For many years, the global health community regarded neonatal resuscitation as requiring intensive care – and thus as inaccessible in resource-constrained settings. Helping Babies Breathe (HBB) changed the paradigm of teaching and performing basic resuscitation and reduced fresh stillbirth and first-day neonatal mortality significantly in low- and middle-income countries [1–5]. Basic neonatal resuscitation is the obvious choice where a single birth attendant cares for both the pregnant woman and the newborn infant. Usually that birth attendant is a midwife, nurse, community-level or auxiliary provider. However, when additional personnel may be available, as in larger hospitals, humanitarian medical teams, or medical missions, there is a natural desire to utilize the skills of personnel with advanced training, especially physicians. Nonetheless, limitations on available equipment and gaps in specific skills, such as the intubation of newborns, make it difficult to follow evidence-based, internationally accepted guidelines for advanced resuscitation. Does an intermediate approach which adds selected advanced interventions really improve outcomes? We argue that such an approach deviates from the science, disregards the principles of education and team communication, and is unlikely to result in improved survival or quality of survival, but instead create unanticipated negative consequences.

Médecins Sans Frontières (MSF) is an internationally renowned and respected organization providing medical care in emergency and humanitarian settings. Sophisticated logistic support and a global pool of highly trained physicians and nurses working alongside in-country health providers offer the possibility of advanced care that would otherwise be unattainable. The report by Umphrey et al. [6] describes the process by which a group of experts developed a midlevel resuscitation algorithm for use in MSF field hospitals.

A number of changes in the proposed algorithm deemphasize interventions that are known to be life-saving in resource-limited settings. The algorithm omits thorough drying as an immediate first step for all babies to provide stimulation and avoid hypothermia. Rather than performing the initial steps of stabilization with the umbilical cord intact and the baby in skin-to-skin contact with the mother as in HBB, the algorithm relegates these considerations to sidebars with "consider delayed cord clamping" and "prevent heat loss." Newborns separated from their mothers and placed on radiant warmers for resuscitation often experience hypothermia without adequate temperature monitoring [7]. Hypothermia is one of the most powerful predictors of mortality and delayed umbilical cord clamping is associated with decreased in-hospital mortality [8, 9]. Attention to these initial steps in...
the HBB Action Plan results in more than 90% of babies beginning spontaneous breathing without the need for positive-pressure ventilation [10]. Maintaining skin-to-skin contact avoids later hypothermia and the separation of mother and baby. It also promotes the initiation of breastfeeding within the first hour, linked to the establishment of successful lactation, long-term breastfeeding, and mortality reduction [11].

The addition of selected advanced interventions deviates from the science and may expose newborns to potential harm. Safe administration of oxygen requires not just pulse oximetry, but also blenders, which are not commonly available with low-pressure oxygen sources in resource-limited settings. Newborns exposed to 100% oxygen experience direct lung injury; preterm infants may be placed at increased risk for prolonged oxygen use and later retinopathy of prematurity. Shifting the focus of resuscitation to more advanced interventions often results in providers neglecting the basic steps and moving quickly to more aggressive interventions, such as chest compressions. Omission of intubation in the midlevel algorithm will likely result in the exposure of infants to chest compressions and medications when the root problem is ineffective ventilation [12]. American Heart Association guidelines now specify that intubation should be performed when the heart rate remains low and chest compressions are indicated in order to maintain a secure airway [13]. The intermediate algorithm also fails to address one of the primary gaps identified, the ability to effectively measure heart rate. A rise in heart rate is the most important indicator of effective ventilation; however, the algorithm relies on the more subjective assessment of chest rise. HBB deliberately focuses on the initial steps of stabilization and positive-pressure ventilation and omits chest compressions, intubation, and medications to help providers to attain mastery of the basic skills that effectively resuscitate 97% of newborns [10].

The proposed intermediate algorithm has potentially negative consequences for education and team communication. HBB is widely disseminated now to over 80 countries (hbs.aap.org), and MSF adopted the HBB protocol for basic resuscitation in 2012. The algorithm is immediately recognizable and serves as a clear and graphic shared mental model for those trained locally and elsewhere. Based on ILCOR Consensus on Science with Treatment Recommendations, the HBB algorithm can link directly from positive-pressure ventilation into the more advanced ILCOR algorithm when the response to bag-mask ventilation is inadequate and expertise and equipment are available [14]. In contrast, the intermediate algorithm trades the simplicity of graphic design and limited steps for multiple, text-based conditional steps and contingencies, which violate many of the principles of human factors design [15]. Decision-making will vary with the individual capacities of team members and equipment available in a particular facility, making standardized training difficult and complicating teamwork and communication. Rather than building upon a successful training program and resuscitation action plan, substitution of a new alternative discounts the training of local providers and creates the need for a separate training infrastructure with contradictory messages.

Revision by expert consensus deviates from the global standard of evidence and program evaluation. Although the authors refer to “informal usability testing” during the process of development, the scale of this testing was limited and educational tools have not yet been developed. Field testing of any algorithm and its associated educational program is essential to determine the impact on provider satisfaction and self-efficacy, cost and resource utilization, and patient outcomes. HBB underwent two rounds of independent Delphi review, beta testing by the editorial committee, and extensive field testing before release [16]. Further large-scale implementation trials examining patient outcomes, as well as specific research focused on educational methodologies, technologies to improve the delivery of care, monitoring, and quality improvement informed the 2016 second edition of HBB [17]. Field evaluation of the proposed intermediate algorithm will be critical to determine the feasibility of training, actual adherence to the algorithm in MSF (and non-MSF) facilities, and patient outcomes.

Evaluation of patient outcomes is crucial to establish that adoption of an intermediate approach to resuscitation does not result in adverse consequences. Contemporaneous focus on improved newborn survival targets not just a reduction of mortality, but also an improved quality of survival [18]. Studies of neurodevelopmental outcome after basic neonatal resuscitation show an equivalent status among babies resuscitated and those not requiring such intervention, while newborns who receive advanced resuscitation have significantly lower neurodevelopmental scores [19, 20]. Outcomes after implementation of HBB show improved first-day survival and improved or stable early neonatal survival [21]. However, sustaining the gains made through neonatal resuscitation requires an improvement of newborn care subsequent to resuscitation [22, 23]. For preterm infants, this implies specialized respiratory support (low-flow and high-flow oxygen therapy, CPAP, mechanical ventilation), administration...
of fluids and antibiotics, and comprehensive support for feeding and nutrition through a prolonged stay in the facility. For asphyxiated term infants the support needed will include the treatment of seizures and possibly therapeutic hypothermia. Finally, survivors of more advanced resuscitation will require screening (hearing, retinopathy of prematurity) as well as developmental and medical therapies following discharge. Transition from the facility, with exceptional levels of support, to the community and public health system represents a period of great vulnerability and late mortality, especially in settings of disaster or humanitarian emergency [24]. While the best intentions motivate technological advancements in care, increasing complexity can be the enemy of simple, context-appropriate, and effective interventions based on evidence.

### Disclosure Statement

The authors declare no conflicts of interest. Dr. Niermeyer is editor of Helping Babies Breathe for the American Academy of Pediatrics. Dr. Niermeyer and Dr. Perlman are past co-chairs of the American Academy of Pediatrics Neonatal Resuscitation Steering Committee. Dr. Perlman is past co-chair of Neonatal IL-COR (International Liaison Committee on Resuscitation) and both authors serve as current members of the Neonatal Evidence Evaluation Group of ILCOR.

### References


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