to thrive, the families have no place to take them to. The nearest health facility is often many miles away, and even at those distant facilities, newborn care expertise is often rudimentary or non-existent.

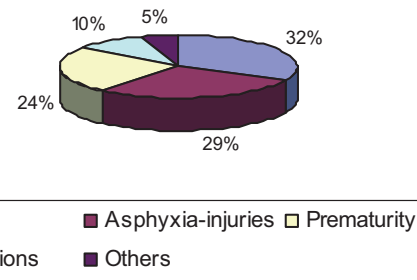


Figure 1 Direct causes of neonatal deaths.

The developed nations have attained and sustained excellent neonatal–perinatal health and survival through access to institution-based, technology-intense systems that have unfolded over many decades. The challenge is to package the well-known scientific principles of newborn care into affordable, feasible strategies for the 117 million neonates born annually in the resource-poor nations of the world.

Direct causes of neonatal mortality

The World Health Organization estimates show that one-third of neonatal deaths occur due to infections, including septicaemia, pneumonia, tetanus neonatorum, diarrhoea and congenital syphilis.¹ Birth asphyxia and injuries account for 29% of deaths, while prematurity contributes to 24% of deaths and congenital malformations cause 10% of deaths (Fig. 1). There is an interesting pattern of major causes of neonatal deaths related to the age of the neonate. Deaths due to birth asphyxia, birth injuries and prematurity are confined to the first three to seven days of life, whereas deaths thereafter are essentially due to bacterial infections.

Importance of low birth weight

Approximately 14% of neonates born worldwide are low birth weight (LBW), with a weight of less than 2500 g; 97% of these babies are born in developing countries.^{1,5} Over half of the 20 million LBW babies are born in South Asia, the region that has an incidence of 26%.⁵ India alone contributes 8 million (40%) LBW babies each year. In developing countries, two-thirds of LBW infants are LBW due to intra-uterine growth retardation, while only one-third are LBW due to prematurity. Notwithstanding

the direct causes of newborn death, 40–80% of newborn deaths occur among LBW infants.

Newborn health agenda and the millennium development goals

Globally, the decline in neonatal mortality has been much slower than that in postneonatal mortality. Between 1983 and 1999, global NMR (per 1000 live births) declined by just 11% (from 44 to 39 per 1000 live births), while the postneonatal mortality rate fell by 45% (from 44 to 24 per 1000 live births). This underlines the fact that the ongoing approaches to child survival have not addressed the problem of neonatal health and survival adequately, and new strategies have to be conceived and implemented.

In 2000, the world's leaders gathered for a special session of the United Nations and pledged a global development agenda to be accomplished by the year 2015. Eighteen millennium development goals (MDGs) were defined to encompass this collective global commitment of all the nations. One of the MDGs is to reduce mortality in under-5s by two-thirds by the year 2015 from the baseline of 1990. This implies bringing down the child mortality to less than 30 per 1000 live births by 2015. Since neonatal mortality would contribute at least 40% of the child mortality, it requires achieving a global NMR of less than 20 per 1000 live births from the current level of 34 per 1000 live births.

As a result of the greater attention now being extended to neonatal health and survival, an increasing number of developing countries will embark on neonatal health programmes in the next few years driven by the MDG commitments. It is, therefore, very timely to examine the relevance of the regionalized perinatal services in developing countries.

The concept of regionalization of perinatal services

The concept of regionalization of perinatal services has been described comprehensively in the other articles published in this issue. In a nutshell, in regionalized services, perinatal care of a geographically defined population is provided by a network of facilities stratified broadly into three levels of increasing sophistication and expertise in obstetric and neonatal care. At the most peripheral level is a set of primary care (level I) hospitals. These are linked to secondary care (level II) perinatal centres that, in turn, are linked to a tertiary

care (level III) regional perinatal centre. An integral component of the regional perinatal services is the existence of an efficient referral transport system to ensure prompt and safe movement of the mothers and babies between the community and the facilities. An outreach extension of the service ensures early contact with the pregnant women and detection of high-risk cases. Together, the regional and network centres are accountable for the overall perinatal health of the entire region. All pregnant women belonging to the region are guaranteed access to the system, and the requisite level of care to her and her baby is assured depending upon clinical needs. The cost of care is borne variously through government funding, insurance, managed care or other mechanisms.

The relevance of regionalized perinatal services for developing countries

The 'standard model' of regionalized perinatal services as outlined above and practiced in the resource-rich countries is not readily applicable to the developing countries. The reasons for this can be grouped into two broad categories. Firstly, there are constraints in establishing and sustaining such services, and secondly, such an approach may be irrelevant because of high NMRs where simpler, more affordable, more feasible approaches may work. We will elaborate on these two themes.

Is the 'standard model' of regionalized perinatal services affordable and sustainable in developing countries?

The developing countries in South Asia and sub-Saharan Africa with the highest burden of newborn deaths have severe resource constraints. These are best appreciated from the actual data (Table 2). As many as 46% of people in sub-Saharan Africa and 40% in South Asia subsist on less than US \$1/day. The government spending on health is miniscule. In such scenarios, it is simply not possible to set up an adequate number of perinatal centres in the country.

It is recommended that there should be one level III neonatal intensive care unit (NICU) bed per 1000 live births.⁸ According to this criteria, India would require at least 26 000 NICU beds (or 1300 NICUs, each with 20 beds). In 1995, India had just 10 level

Table 2 The economic state of developing countries and regions⁵

Gross national income per capita	
Developed countries	US \$28 210
Developing countries	US \$1159
Sub-Saharan Africa	US \$519
South Asia	US \$449
Proportion of population living on less than US \$1/day	
Developing countries	26%
South Asia	40%
Sub-Saharan Africa	46%
Proportion of central government expenditure allocated to health	
Developed countries	12%
Developing countries	3%
South Asia	2%

Ill units for a country of one billion people, with 26 million births per annum.⁹ Thus, for a variety of reasons, it is unlikely that the 'standard model' of regionalized perinatal services could be implemented in these two key regions (Panel 1). Therefore, we have to look at alternative practical approaches to newborn health in developing countries.

Panel 1. Why the concept of regionalized perinatal services is impractical for South Asia and sub-Saharan Africa, the regions with the highest burden of newborn deaths

1. Lack of availability of services

- There is a dismal lack of facilities at primary, secondary and tertiary levels.
- The skilled personnel (midwives, nurses, physicians, specialists) are not available in sufficient numbers. Even when available, they are unwilling to work in rural areas.
- The infrastructure and services are grossly suboptimal, even in the existing facilities.
- The existing facilities are not integrated into a network.
- The HIV epidemic has devastated the health system in many countries in Africa.

2. Lack of access of services to the poor

- There are no health-financing mechanisms for the poor, who experience highest burden of neonatal–perinatal ill health.

- The poor cannot afford expensive services in the private sector.
- The government facilities are not patient-friendly and there are inordinate barriers and delays.
- Social support systems in many African countries have broken down due to HIV deaths among the adult population.

3. Lack of referral transport system

- Several communities have no access by road; communication systems are weak.
- The referral transport system is virtually non-existent.
- The poor cannot afford private transport.

Is the 'standard model' of regionalized perinatal services relevant at the present high NMR levels in developing countries?

As outlined above, regionalized perinatal services are essentially an institution-based system with a tertiary care perinatal centre at the top. Deliveries take place in the hospitals and not at home. Babies are looked after in the hospitals until they are well enough to be sent home. The community outreach programme, if it exists, is complementary and not an alternative to institution-based care.

Is this the only approach to bring down neonatal mortality in developing countries? Let us first examine the stage of neonatal survival at which the concept of regionalized perinatal services was introduced. Historically, regionalized perinatal services were conceived in the 1970s when the NMRs in developed countries were already down to around

15 per 1000 live births and most deaths were occurring among very preterm, very-low-birthweight (VLBW) neonates requiring intensive care obstetric units for maternal care and intensive care newborn units for care of the babies. Regionalization provided a framework for in utero or postnatal transfer of the high-risk mother–perinate dyad to that level of care which gave the best chance for an intact survival.

What is the current situation in developing countries? The average NMR in developing countries is 34 per 1000 live births, with several countries reporting NMRs in excess of 50 per 1000 live births.¹ Even in countries where the overall NMR is lower, the poor populations in rural areas and urban communities experience two to three times the risk of neonatal mortality compared with the affluent populations.¹⁰ In developing countries, a large proportion of neonatal deaths continues to be due to tetanus neonatorum, pneumonia, sepsis and asphyxia, even among the ‘non’-VLBW neonates. The needs of the sick, but full- or near-term, and moderate-sized LBW neonates suffering from these conditions are relatively simple compared with those of the VLBW infants, and they can be managed in the community and at simple facilities. VLBW infants with complications such as respiratory distress, on the other hand, require cost-intensive, high-tech intensive care nurseries. The survival of these babies, constituting just 3–4% of the total neonatal population, may be viewed as a lower priority, given the current state of newborn care in most developing countries, and can be addressed after optimum survival of ‘non’-VLBW neonates has been ensured.

Indeed, it is possible to reach an NMR of less than 20 per 1000 live births through primary care approaches in developing countries without introducing the ‘standard model’ regionalized perinatal services. In order to illustrate this point, we would like to present two case studies; one at a macro or a country level (Sri Lanka), and another at micro level in the operational research setting. Panels 2 and 3 summarize these two cases studies.

Panel 2. The Sri Lanka case study: a model of community-linked institutional newborn care implemented by trained midwives^{11,12}

Sri Lanka is a country of 20 million population with per capita income of US \$830; 9% of the population live with income below US \$1/day.

The female literacy rate is a high 89%. The trends in NMR over the last four decades in Sri Lanka are shown below.

Years	NMR per 1000 live births
1950	49
1960	34
1970	30
1980	22
1989	13

The first NICU came into existence in the mid-1980s in Colombo. In 1999, there were just 40 incubators and three NICUs. The high newborn survival in Sri Lanka is not due to the availability of physicians or specialists, or the high-tech facilities. It is the result of sustained inputs into and utilization of primary care services and facilities in the government sector. Outreach antenatal care is provided by public health midwives with antenatal coverage of almost 100%. In 1996, 86% of deliveries occurred in government hospitals, where services are free, attended by a cadre of 2500 skilled hospital midwives. There is also easy access to healthcare facilities throughout the country. The average distance from house to any health facility is 1.4 km, and from the smaller hospital to the more advanced hospital is around 4.8 km (this is an example of institution-based neonatal services at simple facilities linked to a community outreach system, and primarily implemented by trained midwives).

In Sri Lanka, a country of about 20 million population with an LBW rate of 25%, NMR was brought below 20 per 1000 live births even before the first NICU was developed in the mid-1980s.^{11,12} In late 1990s, there were just 40 incubators in the whole country, but the NMR was down to 12.5 per 1000 live births. The secret of success is the availability of a cadre of around 2500 trained midwives who conduct deliveries and manage neonates at small government hospitals where services are free. Public health midwives provide near-universal coverage of antenatal care and link the community to the facilities. This is an example of a ‘developing country model’ of regionalization of perinatal care characterized by midwife-driven services without recourse to high-tech, specialist-centred secondary and tertiary care components.

Panel 3. The Society for Education, Action & Research in Community Health case study: a model of neonatal–perinatal services delivered by community-based providers^{1,13}

In the Gadchiroli district of India, about 1000 km from the state capital, Mumbai, a remarkable model of home-based neonatal care has managed to significantly reduce neonatal–perinatal and infant mortality in a rural community. Recognizing that hospital-based care for sick newborns was not accessible, or affordable, in their community, Abhay Bang and colleagues at Society for Education, Action & Research in Community Health (SEARCH) conceived the innovative idea of a home-based newborn healthcare programme. It had to be home based, they concluded, because 83% of births in rural areas occur at home, more than 90% of parents are unwilling to go to hospital for treatment of a sick newborn, and local doctors are not trained to manage sick neonates.

The key promoters of neonatal health in this programme are village health workers (VHWs), chosen from the villages, and traditional birth attendants (TBAs) practicing in that area. The VHWs visit each woman three times during her pregnancy, provide health education, and look after the neonate during the first month of life. They are trained to resuscitate asphyxiated babies, support breastfeeding, educate mothers to keep babies warm, provide assisted feeding to LBW infants, and recognize and treat sepsis. TBAs received training and were supplied with clean delivery kits.

By the third year of intervention, 93% of newborns in the intervention areas were receiving home-based care. While the NMR in the control area remained at around 65 per 1000 live births, it dropped to 26 per 1000 live births in the intervention area by the third year of intervention; a 58% reduction compared with the baseline period. The infant mortality rate was also reduced to nearly half. There was improved survival of LBW infants in all birthweight groups including VLBW infants. The impact of home-based care on key variables in the SEARCH study is shown below.

Indicator	Baseline	After intervention (3rd year)	Change
● Neonatal mortality rate (per 1000 live births)	62	26*	-58%*
● Perinatal mortality rate (per 1000 births)	68	48**	-30%**
● Birthweight-specific mortality among LBW infants			
○ <1500 g	69.2% (n=13)	25.0% (n=16)	-63.9%
○ 1500–1999 g	29.5% (n=61)	10.6% (n=47)	-64.1%
○ 2000–2499 g	3.7% (n=246)	1.6% (n=258)	56.8%

Compared with the control area, the differences were -62%* and -71%**.

The second success story is from a remote rural community in Maharashtra, India. Here, a partnership of village-level newborn care workers and TBAs succeeded in a 62% reduction in NMR by providing home-based newborn care interventions without institutional care. The perinatal mortality rate declined by 30%. The package of interventions included antenatal care, care at birth, prevention of sepsis, exclusive breastfeeding, care of LBW infants, detection of sickness, and treatment of sepsis with oral co-trimoxazole and injectable gentamicin. The home-based newborn care approach provided by community providers reduced mortality among all the birthweight categories including VLBW. The package costs an estimated US \$5.3 per newborn, and one death was averted for every 18 babies who received care. The cost per life saved was an estimated US \$95.4, which is less than the cost per life saved with the measles vaccination. This is an example of an exclusive community-based approach to neonatal–perinatal care in which facilities played no role. Ongoing studies in India, Bangladesh and Pakistan are evaluating the effectiveness of the SEARCH model in existing health systems. The Indian government is planning to introduce this model for its national

Table 3 A proposed approach to neonatal healthcare strategies in developing countries

NMR (per 1000 live births)	Approach
>50	<i>Community-based care:</i> tetanus immunization, clean deliveries, health education
50–26	<i>Intensive community-based newborn care:</i> home visiting, antenatal care, care at birth, warmth, breastfeeding, extra contacts for LBW babies, detection of illness, treatment in community, referral of those who cannot be managed in community, postnatal care of mothers (<i>home-based newborn care model of SEARCH</i>)
25–15	<i>Perinatal care at simple facilities:</i> care provided by a network of simple facilities close to the community managed by midwives/nurses or physicians, coupled with effective outreach programme (<i>facility-community-linked model of Sri Lanka</i>)
<15	<i>Regionalized perinatal care:</i> institution-based regionalized perinatal care as practiced in developed countries centred around tiered network of services run by nurses and specialists

NMR, neonatal mortality rate; LBW, low birth weight.

programme with countrywide coverage in a step-wise manner.

A notable feature common to both the case studies was the fact that the services were provided to the population free of cost. This equity consideration, coupled with easy access, stimulated utilization of services by the most needy.

The way forward for developing countries

The above primary care models of neonatal–perinatal care appear to be more relevant to the needs of resource-poor nations with high NMRs than the regionalized perinatal care practiced in developed countries. These approaches may be appropriately modified and adapted by individual countries, piloted and considered for scaling-up systematically.

It should be noted that the two models have very different time frames of maturation. Sri Lanka launched the midwifery training programme way back in the mid-1920s and intensified it in the mid-1950s along with initiatives aimed at systematic strengthening of the primary care services. It took almost four decades to achieve the current low NMR level. In the SEARCH model, the NMR declined from 62 to 26 per 1000 live births in just three years of intervention.¹³ Apart from the different start- and end-point NMRs, the difference was due to the fact that midwives need training for months to years, whereas VHWs can be trained and deployed in large numbers more quickly.

It is quite conceivable for developing countries with high NMRs to introduce home-based newborn care through community-based providers in a matter of a few years time, and concurrently build capacity for the Sri Lanka model of perinatal care which could be implemented over the next two

to three decades. The community-based systems established in the initial phase would complement the later phase by providing the all-important outreach extension of services. Once the NMR has declined to less than 15 per 1000 live births or so, the 'standard model' of regionalized perinatal care system being practiced in the West may be required to make further impact on the residual neonatal–perinatal mortality. However, it should be ensured that the many pitfalls of this approach that have become apparent with experience in different countries are taken care of at the design and implementation stage.

Taking into account the aforementioned considerations, we propose a broad approach to newborn care in developing countries depending on the level of the NMR (Table 3). This approach should be seen as a broad roadmap rather than a prescriptive recommendation. It should also be noted that there is a continuum of scenarios as NMR declines from higher to lower levels. This implies that there will be an unavoidable overlap of approaches during transition from one scenario to the next. Thus, for instance, at an NMR of 35 per 1000 live births, the primary approach could be based on the SEARCH model with concomitant major resource allocation to this approach. However, in order to be ready for the next strategy of institutional care in a few years' time, the country should also invest a rational quantum of resources for strengthening facilities and building capacity for skilled manpower of midwives, nurses and physicians. This component and the corresponding investment should then be gradually intensified as the NMR declines, mandating increasing skilled attendance coverage at births and institutional care of neonates for achieving further improvements in newborn survival.

It is true that no programme or strategy can suit or succeed in all the countries. The ground realities

are very different among and within the countries. Each country has to decide what is feasible for it, given its challenges, resources, strengths and limitations.

Conclusions

The prevalent model of regionalized perinatal services developed and practiced in affluent societies is not readily applicable or suitable for most of the developing countries with high NMRs. Primary care approaches shown to be effective in bringing down NMRs to low levels in resource-poor situations are perhaps more relevant to many settings in the developing world. Once the NMR level declines to around 15 per 1000 live births, and as the nations improve their resources, capacities and systems, regionalized perinatal care may be introduced in a phased manner to achieve further reduction in neonatal–perinatal mortality. Programme strategies in different countries need to be tailored to the respective levels of neonatal mortality and the prevailing healthcare scenarios.

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