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Skills retention in Sudanese village midwives 1 year following Helping Babies Breathe training

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ABSTRACT

Background Over 80% of deliveries in Sudan occur in isolated villages, attended by village midwives (VMWs). Upgrading newborn resuscitation skills with the Helping Babies Breathe (HBB) programme could improve newborn survival rates.

Objective To describe the competencies in newborn resuscitation of selected VMWs pre-HBB and post-HBB training.

Methods In a prospective intervention study, the VMWs’ performances in the HBB Objective Structured Clinical Examination B simulated scenario (manikin requiring face-mask ventilation (FMV)) were digitally recorded and analysed prior to and 3 and 12 months following HBB training. Regular manikin-based practice was encouraged following training.

Results Pre-HBB training, 42% of 71 VMWs (of whom 61% were functionally illiterate) stimulated the non-breathing manikin by holding it by the legs and either stimulated/slapped (30.4%) or shook (12.7%) it, while 25% (18/71) provided manikin mouth-to-mouth ventilation. The low scorings on the ‘preparation for birth’ (0% and 3.1% at 3 and 12 months, respectively) were mainly due to failure to demonstrate the subitems of ‘cleans hands’ and ‘cows hands’. The percentage of VMWs providing manikin FMV within the Golden Minute increased from 37.3% (25/67) to 72.3% (47/65) (p<0.005), but there were no significant differences in the number of VMWs producing at least five FMVs at 3 months (73%, 49/67) and 12 months (58%, 38/65), respectively.

Conclusions VMWs, despite a high illiteracy rate, absorbed and sustained HBB skills for at least a year. Regular, low intensity, manikin-based practice with peers may have helped sustain FMV, but not hand-cleansing skills.

INTRODUCTION

In Sudan, the formal training of village midwives (VMWs) began in 1921. There are now 40 midwifery schools, with at least 2 in each of the 16 states, and about 17 000 VMWs who deliver more than 80% of babies born outside of medical facilities in Sudan. A Ministry of Health analysis highlighted the link between increasing numbers of VMWs since the year 2000 and a decrease in maternal mortality. However, neonatal mortality (50.2% of which was due to asphyxia) remained unchanged at 41 per 1000 live births during this time period.

The Helping Babies Breathe (HBB) initiative is a global, evidence-based neonatal resuscitation and stabilisation programme developed by the American Academy of Pediatrics (AAP) and partners with the aim of producing sustainable improvements in newborn care. It was intended for application in resource-limited countries such as Sudan, where the majority of births occur in rural areas and where the health providers are often isolated, ill equipped and lack the basic skills that lead to a failure in initiating newborn resuscitative steps in a timely manner.

HBB is directed at a range of skilled healthcare providers, using a learner-centred educational methodology with emphasis on mastery of key skills including face-mask ventilation (FMV). The programme relies on the concept of the ‘Golden Minute’ meaning that in the immediate first minute after birth, a baby should initiate and sustain breathing or else be effectively ventilated by FMV. Training in and targeted implementation of the HBB Programme in Tanzania was associated with a significant reduction in early neonatal deaths, fresh stillbirths and early perinatal mortality rates.

While HBB is currently being introduced in Sudan nationwide, there is no information on
how VMWs adopt and sustain HBB skills. The purpose of this paper is to present findings as related to newborn resuscitation (NBR) practices before HBB training and uptake and retention of skills 3 and 12 months after HBB training in a selected group of Sudanese VMWs in a simulated setting.

**METHODS**

This was a prospective intervention study of VMWs’ competencies in NBR skills using manikins in a simulated environment prior to and 3 and 12 months following HBB training.

**Study area and study population**

The sampled area was the East Nile Locality, Khartoum State. The study population was the 294 VMWs who served a population of approximately one million people residing in 307 widely scattered villages covering an area of 300 km². Approximately 30 000 home deliveries occurred in this locality each year, and although the number of deliveries per midwife varied, the annual average was approximately 100 deliveries per midwife. Each VMW reported to one of the 18 medical centres in the locality for supervisory purposes on a bi-weekly basis. Two medical centres, previously involved with research projects with the Department of Paediatrics and Child Health, University of Khartoum, were selected as HBB training sites. All VMWs attending these medical centres were invited to participate in this study, and none of them had previously undertaken the HBB programme.

**Method**

A master HBB trainer and three regional HBB trainers were responsible for training the VMWs. A standard HBB training kit, which included the NeoNatalie manikin simulator, bag and mask, suction bulb syringe, umbilical cord ties, scissors and towels, was used. All of the HBB teaching aids were pictorial in nature and did not require reading skills. Other research tools included a questionnaire on personal and educational data of the VMWs, completed by interviewing each one individually. ‘Functional illiteracy’ was defined as having the basic reading and writing skills that were just adequate to manage daily living and employment tasks.

Following informed consent, the HBB manikin and equipment were presented to the VMWs. They were asked to demonstrate how they would normally resuscitate a newborn infant, and these scenarios were digitally recorded with a hand-held Apple iPad. They were then trained in the HBB programme, in groups of 15–20, with a ratio of 6 trainees per instructor, over 2 days. Objective Structured Clinical Examination (OSCE) A (infant manikin breathes spontaneously at birth) and OSCE B (non-breathing infant manikin requires assisted ventilation by FMV) were administered as formative evaluations of performance during the HBB training. After 3 and 12 months, the OSCE B skills of the VMWs were digitally recorded. Regular manikin booster practice with peers using the NeoNatalie kit was encouraged but not mandated during the VMWs’ bi-weekly visits to their designated medical centres. To maintain anonymity, none of the participants’ faces were recorded during the scenarios. A unique identifier number tag was placed around the subject’s neck, which was recorded during each assessment simulation, providing identification of the participant over time.

**Video analysis**

Digital recordings were analysed using a modified HBB OSCE B checklist. OSCE items were measured as dichotomous variables being marked as ‘Done’ or ‘Not Done’. Items not clearly visualised by the raters were marked as ‘Not Done’. Videos were evaluated by a trained rater (FME) who was blinded to the timing of the videos (pre-HBB or post-HBB). Following a training period by a PhD graduate (GH) who was skilled in analysing NBR videos, 10 random videos were analysed by the rater and PhD graduate to establish inter-rater reliability.

**Statistics**

Paired results were compared using the Cohen $\kappa$ value to measure inter-rater reliability. A McNemar’s test was used to identify changes at 3 and 12 months post HBB training. A two sided p value of <0.05 was considered statistically significant.

Ethical oversight for this study was provided by the Research Ethics Committee of the Faculty of Medicine, University of Khartoum; the Federal Ministry of Health, Khartoum and the Cork University Hospitals Research Ethics Committee, Cork, Ireland.

**RESULTS**

A total of 82 VMWs were recruited; 71 (86.5%) of whom were video-recorded prior to HBB training, 67 (82%) were followed up at 3 months and 65 (75%) at 12 months. Their mean age was 46.3 (SD 10.0) years. On average, they had 21.3 (SD 12.3) years of midwifery experience, almost two-thirds (61%) were functionally illiterate and only 1 in 10 had attended a course in neonatal care since graduation.

Cohen’s $\kappa$ demonstrated good inter-rater agreement (1.00–0.615) in the pre-HBB assessments with the exception of the item ‘Blows at a distance >3 cm from mannequin’s mouth’, where agreement was 70% with a Cohen’s $\kappa$ of 0.286. In the post-HBB analysis (table 1), difficulty in discriminating whether the mouth was suctioned before the nose and whether the head was properly positioned, due to video-recording angles, may have resulted in a lower $\kappa$ on item 3.

**Assessments pre-HBB training**

When asked to demonstrate how they would normally resuscitate a non-breathing baby at birth prior to HBB training, 42% (30/71) of VMWs held the manikin upside down and either stimulate/slapped (30.4%, 22/71) or shook (12.7%, 9/71) it. Direct mouth-to-mouth ventilation was demonstrated by 25%

| Table 1 Inter-rater reliability of Objective Standard Clinical Examination (OSCE) B items as assessed by Cohen’s $\kappa$, using 10 randomly selected recordings and 2 independent raters |
|---------------------------------|-----------------|-----------------|-----------------|
| **Rater A** | **Rater B** | **Proportion in agreement** | **$\kappa$** |
| 1. Prepares for a birth | 1 | 1 | 1.00 | 1.00 |
| 2. Dries thoroughly and removes wet cloth | 7 | 7 | 1.00 | 1.00 |
| 3. Keeps warm, positions head, clears airway | 4 | 2 | 0.60 | 0.091 |
| 4. Stimulates breathing by rubbing the back | 7 | 7 | 1.00 | 1.00 |
| 5. Cuts cord and moves to area for ventilation OR ventilates alongside mother | 8 | 7 | 0.90 | 0.737 |
| 6. Starts ventilation within the Golden Minute | 9 | 8 | 0.90 | 0.615 |
| 7. Ventilates at 40 bpm (30–50 bpm acceptable) | 3 | 4 | 0.90 | 0.783 |
(18/71) of VMWs, while 12.7% (9/71) blew on the manikin’s face from a distance of >3 cm.

**Assessments 3 and 12 months post HBB training**

The VMWs’ performances on the specific items of OSCE B checklist at 3 and 12 months are presented in Table 2. The low scorings on the ‘preparation for birth’ section was mainly due to failure to demonstrate the subitem of ‘cleans hands’. Although there was a significant improvement in drying the baby, the percentage of VMWs keeping the baby warm, positioning the head and clearing the airway was low overall but increased from 6% to 15% at the 3-month and 12-month assessments, respectively (p<0.001). Stimulation of the non-breathing manikin almost doubled from 37.3% to 71% at the 12-month OSCE (p<0.001). The percentage of VMWs providing FMV to the manikin within the Golden Minute almost doubled to 72% (p<0.005) while 88% of VMWs cut the cord of the non-breathing manikin in preparation for FMV (as per HBB recommendation) at the 12-month OSCE. There were significant improvements in the number of VMWs who applied the face-mask (FMV) correctly (p<0.001) and who established a correct FM hold (p<0.001) at the 3-month and 12-month assessments. However, there were no significant differences in the number of VMWs producing at least 5 manikin chest movements with FMV at 3 months (73%, 49/67) and 12 months (58%, 38/65) or at least 10 manikin chest movements at 3 months (82%, 38/67) and 12 months (48%, 31/65).

**DISCUSSION**

In the study we identified unsafe resuscitation practices that were the main approach of the VMWs to NBR prior to HBB training. These included suspension of the manikin by the legs, stimulating/slapping and mouth-to-mouth resuscitation. These unsafe resuscitation practices are met and continued.

Nearly two-thirds of the VMWs in this study were functionally illiterate. Yet, despite these educational disadvantages, they proved ready to appreciate, comprehend and retain their HBB training. Although none of the VMWs achieved full OSCE scores at the 3-month and 12-month assessments, they demonstrated significant improvements in almost all individual OSCE items, with over three-quarters of VMWs starting FMV of the manikin within the Golden Minute and providing at least five effective FMVs at the 12 months post HBB simulation assessment.

These are core HBB competencies since early initiation of basic resuscitation, including FMV, was associated with a reduction in birth asphyxia related mortality. In addition, the risk of neonatal death or prolonged admission increased by 16% for every 30 s delay in initiating FMV.

Performances of the ‘preparation for birth’ were suboptimal during both assessments post HBB training, due to failure to demonstrate the OSCE subitem of ‘cleans hands’ in almost all instances. In their midwifery practice, alcohol formulations, clean running water and sterile gloves are not routinely available to the VMW. Hand-washing is accomplished using cooled boiled water and soap, which were not provided at the scenarios, and therefore did not reflect the context of practice of the VMWs. Future simulations should incorporate the appropriate local hygiene kits into the scenarios with deliberate practice of hand hygiene. This may lead to improved assessment scores and ultimately to improved patient safety against nosocomial infections in clinical practice.

The fact that there was sustainment in ‘FMV within the Golden Minute’, and in FMV skills of the VMWs from 3 to 12, months, is in contrast to the findings of Musaflil and al18 where the number of participants passing and the OSCE scores decreased 3 months post HBB training. Our positive observations may be partly related to the fact that the NeoNatalie simulator kit was made available to the VMWs for practice during their bi-weekly visits to their local medical centre. However, a recent Cochrane review concluded that boosters did not influence skills retention. The authors noted that the evidence was of low quality and the only two randomised controlled trials came from developed countries. Nevertheless, booster training has been shown to be beneficial in some studies from resource poor countries. In a non-randomised controlled trial in Indonesia, there was no decline in the resuscitation knowledge and practice scores of community midwives 9 months after training, with 3-monthly refresher training. Group supervision and practice drills with manikins and checklists were instrumental in maintaining competency in Madagascar where at 6 months, 88% of providers remained competent in performing neonatal resuscitation. The current study, also a pre-post study design, complements these studies and may imply that regular, local, low intensity, manikin-based skills training with peers may be important in sustaining skills following HBB training.

There is still room for improvement in ventilation skills in that only half of the VMWs were able to produce at least 10 manikin chest wall movements with FMV at the 12-month assessment. Consideration should be given to alternative resuscitation devices that might improve FMV performance such as the ‘Upright’ bag mask. This innovative resuscitator was designed to

**Table 2 Number and percentages of VMWs performing OSCE B items at 3 (n=67) and 12 (n=65) months post HBB training**

<table>
<thead>
<tr>
<th>Correct OSCE B sequence</th>
<th>3 months (n=67)</th>
<th>12 months (n=65)</th>
<th>McNemar’s p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prepares for a birth</td>
<td>0 0.0</td>
<td>2 3.1</td>
<td>–</td>
</tr>
<tr>
<td>2. Dries thoroughly and removes wet cloth</td>
<td>23 34.3</td>
<td>10 15.4</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>3. Keeps warm, positions head, clears airway</td>
<td>4 6.0</td>
<td>10 15.4</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>4. Stimulates breathing by rubbing the back</td>
<td>25 37.3</td>
<td>46 70.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5. Cuts cord and moves to area for ventilation or cuts cord and ventilates alongside mother</td>
<td>12 17.9</td>
<td>57 87.7</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>6. Starts ventilation within the Golden Minute</td>
<td>25 37.3</td>
<td>47 72.3</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>7. Chooses correct mask size</td>
<td>66 98.5</td>
<td>63 96.9</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>8. Mask applied correctly</td>
<td>29 43.3</td>
<td>50 76.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>9. Ventilates at 40 bpm (30–50 bpm acceptable)</td>
<td>18 26.9</td>
<td>32 49.2</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>10. Demonstrates at least 5 chest wall movements with FMV</td>
<td>49 73.1</td>
<td>38 58.4</td>
<td>&gt;0.05*</td>
</tr>
<tr>
<td>11. Demonstrates at least 10 chest wall movements with FMV</td>
<td>55 82.0</td>
<td>31 47.7</td>
<td>&gt;0.05*</td>
</tr>
</tbody>
</table>

*Two-tailed Fisher’s exact test was used to calculate these p values. FMV, face-mask ventilation; HBB, Helping Babies Breathe; OSCE, Objective Structured Clinical Examination; VMW, village midwife.
be easier to hold and to enable a better mask seal. In a recent manikin-based randomised controlled trial, expiratory volumes were higher, mask leakage lower and mean airway pressure slightly higher with the upright versus a standard resuscitator.

This study has a number of limitations, including that it was a relatively small study, looking at a select group of VMWs skills 3 and 12 months post HBB training in simulated settings. Occasional actions were not fully visualised within the video frames on some recordings, and this may have impacted on rater reliability of certain items such as proper positioning of the head and sucking the mouth before the nose, giving rise to falsely lower scores. These and other limitations in inter-rater reliability might have been improved through additional rater training. However, the major and important items such as drying, providing warmth (covering the manikin with a cloth), and testing and using the bag mask were always discernible.

This study was a selected convenience sample of VMWs many of who were functionally illiterate but who proved capable of learning and retaining HBB skills. Nevertheless, the study was not sampled to be fully representative of Sudanese VMWs, and our findings may not be generalisable to all VMWs in Sudan. Finally, we do not know for certain if the improvements we have observed in simulated scenarios will translate into better perinatal outcomes. However, an impact study of HBB conducted among 80 000 births over 2 years in Tanzania, which reported a reduction of early newborn mortality by 47% and fresh stillbirth by 24%, is encouraging.

CONCLUSIONS

Training VMWs in HBB has great potential for improving neonatal outcomes in rural and remote areas of Sudan. Despite a high rate of illiteracy, we have shown that a selected group of VMWs can learn and retain core HBB skills for at least 12 months. The evidence that basic NBR training in low and middle resource countries can save lives is strong.

The recent Cochrane review showed for every 227 deliveries attended by VMWs from the East Nile locality for their generosity in participating in this study.

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Contributors AA, SI, SA and CAR contributed to the conception, design and grant-writing for this study; AA and SI were responsible for data acquisition. FMG and GH analysed the video-data and along with the other authors contributed to the interpretation of data. AA, SI and CAR drafted the work which was reviewed critically by the other authors, including GD.

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Competing interests None declared.

Ethics approval Ethical oversight was provided by the Research Ethics Committee of the Faculty of Medicine, University of Khartoum; the Federal Ministry of Health, Khartoum and the Cork University Hospitals Research Ethics Committee, Cork, Ireland.

Provenance and peer review Not commissioned; externally peer reviewed.

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