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CLINICAL ARTICLE

Community-based newborn resuscitation among frontline providers in a low-resource country

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ABSTRACT

Objective: To evaluate a birth asphyxia management program among community midwives in a low-resource rural setting. *Methods:* Concise training with provision of positive-pressure ventilation devices was implemented in Indonesia in 2005. The effectiveness of the intervention among community-based midwives between October 2007 and September 2008 was evaluated. The intervention cohort was compared with a neighboring control cohort. *Results:* Overall, 242 intervention and 106 control midwives were surveyed. In total, 3116 births were attended, 84.0% of deliveries occurred at home, and 97.4% of midwives had not previously owned a resuscitation device. When positive-pressure ventilation was administered, newborn survival on day 1 was equivalent in the 2 cohorts (88.4% versus 84.4%; $P=0.66$). However, significantly more newborns in the intervention group underwent ventilation (risk ratio 2.3; 95% confidence interval, 1.4–8.0). The intervention group had significantly greater scores on both knowledge ($t[144.35]=10.52$; $P<0.001$) and confidence ($t[134.17]=11.66$; $P<0.001$). *Conclusion:* Focused community-based resuscitation training and device delivery resulted in a significantly increased proportion of newborns receiving life-saving positive-pressure breaths, in addition to improved provider knowledge and confidence. Furthermore, the program demonstrated the establishment of an effective training infrastructure within a disrupted health system.

1. Introduction

Although neonatal mortality accounts for more than one-third of childhood deaths before the age of 5 years, it is often unaddressed in public health programming in low-resource countries [1–3]. Every year, there are more than 3 million newborn deaths and 3 million stillbirths worldwide [4,5]. Achieving Millennium Development Goal 4—reducing the mortality rate of children under 5 by two-thirds between 1990 and 2015—will not be possible without the scaling of programs effective in averting neonatal death [6].

Overall, 75% of neonatal deaths occur in the first week of life, with 25%–45% on the first day [2]. Birth asphyxia, or failure of the newborn to initiate regular breathing, is estimated to contribute to 23% of the total burden of neonatal mortality; 98% of asphyxia-related deaths occur in low-income countries. Appropriate resuscitation is effective in preventing the deaths of 65%–80% of asphyxiated neonates [7–10]. Nevertheless, programs have had limited success in implementing the necessary tools among the most vulnerable: the 60 million births occurring each year outside of health facilities [11].

Although an overarching goal worldwide is to increase facility-based deliveries, progress is slow—with many births occurring in the community [11,12]. Consequently, without adequate training of community-based providers, many asphyxiated newborns will die prior to reaching facilities. Growing literature supports the need for community-level newborn resuscitation training in low-resource countries [13,14]. However, few programs have assessed the effect of such training interventions outside of referral centers. Specifically, training methodology and scalability for community birth attendants in resource-limited settings have been lacking in the literature [14,15].

Since 1989, Indonesia has emphasized the role of midwives in improving safe deliveries. As a result of the *Bidan di Desa* ("Midwife in a Village") program, home births assisted by midwives rose from 24% to 59% between 1986 and 2002 [16,17]. In Aceh, however, the civil conflict and the December 2004 Asian tsunami left the primary healthcare system of the region significantly disrupted. A peace agreement after the tsunami provided stability to implement longitudinal health programming. In 2005, the International Organization, for Migration with assistance from Harvard Medical School and the

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Massachusetts General Hospital, was charged with assisting in reconstructing primary healthcare systems in the predominantly rural districts of Aceh Barat and Nagan Raya.

The hypotheses for the present study were that: an intervention cohort receiving both birth asphyxia management training and a positive-pressure ventilation device would exhibit a significantly greater proportion of newborns receiving ventilation; if the positive-pressure ventilation was administered, newborn survival on day 1 would be equivalent for the intervention and the control cohorts; and midwives in the intervention cohort would score greater on both knowledge and confidence scores with regard to managing asphyxia.

2. Materials and methods

The training program was implemented in October 2005. From October 16, 2008, to January 23, 2009, a retrospective cohort study was conducted among community birth attendants in Aceh Barat and Nagan Raya (intervention districts) and in Aceh Selatan (control district). The survey encompassed the preceding 12-month period from Ramadan to Ramadan—a period selected to improve time-bound recall.

The study was approved by the Institutional Review Board (IRB) of Partners Healthcare, Boston, MA, USA. No IRB existed in the study regions and, therefore, in-country approval for the study was gained through signed letters of permission from each district health office. All participants provided written informed consent.

The primary outcome was the proportion of neonates per provider who received at least 1 breath at delivery. Secondary outcomes included early newborn survival rate if given a breath, and provider knowledge and confidence in managing birth asphyxia.

The training intervention was designed and implemented in Aceh Barat and Nagan Raya from October 2005 through June 2009. After June 2009, the respective district health offices assumed administration and management of the training. In order to diminish barriers to participation and foster program sustainability, the training was designed to be concise, on-site, and include provision of a reusable ventilation device.

Training included preparation for delivery, assessment and initial stabilization of all newborns, and ventilation when indicated. The curriculum consisted of an interactive lecture, pre- and post-training knowledge assessments, and hands-on practice using neonatal mannequins. An adapted and simplified Neonatal Resuscitation Program curriculum, up to and including positive-pressure ventilation, was used as the training framework and for the majority of pre- and post-training questions. Consistency was ensured with other programs taught in Indonesia. All materials were provided in the national language (Bahasa Indonesia).

The curriculum included training in the use of both tube-and-mask (Tekno Tube; Tekno, Bandung, Indonesia) and bag-valve-mask (Reusable Manual Resuscitator; Ningbo David Medical Device Company, Ningbo, China) resuscitation devices. Participants practiced administering appropriately pressured breaths to mannequins and into simple water-column manometers of 15 cm and 40 cm of water pressure. The tube-and-mask device was distributed to participants upon completion of the training course. Through a participatory process, this ventilation device was chosen because it was manufactured in Indonesia, it had been approved by the Indonesian Ministry of Health, it had been used effectively in a pilot program, and the midwives perceived the price to be sufficiently low to replace independently [18].

The training took approximately 3 hours and was conducted primarily at sub-district health clinics. To achieve a target frequency of training each midwife twice per year, 3 annual training sessions were planned. The training was most often provided in conjunction with a similarly designed session on the management of postpartum hemorrhage. Participants received a small, standard participatory stipend and light refreshments. The target participants were community midwives employed by or contracted with the Ministry of Health. In addition, hospital-based nurses, midwives, and physicians were invited to participate, if present, on training days. From its inception to the time of the evaluation, the program had trained 573 individual midwives.

To improve on the curriculum content and the clarity of the initial trainings, midwife feedback was solicited. The network structure proposed by the midwives was to have an experienced and respected midwife from each sub-district as a head trainer. Hence, participants were observed and a select number were chosen as head trainers. Initially, non-Indonesian pediatricians administered the training, with concurrent translation by a bilingual Indonesian midwife, nurse, or physician. An Indonesian pediatrician and 3 midwife master trainers experienced in resuscitation training were subsequently employed to scale the program. The master trainers trained the head trainers. In addition, midwives selected—by consensus—from each sub-district a more junior midwife with a recognized aptitude for teaching, and similarly trained her as an associate trainer to ensure that experienced trainers were available when head trainers retired. Each training pair was responsible for providing trainings to an average of 12 midwives in their sub-district 2–3 times per year.

Surveys were conducted within the 2 intervention cohort areas, where the training program had been received, and within the control cohort, which had not received the training. The intervention districts were assigned by the Aceh State Government after the tsunami, based on local needs and minimal overlap with other support organizations. The control district was selected for its similarities to the intervention districts with respect to demographics, geography, tsunami impact, and lack of similar resuscitation training during the intervention period. Midwives in the intervention districts were selected through their sub-district reporting clinics, and survey dates were coordinated with the aid of the midwife supervisor. Data were collected via written, interview-administered survey, with clarification and verbal reading of questions by a trained survey administrator. The survey consisted of 44 items, including a 3-question multiple-choice test assessing core resuscitation knowledge. The recall period for the evaluation was from the end of Ramadan 2007 (October 12, 2007) to the end of Ramadan 2008 (September 30, 2008). Local staff entered the data, which were subsequently verified via double-entry.

A minimum required sample size of 236 midwives was calculated, assuming a Cohen d value of 0.5 and a power of 95%. Data were analyzed via SPSS version 19 (IBM, Armonk, NY, USA). The statistical tests used included the Pearson χ^2 test, the Student t test if the equal variance assumption was met, the Welch t test if the equal variance assumption was violated, and risk ratios. Statistical significance was set at $P<0.05$.

3. Results

In total, 350 birth attendants were recruited, 2 of whom were nurses and, therefore, excluded from the analyses. Of the remaining 348 midwife participants, 242 (69.5%) were in the intervention districts and 106 (30.5%) were in the control district. The evaluation captured 61.9% of 391 midwives working in the intervention districts and 62.4% of 170 midwives in the control district. Total deliveries by study participants accounted for more than one-third of the deliveries reported to the Ministry of Health during the study period. Table 1 summarizes the demographic and delivery characteristics of the intervention and control groups.

More than half of the participants were 31–35 years of age, and more than 80% had been out of school for over 5 years. More than 96% of the participants reported not owning a resuscitation device prior to the tsunami. The surveyed midwives most often delivered in the home (n = 242 midwives [84.0%]) and were typically assisted by either another midwife (n = 132 [37.9%]), a traditional birth attendant (n = 167 [48.0%]), and/or a patient family member (n = 129 [37.1%]).