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EDITORIAL

A few breaths at birth; a lifetime of health**

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Neonatal mortality is decreasing in high-, middle-, and low-income countries. However, neonatal mortality accounts for an increasing proportion of the under-5 child mortality worldwide.[1] The most recent global data indicate that neonatal mortality accounts for 46.0% of the under-5 child mortality.[1] An additional 5.0% of the under-5 child mortality is due to neonatal diseases but occurs after the first month after birth. Over the last 20 years, deaths from diarrhea and lower respiratory infections, the top causes of post-neonatal childhood deaths, have decreased by over 50%. In contrast, preterm birth complications and intrapartum-related deaths (also called birth asphyxia), which are the top causes of neonatal deaths have decreased less.[1]

Birth asphyxia is defined as the failure to establish breathing at birth; deaths due to birth asphyxia are now called intrapartum-related deaths. Preterm infants are at high risk of failure to establish breathing at birth, so resuscitation at birth is an important intervention to reduce neonatal mortality worldwide. While about 10% of all neonates are apneic at birth, gentle stimulation and drying lead the majority to breathe. The overwhelming majority of the non-responders initiate spontaneous breathing after a few seconds of initial ventilation. Thus, a few breaths at birth in these apneic neonates can be lifesaving.

Although the global neonatal mortality rate has decreased worldwide, there are major regional differences. Neonatal mortality decreased by about half in most regions of the world, including Latin America, over the last three decades.[2] However, Latin America continues to have several-fold higher neonatal mortality rates than Europe and North America.[2] Furthermore, variations in early childhood mortality worldwide as well as in Brazil are associated with poverty and geographic location, indicating important disparities.[3] Thus, to reduce neonatal mortality, efforts should focus on the care of preterm neonates and neonates with birth asphyxia.

To address care at birth in the state of Piauí, which has among the highest neonatal mortality rates in Brazil, de Lima and colleagues performed a pre/post-intervention study aimed to evaluate neonatal outcomes after the implementation of the Neonatal Resuscitation Program of the Brazilian Society of Pediatrics.[4] The investigators trained 431 healthcare professionals, including physicians, nurses, physical therapists, nursing technicians, and nursing assistants, who worked in delivery rooms in five cities. Pre- and post-intervention assessments were conducted. There were improvements in the availability of resuscitation materials, sustained improvements in knowledge and practice of neonatal resuscitation, decreased delivery room deaths, and an increase in appropriate transports to higher-level care facilities. The absolute number of delivery room deaths decreased by 72.6%, although the number of births and the rates of delivery room mortality, perinatal mortality, and neonatal mortality were not reported.

The authors used a pre/post-intervention design. While controlled, the pre/post design has some important limitations many of which can be eliminated or minimized with an active baseline design. The active baseline design requires the protocol to be initiated and stable baseline data before data collection for the pre-intervention period is started. After the pre-intervention data collection is completed, training is conducted and data collection for the post-intervention period seamlessly continues. The active baseline design was used in a very large study of training in both Essential Newborn Care (which includes basic neonatal resuscitation) and a simplified version of the Neonatal Resuscitation Program conducted in 18 low-risk healthcare facilities in Zambia.[5] In this controlled trial of over 70,000 deliveries using adjusted models, all-cause early (7-day) neonatal mortality rates decreased from 36.2 to 25.1 per

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1,000 live births ($p < 0.001$) following Essential Newborn Care training and decreased further to 15.9/1,000 live births ($p = 0.003$) following the simplified Neonatal Resuscitation Program training. In a scaled-up intention-to-treat version of this trial that included 6 countries and 88 geographically distinct low-resource rural clusters, there was a significant reduction in the rate of stillbirth (relative risk with training, 0.69; 95% CI, 0.54 to 0.88; $p = 0.003$) for all births including those unattended by a birth attendant.[6] For births with a birth attendant, there was also a decrease in all-cause perinatal mortality from 42.7/1,000 live births to 33.3/1,000 live births (RR 0.88, CI 0.64, 0.94).[6] As randomized clinical trials comparing neonatal resuscitation versus control are unlikely to be conducted due to ethical concerns, these pre/post-intervention and active baseline design trials provide the highest levels of evidence for neonatal resuscitation. Many observational studies of neonatal resuscitation training have also been conducted. A meta-analysis of randomized controlled trials and observational studies that tested the effect of neonatal resuscitation reported that term intrapartum-related deaths were reduced by 30%.[7]

Neonates who survive birth asphyxia are at high risk for neurodevelopmental impairment. Thus, it is important that neurological assessments are performed during early childhood. In the multi-country study addressed above, the rate of moderately or severely abnormal neurologic examinations at 7 days decreased from 8.0% before the intervention to 6.4% after ($p = 0.01$).[6] Furthermore, in a prospective 3-year follow-up study of children who had required resuscitation at birth compared to a concurrent cohort of healthy controls, Bayley Mental Developmental Index and Bayley Psychomotor Developmental Index scores of both non-resuscitated and resuscitated infants were within normal range.[8] Thus, a few breaths at birth in apneic neonates can be life-saving. Importantly, the survivors most likely will have normal neurodevelopmental outcomes.

Training in a package of interventions such as Essential Newborn Care that includes basic resuscitation is among the most cost-effective interventions in perinatal care.[9] The training costs in one trial were $208 per life saved and $5.24 per disability-adjusted life-year averted for the establishment of the program. Maintenance costs would be much lower as a train-the-trainer model is effective. Thus, neonatal resuscitation training is likely to be among the most cost-effective perinatal interventions in many worldwide locations similar to those where the study was conducted in Brazil.

In summary, there is evidence that training in neonatal resuscitation reduces mortality in low-resource settings. The study by de Lima and colleagues conducted in a high neonatal mortality region in Brazil shows the feasibility and potential effectiveness of a neonatal resuscitation training program in low-resource settings. The potential for a global transformational impact of neonatal resuscitation training cannot be understated, as a mere few seconds of tactile stimulation and a few breaths administered at birth have the power to save lives, resulting in most additional survivors having normal developmental outcomes. It is imperative to prioritize the global implementation of neonatal resuscitation training, particularly in low-resource settings.

Conflicts of interest

The authors declare no conflicts of interest.

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