Review Article

Open Access

Reducing Neonatal Mortality in Resource-poor Settings: What works?

Niall Conroy[1]*, Benita Morrissey[1] and Yaron Wolman[2]

[1]Bo Government Hospital, Bo, Sierra Leone

[2]UNICEF, Sierra Leone

*Corresponding author: Niall Conroy, Bo Government Hospital, Bo, Sierra Leone, Tel: +232 77623859; E-mail: niallconroy01@gmail.com

Abstract:

Every year over 3 million newborn babies die during their first month of life. Although the situation has improved greatly over the last two decades, survival beyond the neonatal period is still a challenge in resource-poor settings. When crude numbers are examined, most of these deaths occur in India, Nigeria, Pakistan, China and the Democratic Republic of Congo (DRC) but high neonatal mortality rates can be seen throughout the developing world, particularly in Sub-Saharan Africa. Basic interventions are unavailable in many resource-poor settings. There is, however, a growing body of evidence which can guide clinicians and policymakers in these environments in the use of inexpensive, yet effective, interventions to help reduce the burden of neonatal mortality. It is estimated that effective implementation and high coverage of these interventions could prevent up to 70% of neonatal deaths globally.

Keywords: Neonatal, Neonatal resuscitation, Neonatal mortality, Newborn health

The Global Picture

Every year over 3 million newborn babies die during their first month of life [1], with 99% of these deaths occurring in low and middle income countries [1]. Huge disparities in neonatal mortality rates exist between the most affluent countries and those in the poorest regions of the world, as illustrated by the data presented in table 1. Although neonatal mortality globally has reduced by almost 40% since 1990 [2], survival beyond the first month of life is still a challenge in many low-resource countries. The reductions seen in neonatal deaths have also not kept pace with the reductions in overall child mortality, meaning that newborns now make up an increasing proportion of under-5 deaths [3]. Deaths within the first month of life make up over 40% of the total under-5 child deaths [3].

Country	Year	
	1990	2012
Worldwide	33	21
Japan	3	1
USA	6	4
UK	5	3
Bangladesh	54	24
Democratic Republic of Congo	47	44
Chad	47	40
Sierra Leone	59	50

Table 1: Neonatal mortality rates (per 1,000 live births) in selected countries recorded in 1990 and 2012 [2].

There is now a good evidence base supporting some important interventions, which could reduce newborn morbidity and mortality and help redress this imbalance. It is estimated that up to 70% of neonatal deaths could be prevented if proven interventions were effectively implemented with high coverage where they are needed most [4]. This paper will focus on describing selected first-line interventions, with recent evidence for their efficacy, which have the potential to contribute to a cost-effective strategy for improving neonatal survival in low resource settings.

Neonatal Resuscitation Training

More than one-third of newborns who die within the neonatal period don't survive their first day of life and three-quarters do not survive past their first week of life [1]. Evidence for the effectiveness of immediate care for newborns in the delivery room is growing. It has been shown that clinical staff in many low-resource settings struggle to appropriately manage the care of newborns needing resuscitation at birth [5-7]. In recent years, much work has been done to address this important gap in skills globally. The American Academy of Pediatrics has developed a neonatal resuscitation program for use specifically in developing countries. Known as Helping Babies Breathe (HBB) [8,9], this program is based on simple stimulation and bag-mask ventilation techniques. It has yielded some significant successes, with, for example, a reported 47% reduction in early neonatal mortality and a 25% reduction in fresh still births, which was sustained over a 2 year period in Tanzania [10]. Similar reductions in neonatal mortality [11] or fresh stillbirth rates [12,13] as well as improvements in resuscitation skills [14,15] have been observed with other locally developed or locally adapted training courses in low-resource settings.

The optimal way to implement neonatal resuscitation programs in low-resource countries is still not clear though, with investigators reporting that increased skills did not always transfer into improved neonatal care in some parts of Tanzania [16] and others reporting that clinical skills deteriorated to unsatisfactory levels three months after HBB training [17] (A finding consistent with the picture seen in high

income settings [18]). Nonetheless, Save the Children estimates that equipping delivery facilities with basic neonatal resuscitation equipment could save 229,000 lives per year in low-resource settings [1]. In addition, meta-analysis suggests that implementing neonatal resuscitation programs throughout the developing world could reduce term intrapartum related deaths by 30% [19]. The role of neonatal resuscitation programs in reducing mortality rates amongst preterm neonates is less certain, with some evidence to suggest that neonatal resuscitation training had no effect on neonatal mortality, stillbirth rates or perinatal mortality rates in a population of neonates weighing less than 1.5kg within community or primary care settings [20].

Preventing Neonatal Sepsis

Surviving the "golden hour" after delivery is important. However, 65% [1] of babies who die within the neonatal period do so after they leave the labour ward. These newborns tend to die of sepsis and complications of prematurity [21,22]. An increasingly important tool in the prevention of neonatal sepsis and cord infection (omphalitis) is the use of chlorhexidine to clean the umbilicus after delivery. Clinicians in resource-poor settings have been using chlorhexidine for many years [23], though the practice is not widespread. However, the evidence base for its use has become stronger in the last 3 years. A recent Cochrane review [24] and meta-analysis [25] of the effect of 4% chlorhexidine on the umbilical stump after delivery show a reduction in neonatal mortality of 23% and a reduction in omphalitis of up to 56%. It should be noted, however, that these reductions in mortality were seen only in community settings. The evidence for use of chlorhexidine in the hospital setting is less certain, though mortality reductions have been reported in a neonatal intensive care unit [26].

Managing Neonatal Sepsis

When neonatal sepsis in the community does occur, hospitalization is clearly the most desirable outcome, but is often impractical or unavailable, so clinic -based antibiotic treatment is the only available option in many cases. There has long been uncertainty about which antibiotic regime is most suitable in this environment. Recent evidence from a community setting in Pakistan [27], where the neonatal mortality rate is particularly high, suggests that a combination of intramuscular (IM) procaine penicillin and IM gentamicin has the greatest efficacy, in reducing neonatal mortality and treatment failure. This combination was significantly more effective than the combination of oral trimethoprim and sulfamethoxazole with IM gentamicin. IM ceftriaxone was slightly less effective, though this was not statistically significant, but is a more expensive option. It should be noted that in this study little information on suspected source of sepsis was available, and cases of suspected bacterial meningitis were excluded. Only 5% of infants had microbiological identification of a pathogen (with *Pseudomonas aeruginosa* the most common pathogen) and no resistance patterns were reported. The importance of tailoring empirical therapy to suspected source of sepsis and local resistance patterns (if available) must be emphasized: in many settings ceftriaxone may be the more rational choice, despite these findings.

Reducing Mortality from Prematurity

Preterm birth is the leading cause of neonatal death globally [3]. Those who die of prematurity often succumb to hypothermia, with 80% of newborns weighing below 1.5kg dying if their core temperature falls below 33C [28]. For these babies, "Kangaroo Mother Care"

(KMC) can be a life-saving intervention. This inexpensive technique involves the mother and baby having continuous skin-to-skin contact, in an effort to improve thermoregulation, breastfeeding and bonding. A systematic review [29] and a large meta-analysis [30] have shown that KMC care has a significant effect in reducing low birth weight neonatal mortality in low-resource countries. It showed a reduction in neonatal mortality of up to 51% in preterm neonates without significant co-morbidity.

The role of breastfeeding

Breastfeeding has long been encouraged as a public health strategy in developing countries. Nonetheless, exclusive breastfeeding rates are low in many resource-poor settings. In Africa, Asia, Latin America and the Caribbean, only around half of babies under 2 months of age are exclusively breastfed, with this figure dropping to around 30% by 5 months of age [31]. A recent systematic review suggests that, within the non-exclusively breastfed population, infants who started breastfeeding within 24 hours of delivery had lower all-cause mortality rates than those who had delayed feeding [32]. This benefit seems to disappear in exclusively breast fed infants. Given the suboptimal rates of exclusive breastfeeding, as well as the documented risks of non-exclusive breastfeeding, in many low-resource settings, focus on early initiation of breastfeeding is a potentially high impact intervention.

The role of antenatal corticosteroids

Over the last 5 years, there has been an increased focus on the use of antenatal corticosteroids for the prevention of death secondary to preterm labour in low-resource settings. Steroid use is one of the most effective interventions available to prevent preterm death in high-income countries [33]. There have been calls to roll out this intervention globally [33,34], though some authors have argued for a more cautious approach [35]. A large, multi-country RCT is currently underway [36] to address the lack of data in this area. This should provide a clearer picture for policy-makers and clinicians in the near future.

Conclusions

The interventions above have the potential to expand the options available to those working with newborns in resource-poor environments, and improve neonatal survival. Although they are all relatively inexpensive and should ideally be accessible to most health workers in low-resource countries, their implementation and coverage have so far been limited, even in high-burden settings.

Of course, clinical interventions cannot be viewed in isolation. They need to be delivered within the context of a broader neonatal strategy, which recognizes the need to strengthen health systems at all levels. Structural factors, public health policies and the state of maternal health [17,33] play a pivotal role in the fight against neonatal deaths. In the post-2015, post Millennium Development Goal [34] environment, there is a significant opportunity to push ahead with efforts to reduce mortality in this population. New evidence to guide clinical practice means that clinicians are now better equipped than ever before to offer care to sick newborns in resource-poor environments in a cost-effective way. It is vital that closer links are fostered between those who generate evidence and those who use it to set priorities, so that the lag between evidence being published and appropriate interventions being implemented is minimized. Policymakers and funders need to be especially responsive to the

rapidly changing evidence base available to them, so that policy and priorities are flexible enough to keep pace with a rapidly changing evidence landscape. If the global community comes together on this issue, the tools are now at our disposal to offer an unprecedented level of care to this especially vulnerable subset of children.

References

1. Save the Children(2013) Surviving the first day. State of the world's mothers 2013: London.

2. The Inter Agency Group for Child Mortality Estimation (2013) Levels and trends in child mortality. New York.

3. World Health Organisation and UNICEF (2010) Countdown to 2015 decade report (2000–2010): taking stock of maternal, newborn and child survival. Geneva.

4. Knippenberg R, Lawn JE, Damstadt GL, Begkoyian G, Fogstad H, et al. (2005) Systematic scaling up of neonatal care in countries. The Lancet 365:1087-1098.

5. Conroy N, Jalloh C, Mitchell L, Solanki A, Seedat A, et al. (2014) Neonatal resuscitation skills amongst healthcare workers in Bo district, Sierra Leone. Resuscitation 85: e31-e32.

6. Carlo WA, Wright LL, Chomba E, McClure EM, Carlo ME, et al. (2009) Educational Impact of the Neonatal Resuscitation Program in Low-Risk Delivery Centers in a Developing Country. J Pediatr 154:504–508.

7. Harvey SA, Blandon Y, McCaw-Binns A (2007) Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward. Bulletin of the World Health Organization 85:783–790.

8. American Academy of Pediatrics. Helping Babies Breathe.

9. Singhal N, Lockyer J, Fidler H, Keenan W, Little G, et al. (2012) Helping Babies Breathe: Global neonatal resuscitation program development and formative educational evaluation. Resuscitation 83:90-6

10. Msemo G, Massawe A, Mmbando D Rusibamayila N, Manji K, et al. (2013)Newborn Mortality and Fresh Stillbirth Rates in Tanzania After Helping Babies Breathe Training. Pediatrics 131:e353.

11. Carlo WA, McClure EM, Chomba E, Chakraborty H, Hartwell T, et al. (2010) Newborn Care Training of Midwives and Neonatal and Perinatal Mortality Rates in a Developing Country. Pediatrics 126:e1064-1071

12. Goudar SS, Sommanavar MS, Clark R, Lockyer JM, Revanker AP, et al. (2013) Stillbirth and Newborn Mortality in India After Helping Babies Breathe Training. Pediatrics 131:e344–e352

13. Carlo WA, Goudar SS, Jehan I, Chomba E, Tshefu A, et al. (2010) Newborn-Care Training and Perinatal Mortality in Developing Countries. N Engl J Med 362:614-623.

14. Opiyo N, Were F, Govedi F, Fegan G, Wasunna A, et al. (2008) Effect of Newborn Resuscitation Training on Health Worker Practices in Pumwani Hospital, Kenya. PLoS ONE 3:e1599.

15. Hoban R, Bucher S, Neuman I, Chen M, Tesfaye N, et al. (2013) 'Helping Babies Breathe' Training in Sub-Saharan Africa: Educational Impact and Learner Impressions. J Trop Paed 59:180-186.

16. Ersdal HL, Vossius C, Bayo E, Mduma E, Perlman J, et al. (2013) A one-day "Helping Babies Breathe" course improves simulated performance but not clinical management of neonates. Resuscitation 84:1422-1427.

17. Musafili A, Essen B, Baribwira C, Rukundo A, Persson LA, et al. (2013) Evaluating Helping Babies Breathe: training for healthcare workers at hospitals in Rwanda. Acta Paediatrica 102:e34-e38.

18. Mosley CM, Shaw BN (2013) A longitudinal cohort study to investigate the retention of knowledge and skills following attendance on the Newborn Life support course. Arch Dis Child 98:582-586.

19. Lee AC, Cousens S, Wall SN, Niermeyer S, Darmstadt GL, et al. (2011) Neonatal resuscitation and immediate newborn assessment and stimulation for the prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. BMC Public Health 11:S12.

20. Carlo WA, Goudar SS, Jehan I, Chomba E, Tshefu A, et al. (2010) High Mortality Rates for Very Low Birth Weight Infants in Developing Countries Despite Training. Pediatrics 126;e1072.

21. Lawn JE, Cousens S, Zupan J (2005) 4 Million Neonatal Deaths: When? Where? Why? Lancet 365:891-900.

22. Li Lui, Johnson HL, Cousens S, Perin J, Scott S, et al. (2012) Global, regional and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet 379:2151-2161.

23. Mullany LC, Darmstadt GL, Khatry SK, Katz J, LeClerg SC, et al. (2006) Topical application of chlorhexidine to the umbilical cord for prevention of omphalitis and neonatal mortality in Southern Nepal: a community-based, cluster-randomised trial. Lancet 367:910-918.

24. Imdad A, Baitista RM, Senen KA, Uy ME, Mantaring JB, et al. (2013) Umbilical cord antiseptics for preventing sepsis and death among newborns. Cochrane Database of Systematic Reviews 5: CD008635.

25. Imdad A, Mullany LC, Baqui AH, El Arifeen S, Tielsch JM, et al. (2013) The effect of umbilical cord cleansing with chlorhexidine on omphalitis and neonatal mortality in community settings in developing countries: a meta-analysis. BMC Public Health 13:s15.

26. Sharma D, Gathwala G (2013) Impact of chlorhexidine cleansing of the umbilical cord on cord separation time and neonatal mortality in comparison to dry cord care – a nursery-based randomised controlled trial. J Matern Fetal Neonatal Med.

27. Zaidi AK, Tikmani SS, Warraich HJ, Darmstadt GL, Bhutta ZA, et al. (2012)Community-based treatment of serious bacterial infections in newborns and young infants: a randomized controlled trial assessing three antibiotic regimens. Pediatr Infect Dis J 31:667-672.

28. Stanley FJ, Alberman ED (1978) Infants of very low birthweight. I: Perinatal factors affecting survival. Dev Med Child Neurol 20: 300-312.

29. Penfold S, Willey BA, Schellenburg J (2013) Newborn care behaviours and neonatal survival: evidence from sub-Saharan Africa. Trop Med Int Health 18:1294-316

30. Lawn JE, Mwansa-Kambafwile J, Horta BL, Barros FC, Cousens S, et al. (2010) 'Kangaroo mother care' to prevent neonatal deaths due to preterm birth complications. Int J Epidemiol 39:i144-54.

31. Black RE, Allen LH, Bhutta ZA, Caulfield LA, de Onis M, et al. (2008) Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 371: 243–260.

32. Debes AK, Kohli A, Walker N, Edmond K, Mullany LC (2013) Time to initiation of breastfeeding and neonatal mortality and morbidity: a systematic review. BMC Public Health 13:S19.

33. Mwansa-Kambafwile J, Cousens S, Hansen T, Lawn JE (2010) Antenatal steroids in preterm labour for the prevention of neonatal deaths due to complications of preterm birth. Int J Epidemiol 39:i122-33.

34. Antenatal Corticosteroids for the Reduction of Death in Preterm Babies: United Nations Commission on Life-saving Commodities for Women and Children.

35. Azad K, Costello A (2014) Extreme caution is needed before scale-up of antenatal corticosteroids to reduce preterm deaths in low-income settings. Lancet Global Health 2:e191-e192

36. Althabe F, Belizán JM, Mazzoni A, Berrueta M, Hemingway-Foday J, et al. (2012) Antenatal corticosteroids trial in preterm births to increase neonatal survival in developing countries: study protocol. Reprod Health 9:22.

37. Hofmeyr GJ, Haws RA, Bergstrom S, Lee AC, Okong P, et al. (2009) Obstetric care in low-resource settings: what, who and how to overcome challenges to scale up? Int J Gynaecol Obstet 107:s21-s45.

38. United Nations Millennium Development Goals

39. The Inter Agency Group for Child Mortality Estimation (2013) Levels and trends in child mortality. New York