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Traditional Birth Attendant Education in Rural Haiti

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Abstract

The World Health Organization (WHO) recommends that a skilled birth attendant (SBA) attend every birth. However, most women in the rural community of Fondwa, Haiti, do not have access to SBAs. Throughout Haiti, approximately 85% of rural births occur at home, attended by family members or traditional birth attendants (TBAs). Some reports indicate that TBA education can reduce maternal and infant mortality/morbidity. This pilot study examines learning and retention in a TBA education program (n=17), in an effort to understand whether more advanced life-saving skills could possibly be incorporated into the work of the TBAs in the community. The TBAs were tested for knowledge and skills before the program, at the completion of the program, at six weeks, and at six months. Results for learning and retention between the four tests were analyzed using a Paired t-test. Effects of age, training method, literacy, numeracy, and sex on learning and retention were analyzed using One-way ANOVA. There was a significant (426.35%) increase (p = 0.0000) in total correct test scores between the pretest and the first post-test, followed by a significant (9.97%) decrease (p = 0.0086) between the initial post-test and the six-week post-test, then a 1.38% increase (p = 0.6864) between the six-week post-test and the six-month post-test. The influences of age, training method, literacy, numeracy, and sex on total test scores were significant for

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numeracy only (p=0.0214). Despite low levels of previous education, literacy, and numeracy, the TBAs learned and retained complex concepts and skills, and as a result could possibly increase their responsibilities as community health workers. TBA education is an under-researched area. More research, and the implementation of resultant curricula, may be an important component of safe motherhood until skilled birth attendants become available worldwide.

Key words

Traditional birth attendants, Haiti, health education, safe motherhood, community health workers

Traditional Birth Attendant Education in Rural Haiti

Despite substantial improvements in some nations over the past 15 years, we continue to experience an ongoing global crisis in maternal and neonatal mortality (United Nations [UN], 2015a). According to the World Health Organization (WHO), 99% of maternal deaths occur in developing countries, where the maternal mortality rate in 2015 was 239 per 100,000 live births versus 12 per 100,000 live births in developed nations (World Health Organization [WHO], 2016a). Neonatal death occurs at a rate of 21/1000 in developing countries as opposed to 3/1000 in the developed world (UN, 2015b). Haiti's maternal and neonatal mortality rates are among the highest reported in the western hemisphere at 359/100,000 and 25.4/1000, respectively (WHO, 2016b).

Approximately 15% of all pregnant women develop a potentially lifethreatening complication that calls for skilled care, and some will require a major obstetrical intervention to survive (United Nations Population Fund [UNFPA], 2016). In addition, the WHO states that 43% of newborn deaths and 75% of maternal deaths could be prevented if skilled health workers performed effective health measures at birth and during the first week of life (JHPIEGO, 2015). In this way, maternal and neonatal deaths are linked to a lack of skilled care at birth and within the first week after birth, and the WHO therefore recommends the use of skilled birth attendants at all births (WHO, 2017b). A skilled birth attendant (SBA) is defined as

an accredited health professional—such as a midwife, doctor or nurse —who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns (WHO, 2015a).

Unfortunately, in developing countries nearly half of all mothers and newborns do not have access to skilled care during and immediately after birth (WHO, 2016c), and the proportion of child deaths that occur in the neonatal period has increased in all WHO regions over the last 25 years (WHO, 2017a). In addition, for every woman who dies from pregnancy or childbirth related causes, 20 or 30 suffer injuries, infections, or disabilities. Most of these deaths and injuries are preventable (UNFPA, 2016).

In rural Haiti, where this study was conducted, an SBA attends only 24% of births (Ministry of Public Health and Population, 2012), with the remaining 76% of births occurring at home, attended by family members or traditional birth attendants (TBAs). A TBA is defined by the WHO as "a person who assists the mother during childbirth and who initially acquired her skills by delivering babies herself or through apprenticeship to other TBAs" (WHO, 2012).

Since the 1990's, large-scale training programs for TBAs have not been promoted by the international health community due to concerns about TBA efficacy. However, the WHO recognizes that there is a global health workforce availability crisis, and that the global effort to stop preventable maternal and child mortality therefore requires large-scale efforts that utilize all available national and community resources (WHO, 2012). Their recommendations include the recognition and support of community health workers, which by WHO definition includes traditional birth attendants (TBAs) (Hyde & Hawkins, 2015). The WHO states that they do not have enough evidence-based study results at this time to recommend the use of TBAs beyond supportive roles, such as promotion of birth preparedness, promotion of postpartum and newborn care, vitamin distribution, encouragement of the use of SBAs, and birth attendance in the presence of a SBA. However, the WHO recommends rigorous research into the use of TBAs (and other community health workers) for the independent management of neonatal resuscitation, postnatal maternal hemorrhage, newborn sepsis, and postnatal maternal infection (sepsis) (WHO, 2012).

The role of TBAs in the reduction of maternal and infant morbidity and mortality is controversial, and has been an issue of controversy for decades. In order to put our research into context, it is helpful to understand the historical progression of international concerns and actions regarding TBAs, starting from when TBAs came into the national conversation in the 1970's.

In 1972, the WHO sponsored an international survey on TBAs and their involvement in maternal and child health and family planning. At that time, they concluded that TBAs "have a substantial influence and role to play in the health practices and life habits of rural populations", and that they were a critical component of effective maternal and child health programs (Verderese & Turnbull, 1975). The WHO used information gained from this survey to develop guidelines for the planning, implementation, and evaluation of programs for training and supervision of traditional birth attendants, which were published under the title "*The Traditional Birth Attendant in Maternal and Child Health and Family Planning: A Guide to her Training and Utilization*" (Verderese & Turnbull, 1975).

In 1987, three UN agencies—UNFPA, the World Bank, and the WHO sponsored the Nairobi Safe Motherhood Conference, which launched the global Safe Motherhood Initiative. The goal of the Initiative was to reduce maternal mortality by 50% by the year 2000 (Family Care International, 2007). At this time, 52 countries had TBA training programs in place (Kruske & Barclay, 2004). The goals of TBA training at that time were to reduce maternal and child morbidity and mortality through increasing the number of TBA attended births and increasing TBA's skills. Training programs varied widely in scope and the evidence for their effectiveness was limited and conflicting (Sibley, Sipe, & Barry, 2012). In 1997, participants at The Technical Consultation on Safe Motherhood in Colombo, Sri Lanka, cited evidence from several studies that showed the benefits of TBA training to be "modest at best". The participants concluded "there is no documented case of a society relying heavily on TBAs-trained or untrained-to attend deliveries that has succeeded in lowering its maternal mortality [rate]" (Starrs, 1997). The conference endorsed the presence of a skilled birth attendant (SBA) at every birth, backed up by transport for cases of emergency referral. "Traditional birth attendants, trained or untrained, were excluded from the definition of skilled attendants because they lacked the clinical skills, drugs and equipment, or infrastructure to manage complications such as hemorrhage, eclampsia, or severe infection" (Starrs, 2006).

While the Technical Consultation on Safe Motherhood of 1997 reasoned that a lack of data correlating TBAs with reduced maternal mortality was sufficient to justify their recommendation that an SBA attend every birth, the policy statements did not delineate an understanding of the influence of social factors in the success or failure of TBA training programs. Poverty, low levels of literacy, lack of transportation, and the poor economic and social status of women may all play a role in high mortality rates (Walsh, 2006). However, in 2004 the WHO recognized some of the limitations of the 1997 TBA training de-emphasis when they released the following statement:

It is now generally accepted that one of the main reasons why many TBA-based maternity care programmes of the past did not work, or were unsustainable, was that the programmes failed to link TBAs to a functioning health care system. Hence, in many instances, the TBAs did not work within an "enabling environment"—one in which health care providers at primary, secondary and tertiary levels of the health system function as a team, and in which drugs and equipment are available and effective supervision and systems of referral are in place (WHO, 2004).

In addition, shortly after the release of this statement studies were published that indicated TBA training did, in fact, contribute to reductions in infant mortality and possibly maternal mortality (Sibley & Sipe, 2004). A randomized controlled trial in Pakistan in 2005 showed that TBA training, combined with existing healthcare services, resulted in a significant reduction of about 30 percent in perinatal death, significant reductions in puerperal sepsis and hemorrhage, higher rates of diagnosis of obstructed labor, and higher rates of referral (Jokhio, Winter, & Cheng, 2005). A meta-analysis in 2006 found small but significant decreases in perinatal and neonatal death due to pneumonia and birth asphyxia among trained TBAs, and small but significant increases in women's use of antenatal care and emergency obstetric care (Sibley & Sipe, 2006).

Unlike in the 1970s, when TBA education was well defined, today there is no global standard for TBA training. The current WHO definition of a trained TBA is simply a TBA who has received "some level of biomedical training in pregnancy and childbirth care" (WHO, 2012). Most training programs teach TBAs to provide basic health care and advice for pregnancy and childbirth, breastfeeding, infant care, family planning and related topics. TBAs are not usually trained to provide initial response and stabilization for major maternal and neonatal complications, such as birth asphyxia and sepsis (WHO, 2010a).

However, available data shows a promising relationship between TBA training, including training for management of some major complications, and improved rates of perinatal and neonatal mortality, hemorrhage, birth asphyxia, and referral. A Cochran review found that trained TBAs significantly lowered rates of neonatal and perinatal death and stillbirth (Sibley & Sipe, 2012). In Zambia, training TBAs resulted in a reduction of 45% in neonatal mortality, and a 63% reduction in birth asphyxia (Gill et al., 2011). Results from a study in Pakistan showed that trained TBAs reduced postnatal hemorrhage by 24% (Mobeen et al., 2011). A 2011 meta-analysis showed significant reductions in perinatal and neonatal mortality (Wilson, et al., 2011). And a 2014 publication reported that trained TBAs were able to identify, treat, and refer sick neonates (Gill et al., 2014) (Table 1).

This study adds to the literature that supports the inclusion of the management of major birth-related complications in TBA education, an inclusion that may save lives until adequate progress has been made in the global provision of SBA coverage.

We conducted a small pilot study, utilizing convenience sampling, with TBAs who provide services to childbearing women and their babies in Fondwa, Haiti, where there is no healthcare facility providing delivery services for the approximately 7000 residents, and no birth registry. Therefore, there is no reliable maternal or infant morbidity and mortality data. Births within Fondwa occur in homes (Figure 1), most without access to drivable roads, electricity, or running water, and are attended by friends, family members, and TBAs. Pregnant women who need or want to have their births attended by an SBA must travel approximately 45 minutes to get to the nearest hospital, although

Table 1

TBA training and improved outcomes

Study Article Title	Location	Results
Effectiveness of strategies incorporating training and support of tradi- tional birth attendants on perinatal and maternal mortality (Wilson et al., 2011)	Meta-analysis	Randomized and non-random- ized controlled studies investi- gating strategies incorporating training and support of TBAs. Significant reductions in perina- tal and neonatal mortality. Non- significant reduction in maternal mortality.
Effect of training tradi- tional birth attendants on neonatal mortality (Lufwanyama Neonatal Survival Project): ran- domized controlled study (Gill et al., 2011)	Zambia	TBAs trained to manage common perinatal conditions. Significant reduction of 45% in neonatal mortality. Birth asphyxia reduced by 63%, and by 81% within the first two days after birth.
Traditional birth at- tendant (TBA) training for improving health behaviors and pregnancy outcomes (Sibley & Sipe, 2012)	Cochran Review	Trained TBAs significantly lowered rates of, neonatal and perinatal death and stillbirth. Ad- ditionally trained TBAs had 45% decrease in neonatal death.
Can traditional birth attendants be trained to accurately identify septic infants, initiate antibiotics, and refer in a rural African setting? (additional results from Lufwanyama Neonatal Survival Project) (Gill et al., 2014)	Zambia	TBAs can be trained to identify sick neonates, refer them, and initiate treatment at the commu- nity level.
Administration of misoprostol by trained traditional birth atten- dants to prevent post- partum haemorrhage in homebirths in Pakistan: a randomised placebo- controlled trial (Mobeen et al., 2011)	Pakistan	Postpartum administration of oral misoprostol by trained TBAs at home deliveries. Post-partum hemorrhage reduced by 24%.



Figure 1. Fondwa Home

it takes much longer than that for the many women who must first walk, or be carried, over mountain paths to get to a road or to the bus stop.

Given the lack of infrastructure in Fondwa, and Haiti in general, it is likely that adequate skilled health care coverage is still a considerable distance into the future. Providing education for TBAs can possibly provide a vital interim solution to the lack of maternal and infant health care until enough SBAs can be trained and hired for the community. This study was initiated to evaluate the ability of a group of local TBAs to learn and retain the skills and knowledge necessary for the provision of advanced life-saving care to childbearing women and their infants. Since the TBAs in this program did not have immediate access to an obstetric health facility, the curriculum concentrated on teaching life-saving skills to be employed in the home in the event of hemorrhage, cord prolapse, shoulder dystocia, unexpected breech birth, and newborn apnea. Sterile technique, hygiene, blood pressure, fetal position, fetal heart rate, preeclampsia, tetanus vaccination, postnatal infection, and newborn health were also covered.

We hypothesized that: 1) a TBA education program in Fondwa, Haiti, would result in a significant improvement in TBA skills and knowledge; 2) the learned skills and knowledge would be retained long-term; and 3) training one

of the TBA leaders to co-teach the curriculum would provide the community with a resource for future training.

Methods

Pre-program Assessments

Before developing the education program, the study leader made two trips to Fondwa, at the invitation of a local trained nurse and community leader, to meet with the local TBAs to assess their needs and to consult with them about the components of an education program that would be culturally relevant and useful. An announcement was placed in the community and 13 TBAs responded and attended the meetings. Participants self-identified as TBAs. The nurse, who confirmed that they worked as TBAs, knew all 13. At the end of the meetings, the TBAs requested education on: hygiene, preeclampsia, blood pressure, urine testing, hemorrhage, breech delivery, fetal position, fetal heart tones, shoulder dystocia, postnatal infection, newborn resuscitation, cord care, newborn health, and breastfeeding. They asked for gloves, soap, razor blades, cord-tying string, and gauze.

The local nurse agreed to be a co-leader and a co-teacher of the education program. Our intention was that this would be the first step toward her becoming competent to lead future educational programs and that this, along with the training of other identified community members (preferably TBAs), would be an essential component of our goal of local Haitian sustainability of the program. The nurse was given the curriculum content, methods, and handouts in advance. Two researchers instructed her in how to present the material, and worked with her to be sure she understood the content and was comfortable co-leading and co-teaching.

The Curriculum

The education program curriculum (EPC) for the Fondwa TBAs was developed in accordance with the International Confederation of Midwives Essential Competencies for Basic Midwifery Practice (International Confederation of Midwives, 2010), which establishes the essential knowledge, clinical skills, and critical thinking necessary for entry-level midwifery practice. The EPC does not cover all of the competencies. Rather, it focuses on the identified needs of this community. The curriculum was also developed in accordance with statistical data supporting United Nations Millennium Development Goals (MDG) 4 and 5, to reduce by two-thirds the mortality rate among children under five and to reduce by three quarters the maternal mortality ratio (MMR) by the year 2015 (UN, 2000). As such, the curriculum is in line with the Sustainable Development Goals (SDG) for 2030, to reduce the MMR to less than 70 per 100,000 live births and to reduce neonatal mortality to at least as low as 25 per 1000 live births (UN, 2016). The statistical data supporting MDG and SDG states that the leading causes of maternal death in the developing world are hemorrhage, obstructed labor, infection, complications from abortion, and preeclampsia (WHO, 2010b). Neonatal deaths account for 44% of the deaths in children under five and often arise from complications associated with childbirth, including asphyxia and sepsis (United Nations Children's Fund, 2014). Each component of the EPC addresses one or more of these causes of death, with the goal that upon completion of the program, TBAs would be able to:

- 1. Demonstrate proper hand washing and glove use
- 2. Identify signs of preeclampsia, including measuring blood pressure and proteinuria
- 3. Measure fetal heart rate
- 4. Demonstrate key steps in managing prolapsed umbilical cord
- 5. Demonstrate key steps in managing shoulder dystocia
- 6. Identify fetal position and demonstrate key steps in managing breech birth
- 7. Demonstrate key steps in neonatal resuscitation
- 8. Demonstrate knowledge of key steps in assessing and managing postnatal hemorrhage
- 9. Demonstrate proper care of the umbilical cord
- 10. Identify symptoms of postnatal infection
- 11. Demonstrate ability to identify the location of a facility offering tetanus vaccinations

The Education Program

Participants were solicited from the 13 TBAs who had attended the assessment meeting, the TBAs' recommendations of other TBAs active in the community, and the recommendations of the nurse who had agreed to co-lead the program. Seventeen TBAs took part in the education program. Prior to the first class, each of the 17 TBAs answered a survey to assess age, education, training, literacy, numeracy, and previous use of a fetoscope, a resuscitation bag and mask, a blood pressure cuff and stethoscope, a urine dipstick, and sterile gloves (Table 2). Twelve were illiterate, five had never been to school, and only three had progressed past grade four. Three had taken a one-month health-care training course, 14 had self-training or apprentice training only. None had previously used the listed equipment.

The program was presented with the assistance of bilingual translators trained by Family Health Ministries (FHM)—a Duke University affiliated non-profit with a history of developing the evidence base needed to support maternal and child health programs in Haiti. Informed consents were obtained after a translator read the Kreyol translation of the consent agreement to each participant. Institutional Review Board (IRB) approval was obtained through Duke University and FHM's Haiti-based IRB.

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Table 2

TBA (n=17) demographics and prior equipment use

Demographic Characteristics	n	%
Age		
24 y and under	1	5.9%
25-40 y	2	11.8%
40-55y	6	35.3%
55-70 y	6	35.3%
71 and over	2	11.8%
Education		
Never went to school	5	29.4%
Primary (completed grades <1-4)	9	52.9%
Elementary (completed grades 1-8)	1	5.9%
High (not completed)	2	11.8%
Post high school	0	0
TBA training		
Self trained only	7	41.2%
Apprentice trained only (by family member)	7	41.2%
One-month hospital course plus self/apprentice	3	17.6%
Literacy		
No	12	70.6%
Yes	5	29.4%
Numeracy		
No	5	29.4%
Yes	12	70.6%
Sex		
Female	8	47.1%
Male	9	52.9%
Has previously used equipment		
Fetoscope	0	0
Resuscitation bag and mask	0	0
Blood pressure cuff and stethoscope	0	0
Urine dipsticks	0	0
Sterile gloves	0	0

On the first day of the education program, each TBA was given a pretest to assess knowledge of the curriculum content. After the education program was completed, each TBA took the same test that had been administered before the program began. This same test was also repeated at six-weeks and six-months post-program in order to assess learning retention.

The tests had an oral component and a clinical component. Each TBA was tested in isolation, with two testers present. During the oral component of the test, the TBA was asked to state definitions and symptoms, as appropriate, of high blood pressure, hemorrhage, postnatal infection, fetal heart rate, a sick newborn, and the location of a facility offering tetanus vaccinations. Answers were entered into a database by one of the testers. The clinical component of the test was videotaped to ensure accuracy of assessment, and included neonatal resuscitation using a neonatal resuscitation manikin and a neonatal resuscitation bag and mask; fetal heart rate assessment with a fetoscope; palpation to determine fetal position (confirmed with a portable ultrasound unit operated by a researcher); demonstration of the management of breech delivery, shoulder dystocia, prolapsed cord, and hemorrhage; cord care using life-size models (doll, pelvis, placenta, cord, uterus, vagina); blood pressure with an inflatable cuff and stethoscope; demonstration of hand washing and donning of sterile gloves; and using and interpreting a urine dipstick for protein.

Classes were held from 9:00am to mid-afternoon three times a week for three weeks. Teaching methods included demonstrations, lessons, charts, models, hands-on activities, and handouts that visually depicted proper implementation of critical skills. Each student received a binder containing all charts and handouts. At the end of the program, certificates of completion were issued to each TBA, along with a kit containing gloves, soap, a blood pressure cuff, a stethoscope, urine test strips, paper cups for urine, a fetoscope, a self-inflating resuscitation bag and mask, string for tying the umbilical cord, razor blades, bulb syringes, gauze pads, two receiving blankets, and newborn cotton caps. At six-weeks and six-months, kits were replenished with disposable supplies (gloves, razor blades, cord string, gauze, and soap).

Results

Results for learning and retention between the four tests were analyzed in STATA using a paired t-test. Effects of age, training method, literacy, numeracy, and sex on learning and retention, as well as their effects on total scores, were analyzed in STATA using one-way ANOVA.

Analysis showed statistical significance for amount of learning, as reflected in the difference between the pretest and the initial post-test (p = 0.0000) and for retention between the initial post-test and the six-week post-test (p = 0.0086), and no significant change between the six-week post-test and the six-month post-test (p = 0.6864). The influence of age, training, literacy, numera-

cy, and sex on learning and retention was not statistically significant (p values ranged from 0.193 - 1.0000). Total number of correct answers analyzed for these variables showed a significant influence for numeracy only (p=0.0214).

One hundred percent of the TBAs completed the education program and took all four tests. Despite the numeracy and literacy limitations, the TBAs increased their scores dramatically between the pretest and the initial post-test, and retained skills and knowledge well between the post-tests. Out of a total of 493 questions asked on each of the four tests (29 questions, n=17), 61 (12.37%) were answered correctly on the pretest, 321 (65.11%) on the first post-test, 289 (58.62%) on the six-week post-test, and 293 (59.43%) on the six-month post-test (Figure 2). These percentages of correct answers represent a 426.35% increase between the pre- and the first post-test, followed by a 9.97% decrease from first post-test to six-week test, then a 1.38% increase between the six-week and six-month post-tests.

Out of a possible score of 68 for each individual subject area (4 tests, n=17), the total number of correct test answers (all four tests combined) varied considerably according to the subject of the test question, ranging from 3 (ability to put on sterile gloves with no mistakes) to 62 (proper cord care). The amount of material learned during the education program, as measured by comparing scores from the pretest and the first post-test, also varied considerably by subject, with the most learning occurring in the subjects of neonatal resuscitation, blood pressure, shoulder dystocia, and breech delivery. Retention variance by subject was minimal (Table 3).



The test content falls into two categories: demonstration of skills and mem-

Figure 2. Total number of correct answers on each of the four tests, out of 493 questions asked for each test (29 questions, n=17)

orization of knowledge. Prior familiarity with the subject material (as measured by scoring greater than zero on a pretest question) was greater in the skills category than in the knowledge category. The TBAs as a group were familiar with 7 out of 19 (36.84%) of the skills questions, but were familiar with only 2 out of 10 (20.0%) of the knowledge questions. The amount of material learned during the education program, as reflected in the difference between the pretest and the first post-test scores, was higher by a factor of 2.49 in the knowledge category (818.18% increase) as opposed to the skills category (329.17% increase). The amount of material retained between the first post-test and the six-week post-test was marginally higher in the knowledge category (10.89% loss) than in the skills category (11.17% loss). Retention of material between the six-week post-test and the six-month post-test was better in the skills category (8.20% increase) than in the knowledge category (8.89% loss).

Discussion

This pilot study highlights one group of TBAs who were willing and able to learn and retain the materials in an education program that taught critical lifesaving skills. Despite low levels of previous education and literacy, the TBAs were able to learn and retain complex concepts and skills. This suggests that lack of education does not denote lack of aptitude and that given educational opportunities, TBAs may be able to make a valuable contribution to emergency care in communities that are working to build their health infrastructure, and that this warrants continued study. The participation rate of 100% for the education program, and 100% for each of the four tests, suggests that the TBAs perceived usefulness in the content and were committed to the program, especially since many TBAs traveled long distances to attend.

Limitations

Small sample size (n=17): The study participants were a convenience sampling of TBAs who lived and worked in the Fondwa community, where Family Health Ministries researchers involved in this study planned to put a birthing center staffed by skilled birthing attendants. Therefore, the researchers had an interest in developing a working relationship with the community TBAs, and assessing their capacity for learning and retaining knowledge and skills to be used in emergency situations in which there is not enough time for referral. The researchers were also interested in assessing their capacity to recognize when patients should be referred to the birthing center for evaluation. Despite this study's small sample size, and the resultant non-generalizable aspect of the results, the study provides valuable preliminary data on the abilities of TBAs to acquire the skills and knowledge that could possibly be utilized to improve maternal and neonatal outcomes for families in underserved areas throughout the global community. It is our hope that this education program, and the dem-

Table 3

Learning and retention, as measured by total number of TBAs (n=17) who answered/demonstrated correctly, arranged from subject most learned to subject least learned (top to bottom)

Subject	Pretest	Initial Post-test (learned)	Six-week Post-test (retained)	Six-month Post-test (retained)
Neonatal resuscitation steps, and use of bag and mask	0	17	14	11
Blood pressure, use of equipment	0	16	14	14
Shoulder dystocia, maternal positioning	0	15	12	11
Breech delivery management	1	16	15	15
Shoulder dystocia, first shoulder turn	0	14	16	14
Urine dipstick, dips correctly	0	14	17	16
Hand washing, correct steps	3	16	12	13
Fetal heart rate, use of fetoscope	0	13	15	15
Postpartum infection, knows symptoms	2	14	10	10
Hemorrhage, knows definition	0	12	11	8
Urine dipstick, accurately reads protein	0	12	9	11
Preeclampsia, knows symptoms	1	12	12	8
Fetal heart rate, defines normal range	0	10	9	9
Fetal heart rate, recognizes nor- mal rate	0	10	6	8
Hemorrhage management	0	9	7	6
Prolapsed cord, maternal posi- tioning	0	9	10	8
Fetal position, finds head	7	16	15	15
Shoulder dystocia, second shoul- der turn	0	7	12	13
Fetal heart rate, finds and is ac- curate	0	7	2	5
Neonatal resuscitation steps, and use of bag and mask @ proper rate	0	6	1	3

Subject	Pretest	Initial Post-test (learned)	Six-week Post-test (retained)	Six-month Post-test (retained)
Fetal position, palpation hand maneuvers	7	13	13	12
Prolapsed cord management	9	14	14	15
Blood pressure, knows definition	0	4	4	5
Blood pressure, accurate results	0	4	3	4
Preeclampsia, knows definition	0	3	3	3
Tetanus vaccination, knows location	10	12	13	12
Glove use, dons sterile	0	2	0	1
Fetal position, finds back	6	8	6	11
Cord care	15	16	14	17

onstrated success of these TBAs in learning and retaining skills and knowledge, will serve as a foundation for larger and more generalizable research studies.

Evidence supports the likelihood that TBA training programs are most effective when tailored to the needs and traditions of the community in which they are offered, and when the TBAs are supported by the local community to the greatest extent possible (WHO, 2015b; Sarmento, 2014; Darmstadt et al., 2009). An unexpected limitation of this study is that the nurse who had agreed to be the local leader, and to co-teach the program, became ill within a week of the start of the program and could not continue as co-leader. She subsequently passed away and her death was a substantial loss to the community. We did not have another local community member who could fulfill her role and as a result the position remained vacant. For this reason, an important sustainability aspect of the education program, leadership training, will need to be initiated at another time.

Moving forward, it is important to build on this education program by developing and including a preceptor component that would enable the TBAs to be assessed on their use of learned skills in real life critical management situations. Many of the skills and concepts learned are difficult to put into practice without a supervisor and a mentor who can demonstrate their proper implementation in the field. Even among SBAs, there is great variation in competence, and a discrepancy between the knowledge of a procedure and the ability to perform that procedure correctly (Harvey et al., 2007). Practical experience is acknowledged to be an essential component, along with knowledge and skill acquisition, to an effective birth attendant training program (The United States Agency for International Development, 2017).

Global Implications

The global health community recognizes the importance of mobilizing all available resources in the effort to reduce maternal and neonatal mortality and morbidity. The inclusion of TBAs and other community health workers who are already providing services to childbearing women and their infants is critical to the success of this mobilization. The WHO has stated that "Due to their cultural and social acceptability, knowledge and experience, TBAs are considered an important ally for health education and social support and can provide a positive link between women, families, communities and the formal health care system" (WHO, 2015b). The WHO also recommends rigorous research into the use of Community (lay) Health Workers for the independent management of neonatal resuscitation, postnatal maternal hemorrhage, newborn sepsis, and postnatal maternal infection (sepsis) (WHO, 2012). This study provides preliminary data that supports the additional inclusion of the management of prolapsed cord, shoulder dystocia, breech birth, and preeclampsia in these research studies. These components are all critical to saving lives in resource-deficient areas until the health infrastructure is built up to adequate levels.

There are no TBA education standards in existence in Haiti or internationally (WHO 2012, Darmstadt et al., 2009). The lack of formal education and training, tailored to individual communities and their belief systems, may have played a part in the failure of past TBA training programs to demonstrate effectiveness in reducing mortality, leading to the withdrawal of international support (Walsh, 2006). As we progress towards the goal of 100% skilled birth attendance, there are many years left in which TBAs will by necessity be the primary caregivers for childbearing women throughout the developing world. The development of sound evidence-based research on TBA education programming is therefore an important component of safe motherhood. We hope that our research will contribute to the establishment of confidence in the ability of TBAs to learn and retain life-saving skills and knowledge, thereby encouraging more research on optimal curriculum content and teaching methods for TBA education programming.

Maternal and newborn health strategies are most effective when community members participate in improving services and in program planning (WHO, 2015b). The pre-program assessments for this study are an example of this participation, and may have contributed to the 100% attendance at the education program, as well as the success in learning and retention. However, specific interventions are best implemented in combination with other strategies that address, for example, community barriers to the use of health care, and the ability of women and families to improve care practices in the home (WHO, 2015b). The voices of the most marginalized and excluded are critical to the success of the global strategy to improve outcomes for mothers and babies, and maternal and newborn health must be addressed within the context of addressing disparities related to poverty, malnutrition, gender equity, and availability of contraception, to name just a few (The Partnership for Maternal, Newborn and Child Health, 2016). Large-scale Community Health Worker systems, including those for TBAs, require substantial increases in global support. More research is needed, not only for training, but also for community involvement, management, supervision, and logistics.

We agree with the WHO that every woman deserves to have a SBA at her birth, and every woman and baby deserves to have access to adequate emergency care. However, until the presence of SBAs can be established within functioning health care systems, the education of TBAs in life-saving measures for unpredictable emergencies may be critical to reducing maternal and infant mortality in communities around the world.

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