Designing and Implementing the Helping Babies Breathe Program in Tanzania

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Abstract

The first day and especially the first hour are critical to newborn survival with the highest risk of intrapartum-related neonatal deaths, from 60 to 70%, occurring within 24 hours of birth. Birth asphyxia (BA) or failure to initiate or sustain spontaneous breathing at birth contributes to approximately 27 to 30% of neonatal deaths. In 2009, Helping Babies Breathe (HBB), an evidence-based educational program developed to teach neonatal resuscitation techniques in limited-resource setting, was introduced and piloted in Tanzania. HBB resulted in a significant 47% reduction in early neonatal mortality from 13.4 to 7.1 per 1,000 live-born deliveries ($p < 0.0001$) and a significant reduction (24%) in fresh stillbirths from 19.0 per 1,000 preimplementation to 14.4 per 1,000 births postimplementation ($p = 0.001$). The use of stimulation and suctioning increased, whereas the need for bag mask ventilation decreased significantly post-HBB. This success was attributed to several key strategies including elevating BA as a national priority in health care, identification of a primary person (a pediatrician) at the ministerial level who assumed ownership of the program, local site ownership by a midwife, a commitment to train all birth attendants in the current health workforce in HBB, a commitment to provide required resuscitation equipment at all levels, and periodic review of the data (biannually) at a centralized meeting, under the direction of the Ministry of Health, involving all stakeholders to instill a sense of accountability. A national rollout of provider training is almost complete with almost 15,000 already trained.

Keywords

- ▶ helping babies breathe
- ▶ neonatal mortality
- ▶ fresh stillbirths
- ▶ high-frequency low-dose training
- ▶ birth asphyxia

Introduction

The first day and especially the first hour are critical to newborn survival with the highest risk of intrapartum-related neonatal deaths, from 60 to 70%, occurring within 24 hours of birth.^{1,2} Common causes of death include birth asphyxia (BA), infection, and prematurity. BA or failure to initiate or sustain

spontaneous breathing at birth contributes to approximately 27 to 30% of neonatal deaths, and substantially to neurodevelopmental disabilities in survivors.^{3,4} It is estimated that approximately 1 million babies die each year from BA worldwide.³ In Tanzania, the neonatal mortality rate approximates 32/1,000 live births, i.e., 50,000 deaths annually with approximately 14,000 attributed to BA. A comparable number of fresh

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stillborn (FSB) babies are also delivered annually. Importantly while there were several programs aimed at newborn resuscitation and care (see below), it was also clear from a “Situation Analysis of Newborn Health in Tanzania” report published in March 2009⁵ that the incidence of BA-related mortality had remained unchanged over the prior 15 years. Moreover, that report indicated that the number of skilled providers present at delivery was approximately 50%, and there was a global lack of essential basic resuscitation equipment. These deficiencies were observed in all facilities, including referral hospitals, within the health care system.⁵

For several years, Tanzania had introduced programs that were targeted at newborn resuscitation, such as Integrated Management of Childhood Illnesses including newborn care, which had been rolled out countrywide by the Ministry and District Councils, and Essential Newborn Care, which includes newborn resuscitation as one of the modules. Although major support for these initiatives was derived from the government and council budgets, other technical and financial support also came from local partners, including United Nations agencies (World Health Organization [WHO] and United Nations Children's Fund [UNICEF]). In addition, the Tanzanian government had introduced specific initiatives to address maternal, newborn, and child health challenges through the National Health Policy (revised in 2007), the Health Sector Reforms and the Health Sector Strategic Plan (2003–2007), the National Strategy for Growth and Reduction of Poverty (NSGRP-MKUKUTA), and the Primary Health Services Development Program (PHSDP-MMAM). Furthermore, the Reproductive and Child Health Strategy (2005–2010) and the National Road Map Strategic Plan were also targeted toward addressing this problem.⁶

To begin to address this important issue, several interrelated elements were essential to achieve success in Tanzania. First, to elucidate potential factors contributing to BA-related mortality; second, to conceptualize intervention strategies to reduce mortality; and third, to implement targeted intervention/s to reduce BA-related mortality. This review will address the approach adopted in Tanzania to reduce BA-related mortality, the piloting of HBB, and the national implementation of the HBB program.

Identification of Factors Contributing to BA-Related Mortality

Defining Birth Asphyxia

In the limited-resource setting (LRS), BA has generally been defined as a 5-minute Apgar score < 7 accompanied by the absence of spontaneous respirations, without regard to the potential mechanisms contributing to the flaccid state at birth.⁷ By contrast, in the developed world, the definition of BA is biochemical, characterized by progressive hypoxia, hypercarbia, and acidosis related to interruption of placental blood flow, and is most often identified by the presence of abnormalities in fetal heart rate (FHRT) detected during the labor process. Measurement of an umbilical arterial cord blood gas obtained at birth has been useful in assessing the severity of an asphyxial process. A pH < 7.00 is a threshold value below which the risk for brain damage is increased and

has been defined as severe fetal acidemia.⁸ Importantly the overwhelming majority of infants with severe fetal acidemia transition spontaneously at birth, and are triaged to a well-baby nursery.^{9,10} This latter observation reflects the well-categorized fetal adaptive mechanisms to in utero stress to preserve myocardial, cerebral, and adrenal blood flow, with circulatory arrest invariably influenced by duration and severity of the interruption of blood flow. It is the latter group with circulatory arrest, approximately 1 in 1,000 term infants, who are at highest risk for progression to subsequent brain injury and/or death.^{9,11} By comparison, the rate of BA in Tanzania was estimated to be approximately 14 to 15 per 1,000 live births (a 14-fold difference).

Recent observations from Tanzania indicate that the overwhelming majority of infants—approximately 85%—will initiate spontaneous respirations within 30 seconds following birth and an additional 10% will start breathing promptly in response to basic stabilization steps including drying, clearing the mouth of secretions, and stimulation.¹² Of the remaining infants, most will start breathing in response to bag mask ventilation (BMV), if initiated in a timely and effective manner. These clinical observations are consistent with experimental data in the nonbreathing asphyxiated animal indicating two types of apnea, i.e., primary or secondary apnea, which are related to the duration of an asphyxial process.¹³ Primary apnea relates to asphyxia of short duration, as reflected by a normal systemic pH, with spontaneous respirations initiated in most cases with immediate basic interventions, i.e., stimulation. Secondary apnea relates to a more prolonged asphyxia process, with a marked decrease in heart rate below 60 beats/minute as well as a systemic pH < 7.00. In this situation, more intensive resuscitative efforts, including ventilation ± intubation ± chest compressions/medications, are often required to restore stable cardiorespiratory status.

Identifying Potential Predisposing Factors Contributing to the High Rate of BA in Tanzania

In 2007, we (J. M. P.) spent 1 month observing events at the time of delivery in a labor and delivery area in a hospital in Tanzania. Several critical points were apparent that likely contributed to the high rate of BA-related mortality. First, the midwife was the sole provider at all nonoperative deliveries, providing care to both the mother and newly born baby. Second, following a delivery, the midwife would move a newly born baby over to the resuscitation area, and return to complete the delivery process, irrespective of whether the baby was breathing or not. It is reasonable to assume that most nonbreathing babies are in primary apnea (see above) and will invariably respond to basic interventions, i.e., drying, stimulation, with and without bulb suction by initiating spontaneous breathing. In the absence of an intervention, the nonbreathing baby will progress to secondary apnea. During this phase, the infant may eventually gasp which, if observed, invariably will evoke a response (intervention) from the provider. The baby may then start breathing after the intervention. Such a clinical scenario would fit the

resource-limited definition of BA (as defined above), and would place the baby at high risk for subsequent mortality, and survivors at high risk for brain injury and cerebral palsy. Conversely, if the baby does not gasp, and no interventions are attempted, progression to cardiac standstill will result, and the baby will be classified as a FSB.

In summary, based on these observations, it was apparent that several factors were contributing to the high rate of BA-related mortality, including a failure to initiate resuscitation in a timely manner, a lack of understanding of the basic resuscitation skills necessary to restore cardiorespiratory status, and lack of focus on the midwife as it relates to educational issues, i.e., understanding of the basic physiologic changes occurring at the time of the delivery, as well as skills related to applying basic resuscitation steps, including effective application of BMV.

As noted previously, Tanzania had introduced several programs targeted at newborn resuscitation. Clearly, these strategies had not translated into clinical success. A different strategy had to be adopted. Three elements were considered essential: first, a commitment from the Health Ministry to make BA a national priority; second, to focus on the midwife; and, third, to instill confidence in providers that a difference could be made with basic interventions.

Bringing about Change (2008–2009)

Two important parallel events set the stage for potentially reducing BA-related mortality in Tanzania.

Development of the HBB program: In 2009, Helping Babies Breathe (HBB), an evidence-based educational program developed to teach neonatal resuscitation techniques in LRS, was ready to be piloted.¹⁴ HBB was an initiative of the American Academy of Pediatrics (AAP) in collaboration with the WHO, United States Agency for International Development, Saving Newborn Lives, the National Institute of Child Health and Development, Laerdal Global Health, and several other global health organizations. This program contained several elements and concepts that were essential for success. First, the curriculum was evidence-based and derived its scientist underpinnings from the neonatal section of the International Liaison Committee on Resuscitation (ILCOR).¹⁵ The teaching material included a flip chart and a learner manual, which was easily laid out for the instructor to follow (see ►Fig. 1). Second, there was an action plan poster which stressed the importance of the “Golden Minute®”—the early and immediate intervention in a nonbreathing infant. As noted previously, delay in initiating resuscitation can result in death, brain injury in survivors, and a fresh stillbirth. Third was the development of a low fidelity simulator termed “NeoNatalie” by Laerdal Global Health (Stavanger, Norway), which facilitated application of the HBB curriculum into actual practice. The simulator has the capacity for the student to palpate an umbilical pulse, as well as to identify breathing and/or apnea.

Commitment of the Ministry of Health and Social Welfare: Concurrently during the time period of August 2008 through March 2009, discussions were held with the Ministry of Health that targeted strategies to reduce the burden of BA-related mortality. The ministry responded to a request for

funding application (RFA) put out by the AAP and was awarded a grant to pilot HBB in Tanzania. The Health Ministry committed to additional strategies that were essential to improve newborn health and reduce BA-related mortality (see ►Table 1). Critical elements included elevating BA as a priority in health care, a commitment to train all birth attendants in the current health care workforce in HBB, a commitment to provide health care providers at all levels with required resuscitation equipment, and to appoint a pediatrician (G. M.) from the Ministry of Health to lead the implementation of HBB.

Formula for Survival

In 2003, ILCOR conceptualized a hypothetical formula termed the “the formula for survival” whereby three interactive factors—guideline quality (medical science), efficient education of patient caregivers (education) and a well-functioning system at a local level (local implementation)—were regarded as essential in determining survival from conditions resulting in the need for resuscitation¹⁶ (see ►Fig. 2). This formula was subsequently refined in 2006.¹⁷ At the time of the pilot launch, the medical science based on the ILCOR process was robust, the educational component (an evidence-based HBB curriculum) was available, and local implementation (support from the Health Ministry; ►Table 1) all pointed toward a successful launch of HBB with a reduction in BA-related mortality and improved survival.

Pilot Launch of HBB

A very short time frame (approximately 4 months) was made available from time of the award to launch of the HBB program in September of 2009 in Dar es Salaam. The program was initiated at three referral hospitals (Muhimbili National Hospital, Bugando Medical Centre, and Kilimanjaro Christian Medical Center) and three linked regional hospitals (Amani, Sekotoure, and Mawenzi) as well as Burunguni Health Center, and one district hospital (Haydom Lutheran Hospital). The general characteristics of the hospitals are shown in ►Table 2. These hospitals were selected because it was essential to demonstrate success at the major hospitals before embarking on a national rollout. An oversight committee as well as a data monitoring committee were established to help guide and evaluate implementation of the program. Forty providers from the above hospitals were selected to become “Master Trainers.” A midwife at each of the eight sites was appointed to assume primary responsibility for teaching, to reinforce the quality of training, and to oversee the data entry. A computer was placed in or close to every labor ward for data entry, with subsequent transmission of data to a central repository at the Health Ministry in Dar es Salaam. A national data collection form, which included core and desired elements (18 elements), was developed by the data oversight committee (see ►Fig. 3). The recording of data on every birth followed the standard national policy and procedure, and was logged into the delivery book as part of routine documentation, then transcribed onto the data collection form, which was

Fig. 1 Different components of the HBB curriculum including flip charts, learner manual, action poster, and the simulator (NeoNatalie) (downloaded from <http://www.helpingbabiesbreathe.org>. Accessed May 26, 2015. (Reprinted with permission from the AAP).

completed after 24 hours (this was delayed to determine outcome beyond the delivery room). The government maintained logs of both records. For the purpose of the study, information from the data forms was transcribed to a computer database after 24 hours. There were many providers

who filled out a form after a delivery; however, the transcription to the database was by a dedicated person at all sites.

Data Monitoring: Each hospital collected data for 2 to 4 months prior to implementation, which was used as baseline information. This short time frame was at the request

Table 1 Ministry of Health commitment

Birth asphyxia was designated as a priority area in health care.
Commitment to train all birth attendants in current health workforce in HBB.
Integration of HBB with other relevant programs (e.g., new 3 d newborn care program) to reach new target groups.
Scaling up of health care professionals.
Commitment to provide health care providers at all levels with required resuscitation equipment (Resuscitator, suction, etc.) (built into the budget since 2011).
Strong local project leadership. ^a
Commitment to reach the communities.
Accountability to collecting and reporting defined data on an ongoing basis. ^b
Commitment to sustainability.

^aDr. Msemo—a pediatrician was placed in charge of piloting the HBB initiative.

^bData Monitoring and Steering Committee—meet every 6 months.

of the president who wanted to pilot the HBB program as soon as possible. Postimplementation data collection was only initiated following the initial training of providers in each hospital. Data were analyzed and evaluated every 6 months by the data oversight committee in an ongoing process. Consistency checks of the data were performed intermittently by the principal investigator (G. M.) and every 6 months by J. P. at the primary sites, and the data edited as appropriate.

The program was launched with 2 days of training for the 40 Master Trainers. Over the subsequent 6 to 9 months, the program was implemented at the eight hospitals individually as follows: a 1-day training of health care providers was conducted by the Principal Investigator (G. M.) and other Master Trainers at each hospital. Some of these providers became Regional Trainers and District Instructors, with the defined role to subsequently train health care providers in hospitals, health centers, and dispensaries within each respective district. This represents a cascade model approach to train providers throughout the country. Additionally these trained providers were expected to continue to provide “on-job” and refresher training to other service providers in the same facilities. A simulator was placed in the labor and delivery suite where every provider had to document appli-

cation of basic skills, including BMV, before starting a shift. Since midwives attend most deliveries, a major emphasis was placed on their training. The training was based on the HBB course material (see ►Fig. 1). While initially conducted in English, current training is in both English and Swahili.

A priori, we hypothesized that the majority of babies with BA, i.e., failure to initiate spontaneous respirations, are in primary apnea and will respond to early basic resuscitation. There were two basic objectives: first, to determine whether implementation of the HBB program would enhance the skills of birth attendants and, second, to reduce the incidence of BA-related early neonatal mortality (ENM), i.e., death within 24 hours, by 50% and the number of FSB by 25%.

Some have questioned why ENM (i.e., death within 24 h) was used as the end point in this study. The major causes of neonatal death in the first week include BA, prematurity, and infection.^{1–3} We reasoned since HBB is targeted primarily at reducing BA-related mortality, and the other causes related to prematurity or infection are more likely to result in later deaths, it made sense to look at the early deaths. Indeed for infants between 1,001 and 2,000 g (a proxy for prematurity and low birth weight), application of HBB was associated with a 60% reduction in ENM (see ►Table 3). Finally, many infants are discharged home after 24 hours and are difficult to trace.

Pertinent Findings from the Pilot Launch of HBB

Data were analyzed for 2 months prior to rollout at each institution (*n* = 8,124 births) and postimplementation for 18 months (*n* = 78,500 births) from September 2009 through March 2012. There were 107/7,969 deaths preimplementation and 552/77,369 deaths postimplementation. This represents a significant reduction (47%) in ENM from 13.4 to 7.1 per 1,000 live-born deliveries (relative risk [RR]: 0.53; 95% confidence interval [CI]: 0.43–0.65; *p* < 0.0001).¹⁸ The reduction in ENM was significant for both normal and low-birth-weight as well as term and preterm infants (see ►Table 3). There were 155 FSB (19.0 per 1,000 births) preimplementation and 1,131 FSB (14.4 per 1,000 births) postimplementation. This represents a significant reduction (24%) (RR; 95% CI: 0.76[0.64–0.90]; *p* = 0.001).

Providers trained in HBB who attended a delivery increased from 10 ± 5% to 80 ± 13% (*p* = 0.0001). The use of stimulation increased preimplementation versus postimplementation from 3,756/7,969 (47%) to 67,769/76,817 (88%) (RR: 1.87; 95% CI: 1.82–1.90; *p* ≤ 0.0001), and use of

Fig. 2 Utstein formula of enhancing survival. (Adapted from Søreide et al.¹⁷)

Table 2 Description of the research hospitals involved in the Helping Babies Breathe pilot

Hospital name	University affiliation	Number of deliveries/mo	Number of midwives
Muhimbili	Muhimbili University of Health and Allies Sciences	560–1,400	30
Bugando	Bugando Health Sciences	280–560	16
KCMC	Tumaini University	450–600	13
Haydom	None	420–600	25
Sekotoure	Bugando Health Sciences	560–850	24
Amana	Muhimbili University of Health and Allies Sciences	560–840	25
Mawenzi	Tumaini University	560–840	20
Burunguni	Muhimbili University of Health and Allies Sciences	90–150	23

suctioning from 1,227/7,969 (15%) to 16,628/76,817 (22%) (RR: 1.40; 95% CI: 1.33–1.46; $p \leq 0.0001$). By contrast, the use of BMV preimplementation versus postimplementation decreased from 636/7,969 (8.2%) to 3,998/76,817 (5.2%) (RR: 0.65; 95% CI: 0.60–0.72; $p < 0.0001$).¹⁸

Implications of these Findings

Several important points are apparent from this study and are consistent with the survival model described previously.

- The majority of providers who attended a delivery post-implementation had received training in HBB. As a consequence of this training, there was a significant increase in the number of babies stimulated at birth, as well as those who were suctioned. Conversely, there was a significant decrease in the use of BMV. These findings in totality are consistent with our hypothesis and experimental observations, suggesting that most nonbreathing babies are in primary apnea with a heart rate, and will initiate spontaneous respirations in response to drying and stimulation only, if this is implemented in a timely manner (►Fig. 4).^{12,13,15} We consider this to be the most plausible explanation for the significant reduction in both the ENM and rates of FSB. Although counterintuitive, the most likely explanation for the latter finding is that before HBB training, live-born infants without obvious signs of life were likely misidentified as FSB, as has been suggested in previous reports.¹⁹ Moreover, this beneficial effect was achieved without supplemental oxygen in most cases, endotracheal intubation, or chest compressions. This is highly relevant, as Tanzania lacks the capacity to administer continuous positive airway pressure ventilation and/or to intubate and ventilate a baby. Prior observational studies involving birth attendants using a before-and-after strategy in facilities and communities in developing countries have also shown a reduction in neonatal mortality but not FSB.^{20–22}
- Despite the limitations of a before-and-after study design which hinders a conclusion of causality, it is likely that the reductions in ENM and FSB rates are in part due to specific training elements contained in the HBB program. The first relates to the emphasis on the immediate application of basic

steps such as drying, stimulation, and (if needed) suctioning of any newly born baby. This should rapidly induce spontaneous respirations in those not breathing in more than 90% of cases, if applied within the “Golden Minute®” (see ►Fig. 4). The second relates to the ability to teach providers the basic steps outlined previously, as well as the correct application of a resuscitator for BMV, using the neonatal simulator (NeoNatalie) for both initial and refresher training.

- Critical elements essential for translation of the educational principals contained in HBB into a positive outcome (reduction in ENM and FSB rates) are reflected in the Tanzanian implementation model (►Table 1). Some of these are listed below:
 - There has to be a primary person at the ministerial level, preferably a pediatrician, as is in the Tanzanian experience (GM), who takes ownership of the program as a primary stakeholder.
 - There has to be local site ownership, which at the eight study sites was a midwife. The success of a site depends on the extent of involvement and initiative of the midwife/leader. Specifically, at one of the sites, one midwife (PR) was particularly progressive in establishing HBB in the labor and delivery suite. She introduced the concept of high-frequency, low-dose teaching to the midwife providers, among other important interventions (see ►Figs. 5 and 6). Thus as noted previously, a “NeoNatalie” simulator was placed in the labor and delivery suite. Each midwife had to practice on the simulator prior to starting a shift, as well as document the practice in a record book. She also introduced additional interventions for the midwife providers, which instilled a sense of self-efficacy (see ►Fig. 5). As can be seen in ►Fig. 6, this hospital has had a significant and persistent reduction (for at least 3 years following HBB implementation) in both ENM and FSB rates.
 - The concept of high-frequency, low-dose teaching was extended to a second research site. At this site, care providers were initially assessed on simulated newborn resuscitation pre and post a 1-day HBB course. The pass rate increased from 18 to 74% ($p \leq 0.0001$).²³ However, when observed in practice in the delivery room, basic neonatal resuscitation management, i.e., suctioning,

Helping Babies Breathe
ONE FORM FOR EACH NEWBORN

MOTHERS HOSPITAL ID	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Source of Admission	☐ 1 REFERRAL ☐ 2 INPATIENT
Date of birth	<input type="text"/> <input type="text"/> DAY <input type="text"/> <input type="text"/> MONTH <input type="text"/> <input type="text"/> YEAR
Time of birth	<input type="text"/> <input type="text"/> HOURS <input type="text"/> <input type="text"/> MINUTES
Antenatal care attendance	☐ 1 YES ☐ 2 NO
Pregnancy complication	☐ 1 YES ☐ 2 NO
Labour complication	☐ 1 YES; _____ ☐ 2 NO
Mode of Delivery	☐ 1 SVD ☐ 2 CS ☐ 3 ABD ☐ 4 VACUUM
Birth weight	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> GRAM
Gestational age	<input type="text"/> <input type="text"/> WEEKS
Sex of newborn	☐ 1 MALE ☐ 2 FEMALE
APGAR score (range 0-10)	<input type="text"/> <input type="text"/> 1 MIN <input type="text"/> <input type="text"/> 5 MIN
RESUSCITATION ATTEMPTED	
stimulation	☐ 1 YES ☐ 2 NO
suction	☐ 1 YES ☐ 2 NO
bag and mask ventilation	☐ 1 YES ☐ 2 NO
Who provided resuscitation	☐ 1 NURSE MIDWIFE ☐ 2 OBSTETRICIAN ☐ 3 CLINICAL OFFICER ☐ 4 PAEDIATRICIAN, ☐ 5 MD ☐ 6 AMO ☐ 7 OTHER; _____
Who provided resuscitation trained in HBB	☐ 1 YES..... ☐ 2 NO
If Yes, when last trained	_____
NEONATAL OUTCOME	
After 24 hours	☐ 1 NORMAL ☐ 2 SEIZURES ☐ 3 DEATH ☐ 4 STILLBIRTH (fresh) ☐ 5 STILLBIRTH (macerated)

Fig. 3 National data collection form.

stimulation, and application of BMV, coupled with neonatal outcomes during the corresponding time period, did not improve.²³ No retrainings were performed in this period. Following review of the data and in discussions with the midwife (PR), who had successfully implemented the high-frequency training (see above), it was elected to introduce a similar concept of weekly high-frequency,

low-dose training. One of the local trainers conducted a short HBB training session prior to initiation of the process. All labor staff on duty had to practice weekly with the simulator for approximately 3 minutes, and were encouraged to practice frequently whenever time permitted. The practical sessions focused on the immediate basic stabilization care (drying, stimulation, suction, warmth, and

Table 3 Early neonatal mortality in infants 1,000–1,999 g categories: Preimplementation/Postimplementation

Birth weight	Preimplementation	Postimplementation	Relative risk 95% CI	p-value
1,000–1,999 g	36/209 (172/1,000)	148/2,129 (69.5/1,000)	0.40 (0.28–0.56)	<0.0001

Adapted from Msemo et al.¹⁸

Fig. 4 Schema depicting the potential outcomes and the interventions in a nonbreathing infant at birth. Infants in primary apnea will in general respond to drying and stimulation only. If intervention is delayed, there will be progression to secondary apnea, and with no intervention there will be progression to an “apparent fresh stillbirth.” Infants in secondary apnea will, in most cases, respond to drying, stimulation, and application of face mask ventilation with the onset of spontaneous breathing. A small minority will respond more slowly and initiate spontaneous respirations but will progress to a state of hypoxic–ischemic encephalopathy. Another group will show initial signs of life but progress to early death. (Reprinted with permission from the AAP License # 3737721082087.)

cord clamping) and resuscitative intervention (BMV), following the HBB action plan. The local trainers continuously assisted those in need during the routine trainings and practice, and tried to link the scenarios with real-time recent resuscitations of asphyxiated (depressed) babies. When outcome data were reviewed after 1 year, a change in clinical management of newborn infants was accompanied by a substantial reduction (40%) in neonatal mortality.²⁴ Consistent with the HBB national data, more infants were immediately stimulated and suctioned with fewer receiving BMV. (See ▶ **Table 4**)

- Periodic review of the data at a centralized meeting under the direction of the Ministry of Health, involving all the stakeholders, including the designated midwives at each study site, was essential and instilled a sense of accountability. These were held biannually, with a review of the prior 6 months of activities, lessons learned, discussion of deficiencies identified in the system processes (e.g., equipment issues), and articulation of goals for the next 6 months. These biannual meetings continue to be ongoing. Progress of the national rollout of the HBB program managed by Jhpiego (see below) has been presented at these meetings since 2013.

National Rollout of the HBB Program

Based on the successful pilot study, the Children’s Investment Fund Foundation from the United Kingdom agreed to fund a rollout implementation of the HBB program which started September 1, 2012, and is due to be completed by August 31, 2015. The program is being managed by Jhpiego. The objectives

are to (1) build capacity of regional and district health officials to improve newborn care; (2) increase the capacity of health care workers to manage BA (as of March 2015, ~15,000 providers have been trained in HBB); and (3) improve facility readiness in terms of supplies and equipment to manage BA. The basics include introduction of program support at national, regional, and district levels to include the training of district trainers (~3 regions) and service providers (14 regions) and follow-up visits (4 to 6 wk) posttraining to all facilities with trained participants. Planned monitoring and evaluation includes (1) establishment and maintenance of training, mentoring, and equipment databases; (2) collection of quarterly monitoring data (service statistics); (3) annual observational assessment/audit of skills of a sample of providers; and (4) baseline and end line surveys as part of program evaluation.

Conclusion and Way Forward

Introduction of the HBB program in eight study sites in Tanzania was associated with a significant reduction in early ENM and FSB. This reduction is attributed to early basic interventions, including drying and stimulation of the newly born (key principals of the HBB curriculum), and was effective for both the term and preterm infant. Maintaining competencies in the basic skills, including application of BMV to deliver effective ventilation, is enhanced by high-frequency, low-dose simulation-based training. Instilling a sense of ownership and self-efficacy at all levels is critical to success. However to further reduce both ENM and later deaths in the first week, focus has to include enhanced monitoring of

Fig. 5 Schema of potential strategies to enhance delivery room leader and provider competency and self-efficacy.

Fig. 6 Impact of Helping Babies Breathe (HBB) training on early neonatal mortality within 24 hours (filled circles) and rates of fresh stillbirths (filled triangles) preimplementation (6 mo) and at 6 months, 2 years, and 3 years post-HBB implementation at one site that introduced high-frequency, low-dose training. Note the immediate and persistent reduction in the rates of early neonatal mortality and fresh stillbirth. * $p < 0.0001$, ** $p = 0.001$.

Table 4 Neonatal descriptors, management, and outcomes among infants who received stabilization/resuscitation preimplementation versus postimplementation of low dose high frequency simulation training

	Preimplementation cohort 1 (n = 717)	Postimplementation cohort 2 (n = 787)	p-value
Resuscitation intervention			
Stimulation	712 (99.3)	785 (99.7)	0.207
Suction	634 (88.4)	762 (96.8)	≤0.0005
BMV	357 (49.8)	283 (35.9)	≤0.0005
Outcome			
Normal at 24 h	648 (90.4)	744 (94.5)	0.003
Admitted at 24 h	7 (1.0)	10 (1.3)	0.659
Dead at 24 h	47 (6.6)	26 (3.3)	0.003

Adapted from Mduma et al.²⁴

events during labor (fetal heart rate) as well as reducing the burden of premature mortality (infants of 28 to 35 wk estimated gestational age), through the administration of a package of interventions,²⁵ including administration of antenatal steroids to mothers in premature labor, avoidance of moderate hypothermia at birth (temperature < 36°C), pre-emptive antibiotics, and encouragement of kangaroo mother care where feasible.

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Conflict of Interest

Jeffrey Perlman has received a research travel award from the Laerdal Foundation for Acute Medicine for work in Tanzania but does not have any financial or personal relationships with other people or organizations. Hege Ersdal has received funding from the Laerdal Foundation for Acute Medicine to study resuscitation intervention in Haydom but does not have any financial or personal relationships with other people or organizations. Georgina Msemo and Prisca Ringia do not have any conflict of interest.

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