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Building Capacity to Provide Maternal Health Care in an Indigenous Guatemalan Community Through Ultrasound and Skills Training

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A B S T R A C T

Sustainable Healthcare in Underdeveloped Regions, SHURinc, is dedicated to improving health care delivery in low-resource regions through use of technology and educational training, with the goal that the improvements will be managed and sustained by the local group (www.shurinc.org). This article outlines SHUR's involvement in a project to bring ultrasound technology and skills training to ACAM clinic located in Concepcion, Guatemala and describes strategies used to meet the learning needs of a diverse audience caring for pregnant indigenous women in a rural low-resource area. This article offers experience in working collaboratively with the midwives and other groups to achieve the overarching goal of improving the health of the indigenous pregnant women in the region and their newborn babies.

Introduction: ultrasound in Guatemala

Despite a recent destructive civil war, devastating natural disasters, dangerous gangs, and extreme poverty, Guatemala remains a beautiful and endearing country. It is rich in culture and geographic wonders and its pulsing energy is felt everywhere from Guatemala City to the jungles and active volcanoes. Its people are warm, generous, and resilient. They are our neighbors.

When the SHURinc ultrasound project started in 2010, maternal mortality in Guatemala was nine times higher than the United States, even twice as high as Mexico, which has similar geographic and demographic challenges (World Health Organization, 2010). ACAM is the *Asociacion de las Comadronas del Area Mam* (translated to Association of Midwives of the Area Mam). Serving the local Mayan population, the clinic is operated by traditional Mayan midwives and supported through assistance from various volunteer organizations. Approximately 100 women visit the clinic monthly. Midwives perform 80% of the births in this region either at home or in the clinic (Maya Midwifery International, n.d.).

What happens when a mother dies? Families shatter and the disruption reinforces the cycle of poverty. Babies might be cared for by older siblings, often still children themselves, or other family members, or in orphanages. The societal loss cannot be measured by a single statistic.

Guatemala's indigenous population has some characteristics that make it especially vulnerable to maternal mortality. They tend to live in rural areas that are distant from medical services. Since the women's first language is not Spanish, they experience language barriers when visiting health professionals and facilities.

Although some progress had been made through education and nutrition, the greatest need was to have access to ultrasound for early detection of at-risk pregnancies. Ultrasound was available in nearby cities but required traveling over roads, which if not pocked by mudslides and disrepair were dangerous due to robberies. For pregnant women living in a remote village, the distance, danger, and cost are barriers. Traveling to the hospital also meant having the examination in Spanish, which was not the pregnant woman's first language.

Prenatal care reduces the risk of pregnancy complications. Early health screening, providing advice on diet, exercise, and avoiding exposure to harmful substances (such as indoor pollution caused from poorly vented or nonvented stoves, and smoke from tobacco) help prevent adverse outcomes for both mother and baby. Seventy to eighty percent of indigenous Guatemalan women choose home birth with an attending midwife (Maya Midwifery, n.d.; Safe Motherhood Project, 2003). This makes ultrasound an important tool as it can predict a complicated delivery and warn the mother who is planning a home birth.

Choosing local partners

Sustainable change requires local people able and willing to support the change being introduced. In this setting, skepticism and

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distrust still lingered from the brutal 36-year-long civil war and violence (1960-1996), as well as fear of strangers around babies. In recent years, at least 500 cases have been documented (Brandies University, 2007) of Guatemalan children kidnapped and subsequently exported abroad for profit. For these reasons, a local partner who was trusted by the community was especially important.

Connecting with the ACAM clinic was somewhat serendipitous, though the midwives claim their prayers were answered. In Mayan culture, the midwives are highly trusted and respected. They are fluent in the indigenous Mam language and understand the daily struggles of life, customs, and traditions. With the proper training, equipment, and support, these midwives are an obvious choice to advance the care of pregnant women.

The ACAM Clinic serves a Mam-speaking population of approximately 50,000 located in the western highlands of Guatemala not far from Quetzaltenango, Guatemala's second largest city, also known by its Mayan name, Xelajú. Spanish is the official language of Guatemala, but the linguistic landscape is complex with a total of 24 languages spoken. Of these, 21 are Mayan, one indigenous, and one Arawakan (World Atlas, 2017). The country is divided into 22 regions called departments (Central Intelligence Agency (US)). The Mayan language of Mam was spoken by the ACAM midwives and the Mam people living in the department of Quetzaltenango and surrounding departments of Huehuetenango, Retalhuleu, San Marcos (World Atlas) Figure 1.

Well-established and accepted in the community, the ACAM midwives proved a perfect partner. In the early exploratory phase of our project, the ACAM midwives were asked what would help with the problem of maternal mortality. They said another organization had recently funded construction of their clinic, which gave them a solid building and was providing some midwifery skills training. What they needed now was technology (ultrasound) and training for the technology. They had Internet and mobile phones, ample classroom space, and a lot of heart and enthusiasm.

Equipment acquisition

After 2 years of grass-roots fundraising, asking friends and family for donations, gift basket raffles, fund raising at local restaurants, we were able to purchase an older ultrasound machine. Volunteer team members paid their own travel expenses. Some of the team's lodging costs were offset by accumulated hotel points.

The vision

The initial vision was to provide ultrasound services that could send images for remote reading. There were obstetrical and gynecology (OB-GYN) physicians in Quetzaltenango, Guatemala who were willing to help, but unable to travel 10 miles (about 45 minutes) to the clinic to read examinations. Unfortunately, the age of the initial ultrasound was predigital. However, the clinic had been given a grant to hire a physician part-time, so they had someone who could read the scans. The midwives would, however, need some training to perform the scans.

First year: obtain and deliver an ultrasound machine thus escalating the standard of health care provided

Our initial team was three. The person who initially met with the ACAM midwives recruited a radiology nurse who could answer clinical questions about the ultrasound. A Guatemalan-born cultural specialist with experience working with various volunteer groups in Central America was also asked to join the campaign. Her connections and cultural understanding proved extremely valuable as she not only translated, but she also made outstanding ground transportation arrangements and helped us achieve a solid relationship with the midwives and other partners.

With the aim of creating sustainable and ethical improvements, our process was directed by the needs identified by the midwives and their supporters. Meetings conducted in advance

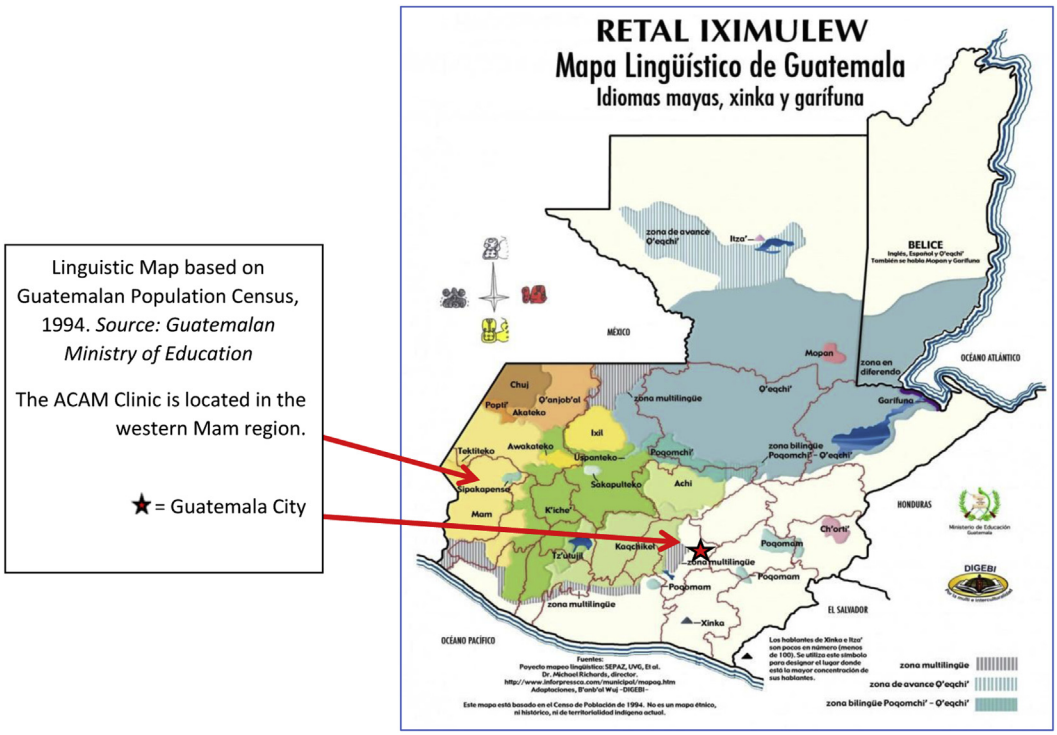

Figure 1. Linguist Map based on Guatemalan Population Census (Guatemalan Ministry of Education).

were respectful of local culture and care standards, and extreme care was taken to avoid imposing personal or religious beliefs. The goal was to empower the midwives through education and provide them with the tools they identified as necessary to improving the health care for pregnant women in this rural region.

Developing a clear understanding of the appropriate and ethical uses of the ultrasound technology is important to avoid improper misuse. In some countries, ultrasound has been used for fetal sex identification with pregnancy termination of unwanted female fetuses in favor of male fetuses. When introducing ultrasound technology, fetal sexing should be discussed in advance (Stanton & Mwanri 2013). These discussions were conducted before the start of our project and reaffirmed with each campaign.

In setting up the ultrasound equipment, we needed a clean and safe storage space with access to electric power. Simple safety practices, such as locking the wheels when storing the machine to prevent roll away during quakes, were discussed. There was great excitement by the midwives and the clinic doctor. Having this advanced technology available locally was a dream come true for the clinic. However, for the indigenous pregnant women, this was still an unknown commodity bringing about a perplexing array of feelings spanning from excitement and curiosity to fear and distrust.

Introduction and Initiation of Ultrasound and Our First Patient

In developed countries, ultrasound is a common imaging method and it is well known to most expectant mothers. However, in rural areas of developing countries, ultrasound is an unknown commodity. Telling a young woman with little formal education, it was possible "to see" the baby moving around inside her could cause opposing (rival) feelings of excitement and wonderment as well as trepidation, fear, and anxiety. In the initial introduction of the ultrasound, a mixture of responses unfolded. Some were very excited by this prospect, others were apprehensive that ultrasound represented some sort of "magic." They had additional concerns that the procedure would be painful, or it would hurt the baby. Others thought that having the ultrasound was a "treatment or therapy" that could strengthen the pregnancy or the baby. To alleviate the fears and misconceptions, we spent time explaining ultrasound scanning and its usefulness in helping to identify perilous conditions.

The preprocedure education and allowing the woman to see and touch the equipment before scanning was helpful in decreasing fear of the unknown. The smile on the faces of women who had already undergone the ultrasound scan and their testament reassured those waiting. Having the trusted midwife present for each patient scan also provided comfort to the patient. As the midwives gained experience and confidence, they began to hold the ultrasound probe. The midwives were also involved in explaining of what the patient could expect during the scan.

The first patient was an 18-year-old married woman who walked into the clinic with no prenatal care. She arrived in early labor. After the successful initial ultrasound was done, word quickly spread of the positive experience and the ultrasound gained popularity. Soon more women showed up to be scanned (Figure 2).

Evaluation of the First Year

The first-year goals were achieved. The ultrasound was delivered and set up in the clinic. Trust had been established with the midwives and villagers, as well as relationships formed with doctors and OB/GYN physician(s) in the community and leaders in the public hospital. These associations were vital to establishing a referral system for women requiring a higher level of care or those identified to have a high-risk pregnancy. The fire department and the Red Cross participation in the project were essential as they might have been involved in transporting the women and/or the newborns or assisting in a field delivery. The need for further education was evident, and SHURinc. committed to return the next year. The relationships built during this first campaign were essential for our next campaign.

Second year

The following year, SHURinc. was given a very generous donation by an ambulance company of some Basic Life Support (BLS)

Figure 2. First clinic obstetrical ultrasound patient was an 18-year-old, walk in, with no previous prenatal care. U/S provided information on the status of the mother and baby. Midwives gather around the clinic doctor performing the scan. Permission to use photos granted by Nikki May, Maya Midwifery Council Board Member.

Target Audience:

40 attendees with varying educations, different languages, and professional backgrounds

- ACAM Clinic Midwives and midwives from other surrounding villages.
- First Responders (fire-fighters, Red Cross workers)
- Medical professionals (doctors, residents, medical student, midwives)

Education Level – zero formal to college level with one illiterate

- College trained (doctors and medical students)
- Apprentice trained (midwives and first responders)

Languages

- Spanish
- Mam (many dialects). Language from one village to next could be a different dialect
- English
  (Medical Interpreters and Cultural Specialist used)

Figure 3. Target audience for education.

equipment, OB field delivery kits, and other medical supplies, so the initial three personnel returned with three additional volunteers:

- A radiologist to provide training in acquiring and reading ultrasound.
- A nurse practitioner to assist in the clinic and see patients as needed and to provide training in the BLS equipment and CPR for adults and children.
- An intravenous access nurse to train intravenous (IV) access and assist with CPR/BLS.

Developing a flexible education plan to meet the learning needs of the diverse Guatemalan audience was key to a successful project. Working closely with ACAM Council and the clinic manager was essential.

A total of 40 people attended all or portions of the education (see Figure 3). Four learning stations (resuscitation, intravenous access, ultrasound scanning, and monitoring) were set up. These were taught by the four clinical volunteers, each teaching their area of expertise, over a period of 3 days (see Figure 4). A master schedule outlining the learning stations, their location, the time, and trainer was compiled by the ACAM manager (see Figure 4). Trainees rotating through the resuscitation, IV skills, ultrasound training stations were limited to 7. The monitoring station remained open to allow doctors and others not rotating through the other stations to attend at times convenient to their schedule. Bridging the varying educational levels, different languages, and professional backgrounds was challenging but the team was able to find solutions. Language was a huge barrier to overcome. Instructional videos and lectures were delivered in Spanish or translated into Spanish by interpreters. For midwives fluent only in Mam, the Spanish lectures were interpreted into Mam. Hands-on skills training with return demonstrations followed.

Literacy was another barrier. Approximately 44% of the Mayan women complete only an average of 2.1 years of schooling (Maya Midwifery International). The ACAM clinic offers a free 2-year apprentice program taught in the Mam language consisting of 1 year of midwifery training and computer classes, followed by a year of training in the Mobile Clinics in the community. They have graduated 39 literate midwives with expanded skills (Maya Midwifery International). A portion of these graduates attended SHURinc's training programs.

Resuscitation station

Two volunteer instructors certified in Basic Life Support/Advanced Cardiac Life Support taught this station following the American Heart Association standards. The equipment was modified and programmed from English to Spanish, the teaching videos were in Spanish, as were the handouts and materials. Low simulation manikins (adult, child, and infant) were used. At the end of the training, champions were identified to carry on the work of education and a low-fidelity Sim classroom was established and all materials and equipment remained. Online educational resources were identified for continued learning and retraining. With the Sim Classroom and materials in place, the continued education of new personnel and the retraining of past attendees could be carried out by the identified champions and strengthened by the collaborative efforts of other nonprofit organization volunteering at ACAM. The convenience of a ready Sim Lab equipped with supplies and materials fosters the continuation of education and advancement of training and skills making it sustainable and solid program in which to grow from (Figures 5 and 6).

Intravenous infusion and access station

Volunteer certified in IV access and experienced in teaching IV skills.

Basic skills:

- Sterile technique
- Vein selection
- Access
- Securement, care, and maintenance
- Discontinuation

Using three (3) certified medical Spanish interpreters, the English lecture was translated into Spanish, followed by hands-on skills training. Using a combination of IV teaching arms and live models, skills were demonstrated. Attendees were allowed 2 attempts.

Currently, ACAM clinic administers intravenous infusions of vitamins and iron solutions. Guatemalan diets are low in iron and other nutrients are important to fetal growth. As the services provided at the clinic continue to grow, and midwives' training continues with consistent physician coverage, more IV use is expected. During the training sessions, 5 talented individuals were identified. Extra time was spent with those individuals to hone their skills and establish proficiency.

Monitoring station

Portable cardiac monitoring station and portable ventilator and oxygen saturation station.

This station required a higher skill level with foundations in cardiopulmonary physiology, electrocardiography, and rhythm

PRE-REGISTERED ATTENDEES.

Midwives were assigned to allow for scheduling coverage to run the clinic operations and for the fire department and Red Cross to work their schedules. Scheduling and arranging of space, pre-registration was done by the clinical manager.

Open slots were available for OB/GYN physicians, medical students and area doctors to visit and rotate through the monitoring station

GROUP 1 Midwives	**GROUP 2 (First Responders & Red Cross)**	**GROUP 3 Midwives**	**GROUP 4 Midwives**
Midwife 1 Midwife 2 Midwife 3 Midwife 4 Midwife 5 Midwife 6 Midwife 7	First responder 1 First responder 2 Red Cross 1 Red Cross 2 Red Cross 3 Red Cross 4	Midwife 8 Midwife 9 Midwife 10 Midwife 11 Midwife 12 Midwife 13 Midwife 14	Midwife 15 Midwife 16 Midwife 17 Midwife 18 Midwife 19 Midwife 20 Midwife 21
Tuesday	**Tuesday** **8am-12pm BLS station**	**Tuesday**	**Tuesday**
Weds **8am-12pm BLS Station** **1pm-3pm IV Skills** **3pm-5pm monitoring**	**Weds** **8am-10am IV skills** **10am-12pm Monitoring**	**Weds** **10am -12pm IV skills** **1pm-5pm Ultrasound**	**Weds** **8am-12pm Ultrasound** **1pm-5pm BLS**
Thursday **8am-12pm Ultrasound**		**Thursday** **8am-12pm BLS station**	**Thursday** **1pm-3pm IV skills** **3pm-5pm Monitoring**

Figure 4. Schedule and training stations.

interpretation. Doctors, medical students, and first responders were taught by nursing volunteers with critical care expertise. The use and application of the equipment was reviewed, and a return demonstration was performed by the attendee.

As ACAM advances in diagnosing high-risk pregnancy, transfer to a higher level of care is anticipated. Providing necessary portable monitoring for safe transfer was identified as optimal.

Training the local doctors, clinical doctors, medical students, and first responders was necessary because they may be involved in the transport of these patients to the hospital or receiving the patient.

Ultrasound scanning station

Ultrasounds were performed in the examination rooms lead by the radiologist contingent on availability of patients/models. After conducting several sessions, it was recommended to decrease the number of trainees in each room. The rooms were crowded with the number of trainees in each session, causing some anxiety for the trainer and possibly the patient. Subsequent recommendations would be not to exceed three trainees in each session with two being the ideal.

Recruiting pregnant models and introduction of ultrasound

ACAM leaders notified nearby villages of the upcoming ultrasound screening event. Pregnant women arrived at ACAM, were greeted, and were registered by ACAM midwives. Information regarding the ultrasound scan and what to expect were given in Spanish and Mam when appropriate. Translators were used to disseminate the information.

Remaining open minded is beneficial to finding solutions and bridging the cultural barriers

Before an abdominal ultrasound, it is typical for patients to be instructed to drink water before scanning. The water helps fill and distend the bladder and helps to move the bowel making it easier to see the pelvic anatomy. We discovered the pregnant women

Figure 5. Midwives, firefighters, and Red Cross personnel practice CPR on manikins. Permission to use photos granted by Nikki May, Maya Midwifery Council Board Member.

waiting for their ultrasound examination were reluctant to drink the preprocedure water offered. Instructions were repeated in their spoken language, Mam or Spanish, and they were asked if they had any questions. After 30 minutes, the women had still not drunk any of the water. We asked the cultural specialist to assist us in understanding the issue or concern. The water in rural Guatemala is unsafe to drink. It requires boiling the water or using special filtering/processing devices to kill harmful microorganisms to avoid contracting illness. Typically, tea is the drink of choice. Although we were using filtered or bottled water, the women were uncomfortable drinking the cold water. Once the issue was identified, warm tea was substituted for the water and women were receptive to the instructions.

Lessons learned

- Incorporating local customs and norms into the training program is important. Mayan midwives have family and home life duties that must be accounted for when creating a training program. Mam mothers brought their young children to the trainings carrying them on their backs. Although we were amazed that the kids were quiet and not much of a disturbance, breaks were necessary to provide mothers time to tend to their children's needs. Safety considerations were taken during AED training to ensure the children were supervised and not at risk for accidental injuries. Scheduling trainings with flexibility and sensitivity to these other responsibilities is necessary (Figures 7 and 8).
- We terminated training sessions in the early afternoon to allow the midwives to return to their families and home duties. For those midwives who traveled from a distant village, it was important to allow them ample time to return home safely before dark.
- The training sessions were opened to others in the region. Some midwives traveling from distances outside the Concepción community were housed in the clinic. Sharing meals and socializing together is an important cultural tradition. Although time for breakfast, mid-morning snacks, and lunch was part of the schedule, we had not anticipated the extra time taken by the social interactions that required adding additional time to the original program.

Figure 6. Midwife performs return demonstration of pediatric resuscitation skills. Permission to use photos granted by Nikki May, Maya Midwifery Council Board Member.

Outcomes

Five individuals successfully completed IV insertion training and performed a return demonstration. Champions were identified to continue the BLS education. A low-fidelity Sim Lab was established for BLS training. Partnerships were strengthened with local partners who would be involved in transporting sick or high-risk patients from the clinic to a higher level of care. We visited the public hospital and met with providers to strengthen the relationship and develop a referral process to be used when complications or high-risk pregnancies were identified. To further facilitate a referral system, we met with local OB-GYN physicians inviting them to participate in the program, familiarize themselves with the equipment, and possibly share the ultrasound resources.

Portable and remote imaging: continued progress in Guatemala and other regions

Portability, durability, and relative affordability of newer compact ultrasound devices make it ideal to use in low-resource environments (Stanton & Mwanri, 2013). Since the two campaigns by SHURinc., a new updated portable ultrasound was donated to the clinic that has the capability to send images for remote reading and is ideally suited for use in the mobile community program. The mobile clinic has an equipped four-wheel drive vehicle staffed by ACAM personnel offering prenatal, family planning, and primary care to isolated communities in the region (Maya Midwives International). The roads in these communities are often narrow dirt roads too small to drive fire or rescue trucks through that become muddied during the rainy season. Travel for a

Figure 7. Mayan women carry their children on their backs and bring them to classes. Permission to use photos granted by Nikki May, Maya Midwifery Council Board Member.

pregnant woman in these conditions can be difficult or impossible. The smaller four-wheeled drive mobile clinic vehicle is better suited to navigate the tight roads. The addition of portable ultrasound elevates the level of care that can be delivered, making consults conducted from the field possible in the future.

Other groups have been successful in incorporating various ultrasound programs in low- to medium-resource countries. Robert Nathan et al., (2017) from the University of Washington participated in a cluster-randomized clinical trial designed to assess the effect of basic obstetrical ultrasound in five low- and middle-income countries (Democratic Republic of Congo, Guatemala, Kenya, Pakistan, and Zambia) utilizing professionals with no prior ultrasound experience. Through the University of Washington Department of Radiology, a 2-week course in basic OB was designed followed by a 12-week supervision period. They trained 41 ultrasound native health care workers (midwives, nurses, radiographer, and medical officers) to perform OB US to screen for high-risk conditions: multiple gestations, malpresentation, placenta previa or low-lying placenta, oligohydramnios, polyhydramnios, and cervical insufficiency. Following the training and oversight period, trainees performed screening ultrasounds independently achieving a 99.4% concordance score with reviewers, pointing to the benefit that these trained individuals maybe a useful adjunct in ultrasound screening for high-risk OB conditions where access to care is limited (Nathan et al., 2017).

In Kenya, Africa, to compensate for a shortage of sonographers, radiologist Sudhir Vinayak trained midwives to perform focused point-of-care ultrasound for screening high-risk pregnancies using tablet software and cell phone transmission (Vinayak et al., 2017). They found image transmissions maintained good quality and represented a potential efficient cost-effective method of exchanging images.

Stanton and Mwanri from the School of Medicine, Flinders University in Adelaide, Australia, conducted a literature review assessing the potential of obstetric ultrasound to improve maternal and newborn health in low-resource settings. Although they found the literature lacked large-scale trials especially in rural and remote areas, they reported teleradiology and portability of ultrasound offer opportunity for improved access, potentially improving maternal care and outcomes. They found ultrasound especially helpful in screening number of gestations, fetal lie, placental position, due date, and fetal growth (Stanton & Mwanri, 2013).

Figure 8. Mayan women carry their children on their backs and bring them to classes. Permission to use photos granted by Nikki May, Maya Midwifery Council Board Member.

Conclusion

With each campaign, the team gained greater insight into local customs, needs, learning styles, and the barriers. Continual project reassessment and adjustments were necessary. We began each day with a plan of the day and ended with a debriefing session. Obtaining feedback from the midwives, the interpreters and other supporting groups allowed for continuous modifications of the training sessions and real-time process improvements. Trainers remained hypervigilant of unanticipated cultural barriers and hardships adapting and making changes quickly. Flexibility and comfort in adjusting teaching methods on the spot is necessary and key to success.

Creating sustainability is difficult but doable. No group can meet the extensive education and health needs in these rural areas. Even when a donation of new technology such as ultrasound is done, the greater problem is often finding the expertise to use the equipment (i.e., trained health personnel, radiologists, technologists, nurses). By working cooperatively with other volunteer groups, each contributing its strengths and resources increases the ability to reach the desired goals identified by the ACAM midwives. These campaigns were a part of a larger plan that contained other volunteer groups who could continue initiatives and trainings. Other volunteer groups of radiologists, technologists, nurses, and midwives have joined alone or in combination to continue the work started or advance the project goals.

Although quality data are difficult to obtain, at the time of this writing, we have been told there have been no reports of maternal deaths and five conditions identifying a high-risk delivery found on ultrasound by the trained midwives.

For the indigenous pregnant woman, having the ultrasound in the local midwives' clinic means that she can get the same care in her community and not travel by bus to the public hospital. Hearing the baby's heartbeat makes the pregnancy suddenly very real. Getting a picture of the unborn baby from an ultrasound examination enables the mother to share the affirmation with others.

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