Simulation and education

Educational impact of a hospital-based neonatal resuscitation program in Ghana

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Aim of the study: To assess midwives’ baseline cognitive knowledge of evidence-based neonatal resuscitation practices, and short- and long-term educational effects of teaching a neonatal resuscitation program in a hospital setting in West Africa.

Methods: All midwives (n = 14) on the labor ward at Ridge Hospital in Ghana were trained using materials modified from the American Academy of Pediatrics (AAP) Neonatal Resuscitation Program (NRP). This training program included didactic and practical teaching and was assessed by direct observation within delivery rooms and written pre- and post-test evaluations. Written and practical modules 9–12 months after the initial training session were also conducted to assess retention of NRP knowledge and skills.

Results: Fourteen midwives received NRP training on the labor ward. Both written and practical evaluation of neonatal resuscitation skills increased after training. The percentage of items answered correctly on the written examination increased from 56% pre-training to 71% post-training (p < 0.01). The percentage of items performed correctly on the practical evaluation of skills increased from 58% pre-training to 81% (p < 0.01). These results were sustained 9–12 months after the initial training session.

Conclusion: After receiving NRP training, neonatal resuscitation knowledge and skills increased among midwives in a hospital in West Africa and were sustained over a 9-month period. This finding demonstrates the sustained effectiveness of a modified neonatal resuscitation training program in a resource-constrained setting.

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1. Introduction

Worldwide, approximately 4 million infants die in the neonatal period.1 Of these neonatal deaths, 75% occur in the first week with the highest risk of death occurring on the first day of life. Low and middle income countries account for 99% of the global burden of this problem.2–4 In these settings, birth asphyxia defined by the World Health Organization (WHO) as “failure to initiate and sustain breathing at birth”, accounts for 25% of these neonatal deaths.4 The incidence of birth asphyxia is greater in low and middle income settings because of insufficient antenatal care, higher rates of intrauterine growth retardation, preterm delivery as well as inadequate training of neonatal resuscitation.2–4

Neonatal mortality rates in Ghana, a low-resource setting in West Africa, continue to pose a troublesome challenge and each year, an estimated 29,000 infants die in the first month of life.5,6 This neonatal mortality rate of 30 deaths per 1000 live births in 2008 was more than 10-fold higher than in some high-income countries and 23% are estimated to occur from birth asphyxia.2,6–8 Only 59% of deliveries in Ghana have a skilled attendant (doctor, nurse, midwife or community health officer) present and most hospital-based deliveries are attended by nurse midwives, many of whom have minimal newborn resuscitation training.6 Establishing adequate resuscitative skills of local health providers who attend deliveries may offer a sustainable opportunity for improvement in hospital-based neonatal outcomes in Ghana.

The Neonatal Resuscitation Program (NRP) is an educational program of the American Academy of Pediatrics and the American Heart Association for training healthcare providers in both the knowledge and practical skills of neonatal resuscitation.9 In low and middle income countries, implementation of neonatal resuscitation programs reduced all causes of neonatal mortality.10 and basic resuscitation techniques (drying the infant, clearing
the airway, providing positive pressure ventilation with a self-inflating bag, and administering chest compressions)\(^5\,\text{,}11\,\text{,}12\) were used successfully to resuscitate compromised neonates. In addition to these broad effects, several studies have shown reductions in asphyxia-related perinatal mortality and hospital admissions after implementation of basic resuscitation skills.\(^4\,\text{,}6\,\text{,}13\text{–}16\)

While previous studies established the effectiveness of initial NRP training for midwives in low and middle income countries,\(^6\,\text{,}14\,\text{,}15\,\text{,}17\,\text{,}18\) there has been little assessment of the educational retention of NRP knowledge in such settings. The objectives of this study were to determine whether a modified NRP training program improved the knowledge and practical skills of nurse midwives, and to determine whether these improvements were maintained 9–12 months after the initial training sessions.

### 2. Methods

#### 2.1. Setting

The training sessions and evaluations were performed at Ridge Regional Hospital, one of the main referral institutions in the Greater Accra Region of Ghana from January 2007 to January 2009. Nearly 80% of deliveries are high risk referrals from other institutions and the catchment area extends beyond Greater Accra to the contiguous regions. Demographic data for Ridge Hospital are presented in Table 1. The labor ward has ten beds staffed by 3–4 midwives per shift, and an operating theater for cesarean sections is located remotely from the labor ward.

#### 2.2. Instructors and participants

Certified NRP instructors (2 neonatologists, 1 neonatal fellow and 1 nurse practitioner) from the University of North Carolina evaluated and trained 14 midwives on the labor ward at Ridge Hospital in Accra, Ghana using materials modified from the AHA/AAP Neonatal Resuscitation Program. These instructors are all members of Kybele Inc., a 501 (c)(3) non-profit humanitarian organization dedicated to improving childbirth conditions worldwide through medical education partnerships. Midwives in Ghana are defined as those who have completed 3 years of nursing school and an additional 2 years of midwifery school. Participants were trained and assessed, then assessed a second time, 9–12 months later.

#### 2.3. Neonatal resuscitation training module

Training consisted of a single 3-h didactic session based on the first four chapters of the AAP Neonatal Resuscitation Textbook 2006 (Overview and Principles of Resuscitation, Initial Steps of Resuscitation, Use of Resuscitation devices for Positive-Pressure Ventilation and Chest Compression).\(^9\) In addition, the instructors provided extensive hands-on teaching of basic resuscitation techniques: drying the infant, clearing the airway, providing positive pressure ventilation with a self-inflating bag, and administering chest compressions.

### Table 1


<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesarean sections</td>
<td>2971</td>
<td>4793</td>
<td>6049</td>
<td>7465</td>
<td>8230</td>
</tr>
<tr>
<td>Number of deliveries</td>
<td>868</td>
<td>1555</td>
<td>2161</td>
<td>2454</td>
<td>2826</td>
</tr>
</tbody>
</table>

![Fig. 1. Average scores (±SD) of written and practical evaluation of midwives. Results of pre-training, post-training and 9- to 12-month follow-up.](image)

2.4. Evaluation of training on cognitive knowledge and practical skills

To assess knowledge and skill acquisition of the material, each midwife completed a written and practical evaluation prior to, and the day after the training session. The written assessment was a 21 question multiple choice test and the practical assessment a 27 point scored performance-based evaluation of practical skills based on the AAP/AHA NRP megacode.\(^9\) Using the same written and practical evaluations, the core NRP instructors assessed retention of NRP skills 9–12 months following the initial training period. The testing of the midwives was equally distributed at 9 months or 12 months following the initial training period. The NRP instructors were blinded to the original scores of the midwives.

#### 2.5. Statistical analysis

Repeated measures ANOVA with the Bonferroni correction was performed for comparison between the three time periods to determine mean scores, standard deviation and significance. A p-value < 0.05 was considered statistically significant.

The institutional review board at the University of North Carolina at Chapel Hill and Ridge Hospital in Accra, Ghana reviewed and approved this project.

### 3. Results

All 14 midwives from the labor ward received NRP training. The midwives had been in nursing practice for 25 years (range 10–36 years; median 25 years) and in midwifery practice for 8 years (range 0–34 years; median 7 years). The majority (n = 11) had received some previous neonatal resuscitation training, but no formal NRP course.

After receiving neonatal resuscitation training, there was a significant increase in the test scores for both written and practical evaluation of neonatal resuscitation skills. Scores are presented as mean score ± standard deviation. The percentage of items answered correctly on the written examination increased significantly (p < 0.001; see Fig. 1). The increase in written evaluation scores was a mean percent change of 27%. The percentage of items performed correctly on the practical evaluation of skills increased significantly as well (p < 0.01; see Fig. 1). The increase in practical evaluation scores was a mean percent change of 45%.

Testing of the midwives 9–12 months after completion of the initial training was completed showed that neonatal resuscitation knowledge and skills were retained over that period. The percent-
age of questions answered correctly on the follow-up written and practical examinations showed no significant difference in scores from post-training evaluations 1 day after training ($p = 0.68$ and $p = 0.18$, respectively; see Fig. 1).

4. Discussion

In this study, we found that administration of a modified neonatal resuscitation training module resulted in a substantial increase in neonatal resuscitation knowledge and performance among midwives at Ridge Hospital; most importantly, these increases were sustained for at least 9–12 months.

Most studies regarding NRP training and its effectiveness on increasing knowledge have been performed in high income countries, and the majority have assessed physicians. Few studies have been conducted in low and middle income countries or involve nurses and midwives. A recent publication from Zambia assessed effectiveness of NRP training for midwives and nurses from primary health facilities and reported an increase in cognitive knowledge after an NRP program was taught. Our study provides further supportive evidence that a modified NRP training module is effective in a West African hospital setting, and, in addition demonstrates the lasting effectiveness of this intervention.

The increase in neonatal resuscitation knowledge acquired by midwives at Ridge Hospital was sustained over a 9- to 12-month period. Although other studies have shown that NRP training results in an improvement in test scores after a training session, this knowledge was not sustained beyond 6 months. Many of the studies finding a lack of sustained improvements involved residents who take the NRP training course, and may then be rotated through many other fields where they are not involved in neonatal resuscitation. Skidmore and Urquhart in Canada reported that cognitive knowledge of neonatal resuscitation was maintained for 1 year, although practical abilities declined after 6 months. We speculate that the sustained retention of skill and knowledge in the present study occurred because participating midwives worked in a high risk referral hospital and used these new skills daily.

A potential limitation of this neonatal resuscitation program is that it only involved a small group of midwives. However, this small number of midwives in 2008 performed more than seven thousand deliveries each year, underscoring the potential impact that such an NRP program might have. Another potential limitation is having the same NRP examiners reassess midwives after the training and 9–12 months later. However, we reduced this potential bias by blinding the examiners to the original scores of the midwives.

5. Conclusion

In conclusion, this study reports an improvement in neonatal resuscitation knowledge and practice after introducing a modified NRP training course to midwives in a low income country. This study adds to our understanding of NRP training in this setting and, most importantly, demonstrates that these skills and knowledge can be maintained well beyond the initial training. Further research is needed to determine how long such knowledge is maintained in order to determine appropriate timing of refresher training. In addition, more research is needed on how to disseminate such a program across a resource constrained country. While previous studies indicate a good correlation between neonatal outcomes and NRP skills and knowledge in well-resourced facility-settings, cause and effect has not yet been demonstrated in low-resource settings such as described for this program. An adequately powered, randomized control trial is required to study what impact this form of training has on neonatal mortality in a resource constrained context.

Conflict of interest statement

There are no conflicts of interest to disclose.

Acknowledgement

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References