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Original Article

Implementing minimum basic training for nurs es,midwives and CHEWs in limited obstetrics ultrasound (LOUS) in resource-scarce primary healthcare settings: the Borno state pilot experience

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Abstract

Background: The acute shortage of sonographers and healthcare providers with specialist training in sonography is a significant challenge to providing ultrasound services in primary healthcare centres in regions where resources are scarce. **Objective**: This study aimed to determine the feasibility of implementing POC USS training using the ISUOG guide for training ultrasound-naive healthcare providers in primary healthcare centres to achieve some level of competence in limited obstetric ultrasound. **Methodology:** A point-of-care obstetric ultrasound training program for primary healthcare providers was conducted in collaboration with the Borno State Primary Healthcare Development Board at the Mubil Women's Outpatient Clinic and Ultrasound Services in Maiduguri. The target group consisted of nurses, midwives, and Community Health Extension Workers (CHEWs). A five-day obstetric ultrasound training was conducted from December 16th to 20th, 2024. Using the six-step approach proposed by the International Society for Ultrasound in Obstetrics and Gynaecology (ISUOG) as a guide for the training. Descriptive statistics were used for data analysis. The Statistical Package for Social Sciences (SPSS) version 21.0 was used for data analysis. **Results:** A total of 3(50%) participants were Nurses/Midwives, while 3 (50%) were CHEWS, and 3 (50%) were computer literate, while 3(50%) were not. There was a significant difference in the participants' pre- and post-test performance, $p < 0.05$. There was uniform positive feedback from the participants regarding the content and scope of coverage and the nature of the training delivery. **Conclusion:** This pilot implementation has demonstrated that some level of ultrasound competency is achievable among ultrasound-naive Nurses/midwives and CHEWs within a short timeframe using focused and intensive didactic and hands-on training.

Keywords: *Limited Obstetric Ultrasound, Midwives, Nurses, Point-of-Care Ultrasound, Resource-Scarce Settings.*

Introduction

Since the commencement of the use of diagnostic medical ultrasound in the early nineteenth century, ultrasound use has spread across various medical specialties, pushing professional boundaries. It is still moving as evidence, and clinical demands keep expanding.[1]

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The acute shortage of sonographers and healthcare providers with specialist training in sonography is one of the significant challenges to providing ultrasound services in resource-scarce settings. [2] An innovative proposal for training Nurses/midwives to perform limited obstetric ultrasound (LOUS) to identify high-risk pregnancies for appropriate/specialist care was first proposed by Nathan et al. [3] This algorithm is similar to the triaging service that identifies patients requiring additional care. LOUS is a directed ultrasound examination performed in suboptimal conditions to pick up high-risk cases early and refer them for further care; however, it is not a replacement for a comprehensive ultrasound. The minimum training required to perform LOUS needs to first reflect the peculiar needs of the population of deployment. [2,3]

Technological intervention in health using ultrasound can aid in improving healthcare delivery and outcomes, especially in developing countries. However, ultrasonography is a highly operator-dependent procedure with a long learning curve. [4] Several international societies like the Society for Ultrasound in Obstetrics and gynaecology (ISUOG) recommends a trainee in ultrasound to spend not fewer than 100 hours of supervised sessions and complete not fewer than 100 ultrasound examinations before practicing independently with minimal supervision, [5] the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) recommends trainees complete 300 ultrasound scans before independently performing ultrasound scans with minimal supervision. [6,7] The World Health Organisation (WHO) recommends a 3–6 months training program, completing not fewer than 300-500 ultrasound examinations for medical personnel and a minimum of 6 months period of training for other healthcare providers with a prior 2 to 3 years training from a recognized training health institution; it also recommends a minimum of 200 first-trimester ultrasound scans and 200 ultrasound scans for second and third-trimester examinations for obstetrics application. For abdominal applications, 250 ultrasound scans were recommended and 50 scans for pelvic applications to meet the minimum proficiency level in these areas. [2,8-10] However, these recommendations may not be feasible in resource-scarce settings.

Other training models have been used in different settings, yielding the desired results after one week [2,11,12], two to three weeks [13-15], nine weeks [16,17,] and after twelve weeks of training.[17,18] These trainings were tailored to the peculiar needs of the population of their deployment, providing valuable knowledge and ultrasound skills to the low and middle-level healthcare providers. Training generally covered topics like physics of ultrasound, instrumentation in ultrasound, and cross-sectional anatomy of the abdomen, pelvis, obstetrics and gynaecology, estimation of gestational age by ultrasound, ultrasound evaluation of the cervix, and the placenta, preventive care and maintenance, image optimisation, among others [4,8,11-18.] Importantly, the training must cover the needs and peculiarities of the population of deployment. Most models may not require rigorous training; some have a level of flexibility to ensure that it does not interfere with service delivery, where healthcare personnel are trained on the job by rotating physicians. [9,10,14] Proper training and continued follow-up, quality assurance, and a second opinion from an experienced sonographer/sonologist using telecommunication and other social media platforms like WhatsApp for second opinions from remote locations are very important to maintain proficiency and skill in ultrasound imaging in this context. [2,19-21]

Despite the recommendations from international health bodies and findings from several projects, there is still no universally accepted minimum training standard for non-sonographer health workers performing LOUS. This is therefore a need to define and test locally appropriate models that balance training quality with feasibility and service delivery continuity. To address this gap, we sought to determine the minimum basic training required to equip ultrasound-naïve health workers to achieve competence in performing LOUS safely and effectively, in a resource-scarce primary healthcare setting. Using an intensive, hands-on approach adapted from international best practices, this implementation initiative is meant to provide the health worker with skill sets that will facilitate the identification of high-risk pregnancies and referral for appropriate management and care.

Materials and methods

This was a short-term, implementation-focused intervention using a cross-sectional design. The study was conducted from December 16th to 20th, 2024, at the Mubil Women's Outpatient Clinic and Ultrasound Services located on Bama Road, Maiduguri, Borno State, Nigeria. The clinic served as both the training site and recruitment centre for participants and volunteer patients. The training was supported under the State Primary Health Care Development Board

(SPHCDB), a collaborative initiative sponsored by the Nigerian Governors' Forum, Bill and Melinda Gates Foundation, Aliko Dangote Foundation, and UNICEF, in partnership with the Borno State Government.

Six healthcare workers comprising Nurses/ midwives and Community Health Extension Workers (CHEWs) were purposively selected from 3 identified busy primary health centres across Maiduguri Metropolitan Council and Konduga Local Government Area. None had prior ultrasound experience. Selection criteria emphasised frontline roles in maternal care and facility workload to ensure practical relevance and impact. This training introduced ultrasound to the Nurses/midwives and CHEWs to identify high-risk pregnancies and refer them for appropriate and specialist care [13]. These centres were also coded A, B, and C for anonymity.

Volunteer pregnant women attending routine visits at the clinic were recruited for ultrasound practice sessions. All participants provided informed consent after explanation of the procedure. They received free scans and light refreshments during their wait. Participation was voluntary and did not affect the care received.

The five-day training was designed around the six-step ISUOG training model, adapted for point-of-care obstetric ultrasound. The training team consisted of two instructors: a professor of Obstetrics and Gynaecology certified in ultrasound and a PhD-level sonographer with over 15 years of clinical experience. The training sessions included both didactic lectures and hands-on practice. The training covered topics in ultrasound physics, instrumentation, safety, maintenance, and basic obstetrics measurements for determining gestational age. Nurses/Midwives were trained on how to turn the machine "ON and OFF," enter patient data, adjust equipment settings, save images, clean the probe, and properly secure the machine. The six-step approach proposed by the International Society for Ultrasound in Obstetrics and Gynaecology (ISUOG) [5,22] was used as a guide for this training. These included determination of foetal presentation and lie, detection of foetal cardiac activity, identification of the location and position of the placenta, estimation of amniotic fluid, and then the foetal biometric measurements [5,22], as recommended. The instructors concentrated on one foetal biometric measurement, which was the Bi-Parietal Diameter (BPD) measurement, and reviewed the saved images of the Nurses/Midwives as well as their data sheets.

Competency was assessed using a structured Objective Structured Clinical Examination (OSCE) at two points: pre-training, to assess baseline knowledge, including computer literacy and ultrasound familiarity, and post-training, to measure improvement in technical and interpretative skills. Performance was analysed quantitatively to evaluate the effectiveness of the training. A total of 40 pregnant women were scanned during the training season. Each Nurse/Midwife or CHEW scanned 2 pregnant women under the careful supervision of one of the facilitators before they were rotated to the next facilitator to carry out a similar procedure on different subjects during the training. Rotating trainees through multiple facilitators ensures that they are evaluated on the same criteria across different subjects, reducing subjective bias. Close supervision by subject-matter experts has proven to ensure safe, accurate practice and immediate feedback before trainees begin independent practice[23]

Data Analysis

Descriptive statistics were used for data analysis, with frequencies, percentages, and means ± standard deviations reported for the study. A paired t-test was used to compare the means before and after the training. A questionnaire was used to collect feedback from participants regarding their experience with the training. Statistical Package for Social Sciences (SPSS) version 21.0 (IBM Corp., 2021)[24] was used for data analysis.

Results

A total of six (6) healthcare professionals participated in the training. Among them, 3 (50%) were Nurses/Midwives, while 3 (50%) were CHEWs. Three (50%) of the participants (2 nurses and 1 CHEW) were computer literate, while the remaining 3 (50%) (2 CHEWs and one Nurse/Midwife) were not, as seen in Table 1.

The boxplot in Figure 1 compares the distribution of scores between the pre-test and post-test. Observed data reveal that pre-tests have a lower median score with a wider spread of results, while the post-test displays a higher median and generally higher scores, indicating improvement.

Table 1: Professional Affiliation of Participants

Professional Affiliation	Place of Practice	Years of Practice	Computer Literate
Nurse	1000 Housing Estate Clinic	34	No
Chew	Mala Kachalla PHC Maiduguri	12	Yes
Nurse	Mala Kachalla PHC Maiduguri	30	Yes
Nurse	Yerwa PHC	35	Yes
Chew	Yerwa PHC	25	No
Chew	1000 Housing Estate Clinic	34	No

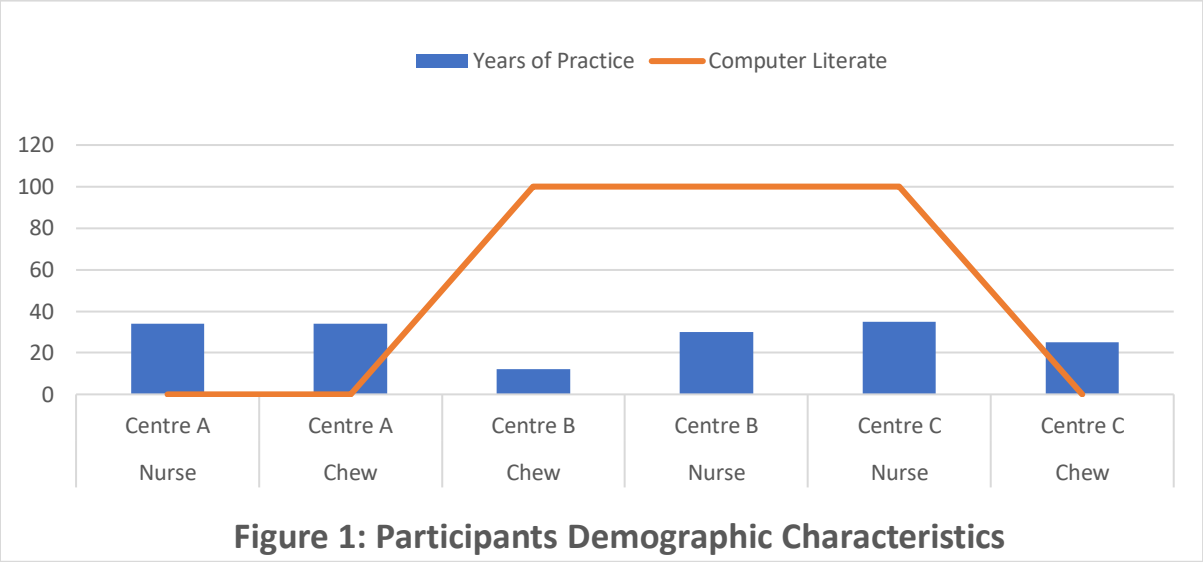

Figure 1: Participants Demographic Characteristics

Key
Chew: Community Health Extension Workers
Place of Practice: Centres A, B and C (Primary Health Care Centres)

The learning curve chart in Figure 2 illustrates each participant's progress. Most lines show an upward trend from pre-test to post-test, indicating an increase in scores. Only one line shows a slight downtrend, suggesting either no change or a drop in performance after the post-test. There was a significant difference between the pretest and post-test, $p < 0.05$. Implying the observed increase in test scores is unlikely to occur by random chance. The statistically significant improvement strongly suggests that the training was effective in enhancing trainee competence.

The bar chart illustrates participant responses to various questions at the end of the training regarding their expectations. Each question measures satisfaction and perceived effectiveness of different aspects of the training program. The uniformly positive feedback across all questions indicates a highly successful training session, both in content and delivery. This suggests a strong alignment between training design and participant expectations and needs, as shown in Figure 3.

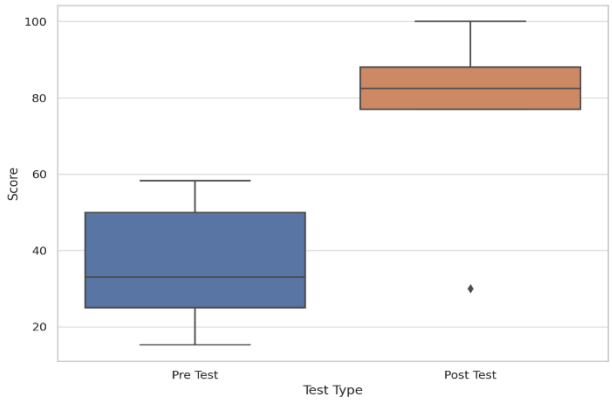

Figure 2: Boxplot of Pre- and Post-Test Scores

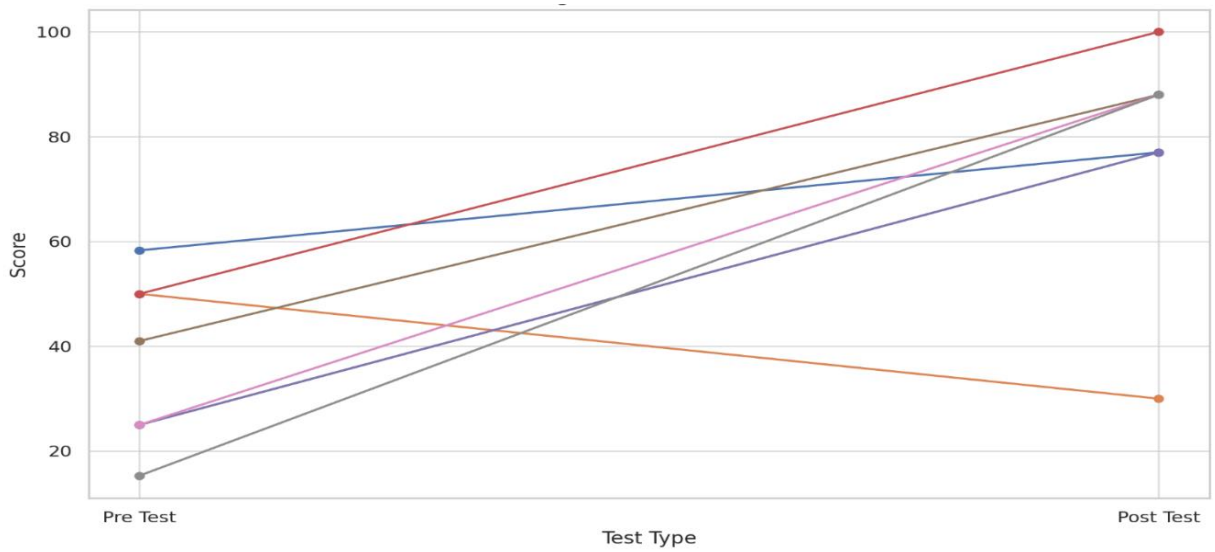

Figure 3: Learning Curve for Each Participant

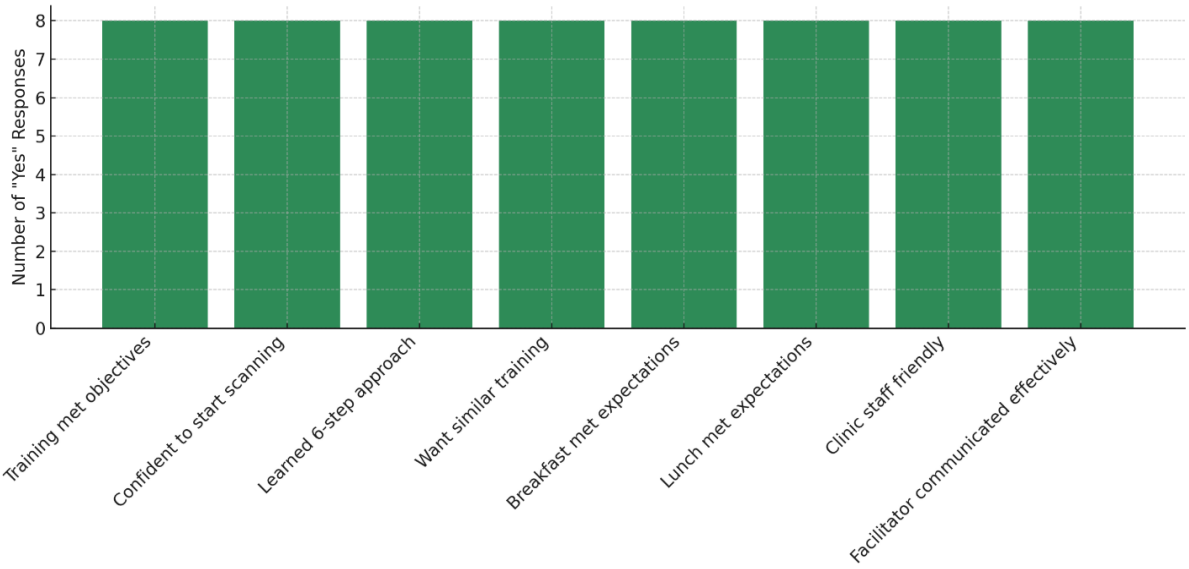

Figure 4: End of Training Evaluation Summary

Discussion

This study seeks to provide evidence-based minimum basic curriculum requirements for nurses, midwives, and CHEWs in resource-constrained settings to perform limited obstetric ultrasound (LOUS), identify high-risk pregnancies, and refer them for appropriate management and care, thereby reducing the high burden of maternal and child morbidity and mortality. Ultrasound imaging is one of the imaging modalities tagged as the workhorse for the primary health care centres in regions where resources are scarce. [25] However, very few primary healthcare centres in Borno State, Nigeria, and other sub-Saharan African countries can boast ultrasound imaging facilities.

This pilot phase implementation initiative demonstrates that a well-structured, short-duration training can equip ultrasound-naïve

nurses/midwives and CHEWs with the basic skillsets required to perform LOUS in primary health settings. Leveraging and adapting the six-step approach of the ISOUG, the training successfully built the foundational skills required to identify high-risk pregnancies and refer to a specialist for expert evaluation and management.

The training consisted of 6 (100%) healthcare personnel, including nurses/midwives and CHEWs. This set of healthcare personnel was recruited from the primary healthcare centres in the communities where the in-house on-the-job training occurred. It has been reported previously that nurses, midwives, and CHEWs were the most reliable set of healthcare professionals who have high retention rates in service, especially in the primary healthcare centres within the rural communities, as other healthcare professionals are more prone to migration and working in tertiary and secondary healthcare facilities [26,27]. Nigeria is in dire need of manpower resources for health; therefore, training of middle to lower-level healthcare professionals to acquire basic essential skills needed to provide critical services in the rural and hard-to-reach areas is very important in meeting the goal of ensuring that no one is left behind. [28, 29]

Our participants consisted mainly of Nurses/Midwives and CHEWs, who were recruited from primary healthcare centres in Maiduguri Metropolitan Council and Konduga Local Government Area in Borno State. This reflects the true nature of the quality of healthcare personnel manning most of the primary healthcare centres. The Alma-Ata declaration in 1978 and the Astana reaffirmation in 2018 highlighted how important primary healthcare is to achieving healthcare for all, and as the first point of care for individuals and their families, this should be accessible and affordable to achieve universal health coverage and the Sustainable Development Goals. [30] As such, adequate training and retraining of primary healthcare workers are essential to obtain the requisite skills and competence to serve the ever-growing rural populace. This is because healthcare personnels in the primary healthcare centres which are mostly situated in the rural communities are faced with peculiar challenges of not only the inadequate infrastructure, but there are also limited opportunities for continues professional developments and career progression as such, trainings like this offer them opportunity to acquire specialized knowledge, skills and competence to provide effective and accessible services, especially in areas where resources are scarce. [31]

There was an observed improvement in the participants' performance in the post-test compared to the pre-test; this was statistically significant with $p<0.05$. This is an indication that the training was effective. Previous works reported an improved overall performance of their trainees' post-training evaluation. [4,13,21,32]

The current study reports the improvement in knowledge and skill on limited obstetrics ultrasound after an in-house training by Nurses/Midwives and CHEWs, thus indicating that the curriculum was effective in delivering its set objectives to achieve competence in the provision of limited obstetrics ultrasound services in rural communities and hard-to-reach areas where resources are scarce. Also, this confirms the value of short, intensive, hands-on learning models and aligns with findings from other implementation contexts where competency-based ultrasound training was delivered in one to three weeks. [4,11-15] Overall, training had a positive impact on the participants, as observed improvement in the trainees' knowledge of ultrasound physics, instrumentation, safety, maintenance, and basic obstetrics measurements for the determination of gestational age. The training concentrated on the six-step approach by the ISUOG, where the foetal presentation, lie, cardiac activity, identification of location and position of the placenta, estimation of amniotic fluid, and one important foetal biometric measurement, which was the Bi-Parietal Diameter (BPD) measurement. All the participants except one showed improved performance as shown on the learning curve in Figure 4. This agrees with the reports from previous findings [4,6,13,21], which reported a varying degree of competency in the performance of various foetal parameters during foetal biometry. This is because ultrasound has been reported as a highly skilled technique with a very long learning curve requiring a high level of hand-eye coordination.

On the perceived expectation and satisfaction with the training, participants' expectations were met and even surpassed, as expressed by some of the participants, and they were satisfied with the training program in terms of its scope, content, and delivery. This may not be unconnected to the clear delivery of the course content by the facilitators and the intensive hands-on practical sessions using the six-step approach. As in-house training programs are designed and customised to help the trainers address the trainees' needs and also help them build a sense of competence and autonomy, which are very important in the field. [21,34-36]

A major strength of this study was its design around

real-life constraints. Participants were selected from busy clinics in major cities in the state; this will help maximise downstream impacts. Also, the training content was targeted; the instructors focused on one foetal biometric measurement, that is, the Bi-Parietal Diameter (BPD) measurement for the duration of the course. Furthermore, the instructors reviewed the saved images and data sheets of the participants, providing continuous feedback, which helps reinforce learning. This quality control mechanism, combined with structured OSCE assessments, helped ensure skill acquisition within a short timeframe.

One limitation of this study is the small size of the participants, which may limit the generalizability of the findings. However, the pilot study provides proof of concept that can be used to conduct larger studies.

Conclusion

This study has demonstrated that ultrasound-naive Nurses, Midwives and CHEWs can achieve some level of ultrasound competency after an in-house intensive didactic and hands-on training using the six-step approach as proposed by the ISOUG, where the foetal presentation and lie, cardiac activity, location and position of placenta, amniotic fluid and foetal biometric measurements, along with other basic information, can deliver the expected outcome within a 5-day training period when backed by continues monitoring and evaluation for three months post training.

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