

# Limited Obstetrics Ultrasound by Midwives in Gauteng, South Africa: Benefit of Service-oriented Competency Development in Primary Healthcare Delivery: A Pilot Study

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**Abstract:** In South Africa advanced midwives are expected to independently provide comprehensive midwifery care from prenatal to postnatal stage. The integration of obstetric ultrasound diagnostics capability into routine pregnancy care delivery by the first healthcare responders will augment clinical decision making and appropriate case management action. The current PHC service delivery has not integrated basic ultrasound capability into routine pregnancy care service. Advanced midwives were trained on basic obstetric ultrasound and make a care management decision based on ultrasound findings performed. Midwives could accurately diagnose morbidity related complications. We conclude that advance midwives care management plan is augmented when competence and provision of limited obstetrics ultrasound is integrated as a routine pregnancy care service in a maternity outpatient unit and community health centre. Because close to fifty percent of women from the community who attend these clinics could not accurately recall their last menstrual period, it is appropriate, and should become an expectation for these first responders to utilise ultrasound to offset potential morbidity induced by uncertainty of gestational age and weight estimation. These should be an integral component where this program is transferred or reproduced.

**Keywords:** Ultrasound, Advance Midwife, Primary Healthcare PHC, Referral, Antenatal Care

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## 1. Introduction

There is growing evidence to intergrate Obstetrics Ultrasound in rural primary healthcare facilities PHC, performed by health workers especially Midwives, with improve attended births, first antenatal care ANC booking and +4 ANC attendance, and some evidence have shown good potential to improve composite indicators like maternal and new born mortality rate [7, 12, 13]. These reports are almost usually within the context of ultrasound related primary healthcare pilot program, intervening in resource limited setting having inherent poor maternal outcomes. All such reported programs have training of health workers as the

primary input activity to establish competence without which the intervention is flawed. These reported training sessions significantly vary in structure, primary competency expectation and cost of implementation, quality assurance inputs and seldom take into account possibilities of its devolution into routine maternal and new-born health service delivery. For such training to be replicated, transferred or incorporated into the service training system as a competency requirement for improved service provision, it becomes necessary to benchmark same with any internationally proposed training standard, test and competency standards, it also requires a structured appraisal matrix to enable continuous improvement in practice and performance. It should also allow for new knowledge addition and expansion

in the context of continuous professional development (CPD).

The midwives' use of ultrasound is now a widely acceptable practice in the ANC service delivery especially in low to mid income countries (LMIC) primarily because of its ease of sustainability especially with availability of low-cost scanners like the GE's Vscan access and standard service focused, easy to scale training accompaniment like the GE's LOU. In this article we demonstrate how competence in a structure limited obstetric ultrasound training LOU has been successfully matched with ANC service, which translates into ANC outputs improvement through expansion of the midwives capabilities. First, we accredit the scan performed by the midwives comparing with a sonography standard, primarily because ultrasound triaging has been an acceptable measure to categorize normal from abnormal pregnancies and to date pregnancy, when used by new cadre of workforce with no previous ultrasound experience should be equally weighted as the standard of care: the sonographer, for patient and public safety. This became an objective of the training pilot program, and its quality assurance mechanism described here. Secondly, we evaluate the interrelationship between the trained advanced midwives competence and related ANC services outputs. Focus antenatal care was revived in 2002 by the World health organisation WHO (WHO 2002, 2016, 2018) basically as a strategy to improving access to essential antenatal care for expectant mothers. Since then, many complementary services delivered by health workers have been introduced in various setting to strengthen its delivery and improve its effective composite benefit, against the backdrop of improving equity and quality of care. The LOU service should be one of such. It allows for dating pregnancy and ascertaining normality of the growing foetus by the first responder usually a midwife. Pregnant mothers should expect LOU at least once during that pregnancy at our intervention site. This is consistent with the WHO recent recommendation of at least 1 ultrasound scan (WHO 2018) and the International Federation of Gynaecology and Obstetrics FIGO recommendation of at least two ultrasounds [4].

With a structured training approach and establish competency linked to pregnancy service requirements, it will no longer matter if the Limited Obstetric Ultrasound service is performed by a sonographer, physician, midwife, obstetrician or radiologist while allowing for appropriate referral and respect for local guidelines. Such structured ultrasound training delivered through our project in Gauteng province in south Africa allows for equitability and quality of pregnancy experience amongst community women.

We describe outcomes of the LOU, its approach, structure, methods, competency assessment mechanism and its effect in service provision when used as a point of care modality. We attempt to answer the primary question: are advance midwives (AM) able to perform obstetric ultrasound and accurately date pregnancy?

Ethical Approval: Permission was granted by Sefako Makgatho Health Sciences University research ethics committee to conduct the project. Ethical Approval reference: SMUREC/M/270/2017:IR.

## 2. Methodology

A quantitative evaluation of midwife's competence to perform protocol specified limited obstetric ultrasound LOU was performed. The 10 (ten) advance midwives, 2 (two) from 5 (five) health districts of Gauteng Province with no previous ultrasound experience underwent 18 weeks training comprising of 10 days' classroom and 16 weeks user mentoring and grading (UMG) session. The UMG comprised of 5 structured supportive mentorship physical visit to trainee's health facility per facility resulting to about 115 equivalent man hours and more than 2 hours of structured phone calls per trainee to provide trainee with remote supportive mentoring intended to be as real time as possible within the UMG period. The General Electric's GE portable battery powered Vscan access ultrasound equipment was used during training and in their practice. On completion of the training, the midwives were evaluated on their competence in foetal biometric measurement for gestational age determination, identification of normal pregnancy and their ability to refer the pregnant women with unsure or abnormal findings based on the GE's LOU protocol. The midwives recorded their finding into ultrasound scan logs and archived protocol-specified sonogram per patient and machine generated report in the handheld ultrasound machine. For evaluation, all the sonograms taken for each patient was extracted using a USB memory stick with date of examination, last normal menstrual period, sonograms and machine generated report containing both composite ultrasound age and gestational age by LMP. The Consultant Sonographer and the Obstetrician provided quality assurance inputs during UMG and practice, and where responsible for practice accuracy and standards during the pilot. The Consultant Sonographer serve as standard, reviewed every image generated by each midwife, graded for accuracy of scan plane, accuracy of calliper placement during each biometric measurement, image optimisation, pattern recognition, completion of scan protocol and patient management/referral and provided the midwife with quality improvement feedback.

All 10 (ten) midwives scanned in a community outreach model. 35 (thirty-five) healthcare facility, 10 (ten) maternity outpatient unit MOU, and 15 (fifteen) community health centre (CHC), inclusive of their primary clinic across the 5 (five) health districts of the province was supported. Case referral where made in accordance with the Gauteng department of health DOH guidelines. Each midwife supported at least 3 (three) facility and all 10 (ten) in total have scanned more than 7500 (seven thousand five hundred) mothers during the study period. The intervention did not include a community sensitization component.

More than 70,000 (seventy thousand) images were generated and evaluated. Comparison are made between the performance of nurses using Vscan access and the finding by the consultant sonographer. During analysis of agreement of gestational age, gestational age was rounded up to the nearest week if above or below 3 days. The Mean  $\pm$  Standard deviation, a *t-Test* and its transformation to *p-value* was

computed for each category of biometric parameter. Pearson's Correlation coefficient ( $r$ ) a bivariate correlation between the gestation age determined by the AM as against gestation age determined by a sonographer was computed ( $X=AM$ ;  $Y=Sonographer$ ). Pearson's correlation coefficient was assigned a value between +1 and -1. when it is (1) it represents total positive linear correlation, when it is (0) it represents (no linear correlation), when it is (-1) it represents total negative linear correlation. A quantitative evaluation of the patient knowledge of their LMP, indication for scanning, ultrasound findings, corresponding action based on ultrasound finding including appropriate referral was extracted from the

ultrasound log book and analysed. Incompletely log details was not utilised during analysis.

### 3. Results

#### 3.1. UMG Assessment

Figure 1 shows improvement in the knowledge and skill amongst the advanced midwives progressing through the UMG period. At end of 16weeks 10% ( $n=1$ ) of trainee AM was given an additional 6weeks intensive probation to meet up the competence pass of > 71%.

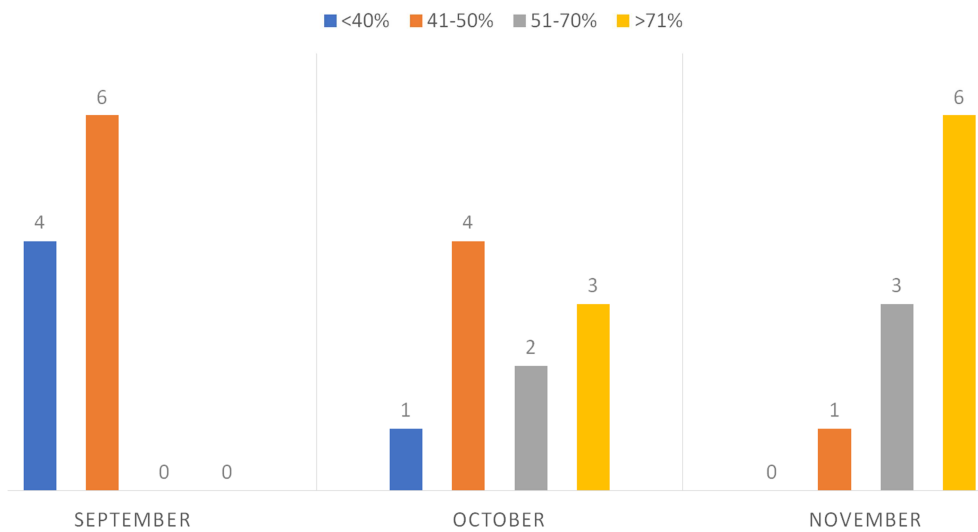


Figure 1. Performance of AM's over the UMG period.

Biometric parameter	[n]	GA Range (weeks)	[Mean] AM	[Mean] Sonographer	SD AM	SD Sonographer	P Value	[r] Value	CI 95%
Gestational Sac	218	5-9	11.0	12.3	5.2	6.42	0.0190 (statistically significant)	0.80 (good correlation)	[0.03-1.570]
Biparietal Diameter	3116	14-40	24.0	23.7	6.5	6.3	0.0310 (Statistically significant)	0.9860 (Excellent correlation)	[0.761-1.211]
Femur Length	3110	14-41	23.9	23.6	6.4	6.3	0.0630 (not significant)	0.960 (Excellent correlation)	[0.735-1.185]
Abdominal Circumference	3110	14-41	23.7	23.6	6.4	6.3	0.5320(Not significantly different)	0.980 (excellent correlation)	0.757-1.203
Crown rump length	292	6-13	10.5	10.4	2.0	1.9	0.5360(Not significant)	0.950 (Excellent correlation)	0.77-1.123
Head Circumference	3103	14-40	23.9	23.6	6.5	6.2	0.0630(Not significant)	0.985(Excellent correlation)	0.762-1.201

Figure 2. Performance of sonographic biometry by AM against results by quality assurance.

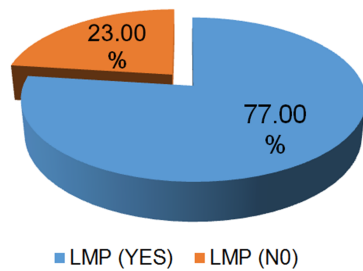
#### 3.2. Fetal Biometric Assessment

Figure 2 shows excellent correlation between the midwives gestational age determination for foetuses in second and third trimester when compared with the standard. First trimester assessment was within acceptable range.

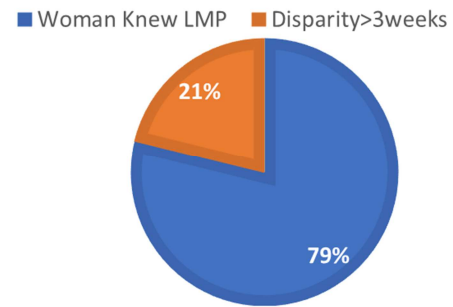
#### 3.3. Knowledge of Last Menstrual Period LMP Amongst Women Who Received Ultrasound Service

In Figure 3, 77% ( $n=3898$ ,  $N=5065$ ) of women who received scan could recall their LMP. 23% ( $n=1167$ ) women could not recall their LMP. Of the patient who could recall their LMP, 21% ( $n=1486$ ) had a significant disparity greater than 3weeks (range

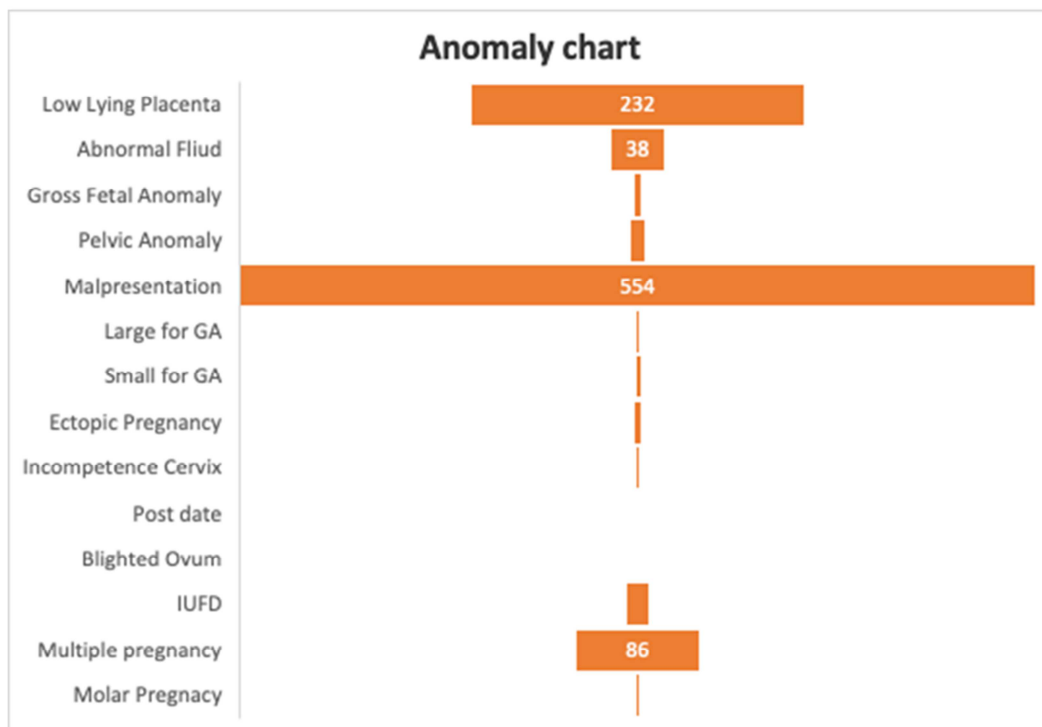
3-12weeks) between the GA by LMP and GA by the composite ultrasound age CUA as shown in Figure 4.



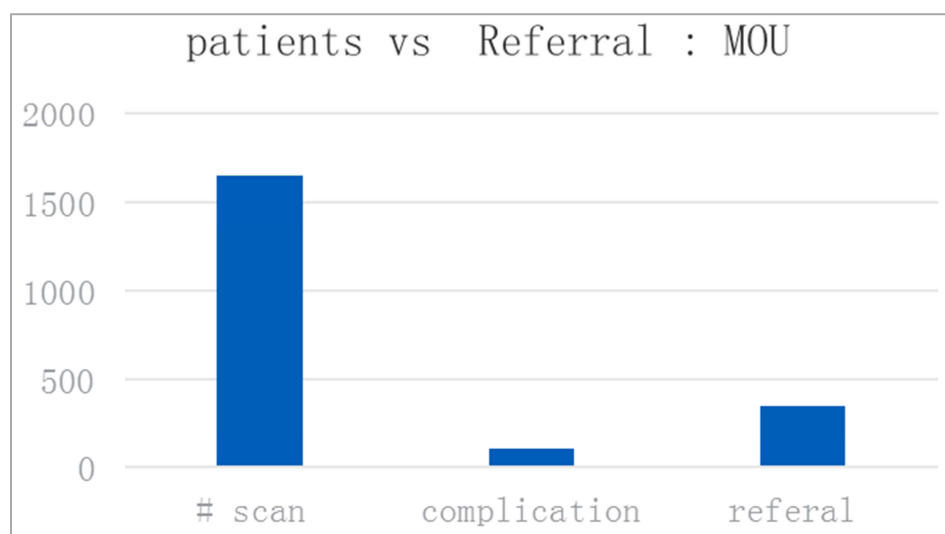
**Figure 3.** Knowledge of LMP amongst women who received scan.



**Figure 4.** Knowledge of LMP vs disparity >3weeks between GA by ultrasound (composite ultrasound age) and GA by LMP amongst women who received scan.



**Figure 5.** Distribution of anomaly.



**Figure 6.** Patients vs Referral.

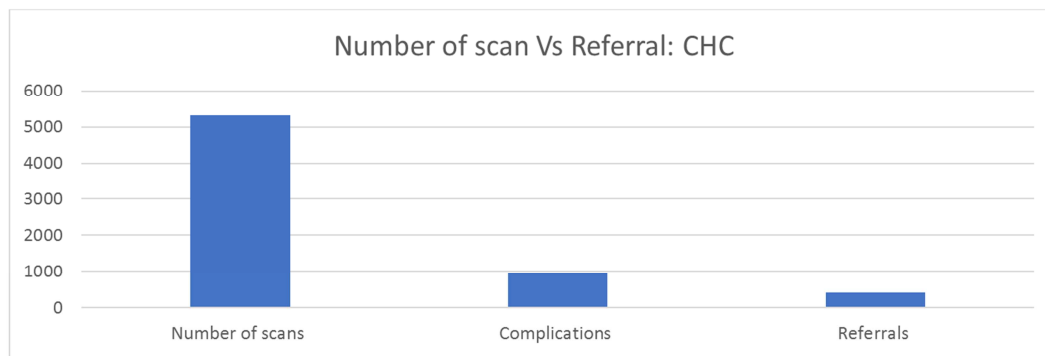


Figure 7. Number of scan vs Referral: CHC.

### 3.4. Total Complication Identified and Pattern of Ultrasound-based Referral at MOU and CHC

There were 944 pregnancy abnormalities identified. Figure 5 shows the distribution of anomaly. Malpresentation and Low-lying placenta and multiple pregnancy were the most common. When disaggregated by indication, 89% (n=840) patient who receive ultrasound were asymptomatic women attending the ANC. 13% (n=109) of these patients had an ultrasound detected anomaly. 11% of women presented in the clinically high-risk category by indication. There was an associated complication detected in 80% of women in the high-risk category.

The pattern of referral differs between the MOU and the CHC as shown in figures 6 and 7 primarily because, some MOU facilities were operating from 07H00 and closed at 16H00 while the CHC where CEMoNC facility with capability to manage most complications identified.

## 4. Discussion

The safe use of ultrasound at the primary health care level requires that practitioner should meet the minimum approved competency standard. Our study confirms the capability of 10 (ten) advanced midwives to perform limited obstetric ultrasound LOU after undergoing an eighteen weeks training course. We demonstrate in figure 1 that skills and proficiency improve overtime and with consistent exposure to hands on practice, continuous mentorship, grading and feedback against clear competency objectives. During the UMG implementation, 30% of health workers could not attain the desire competency during the UMG phase, warranting an extension of UMG support and timeline to bring them to the desire competency level after additional 8 weeks. In an unstructured in-depth discussion, increase workload due to additional task was a central theme cited. In response, we did advocate for a supportive learning workplace, essentially putting in place a work schedule which frees the already overwhelmingly busy health workers, creating time to practice and reflect in practice within the UMG phase. While recent studies have pose a casual association between increase workload on health workers with poor maternal service provision (Fabienne N et al 2018) and women ability to decide

to seek care in a health facility [2, 11, 14], we observed that increased workload due to addition of new task prevents the health workers reflective learning in practice. The WHO have set forth guidance in the 2010 workload indication of staffing need WISN (2010), and we strongly advocate its adoption where ultrasound service is delivered at primary care center. Increase in workload on trained staff must be accounted for to ensure learning which translate to positive effect of the ultrasound service.

The competency parameters met by the AM in the LOUT includes accurate biometric evaluation, completion of scanning protocol to assess for fetal presentation, confirmation of fetal heartbeat, placentation, number of fetus, liquor volume, gross fetal anatomy assessment, cervical length assessment, fetal growth and anomaly associated with length of gestation and fetal weight. In first trimester, it includes assessment of the adnexa, the uterus and measurement of its length, gestational sac assessment, number of fetal poles, biometric dating, and identification of common conditions like anembryonic gestation, molar pregnancy. The LOUT competency was derived by aggregation of ultrasound image assessment, fulfilment of minimum competency in the checklist and completion of scanning according to protocol. Our intension is not to provide a vivid description of the competency assessment method been proprietary of General electric healthcare. Our training structure and delivery is similarly described by Nathan R et al [10]. Our defined minimum competency in the LOUT compares to the International Society of Obstetrics and Gynaecology ISOG level 1 (Basic requirement) competency requirement (ISOG 2013), the American institute of ultrasound in medicine AIUM limited first, second and third trimester ultrasound assessment recommendation (AIUM 2018). Benchmarking the midwives competence against international standards allow for skill transferability, practice standardization, compensation and competitiveness, workforce retention and skill indexing. The AM received certificate after completion of UMG phase.

To ensure quality, a consultant sonographer served as a standard and evaluated all sonograms remotely that where produced by the AM. We show in figure 1 that the AM competence was satisfactorily. During practice, more than seventy thousand sonograms was review and verified by the consultant sonographer remotely and selectively real time.

There was excellent agreement for second and third trimester biometric parameters, and when compared to first trimester parameter, the reduce number of first trimester practice exposure due to reduce number 1<sup>st</sup> trimester ANC patient during training is responsible. LOU training delivery must plan to ensure that 1<sup>st</sup> trimester subject logistics is enough to drive the required skill and competence required.

Accurate gestational age assessment and the reduction of disorders related to length of gestation and fetal weight is now a well-accepted benefit of ultrasound. In the Gauteng province, ANC coverage by the PHC remains at 50% similar to Kenya, Mozambique, Nigeria and Rwanda, hence improvement of gestational age assessment can significantly and consistently offset the reported perinatal mortality (Statistics South Africa, 2016). We show that 50% of GA determined by LMP among study population of women was unreliable. This agrees with the multicounty study by Rada S, Gamper J et al (2018), and study conducted in California by Wegienka G and Day B (2005). One will not expect such finding from the Gauteng province, been is a sub metropolis and having a higher level of female literacy, however the LMP recall by women of reproductive age does not correlate with their education status. (Wegienka G and Day B 2005). Qualitative insights from the AM (providers) reveals that most mother's reliance on contraceptive methods (the SADH keep contraceptive coverage at 58.3%, while the use of male contraceptive method has increase since 1988 at its current 18%. SADH 2016) against the background of reported high contraceptive failure (Chersich M et al 2017) is likely responsible for this trend of poor recollection of LMP and consequently poor gestational dating, hence we are suggesting their causal association to greater than a 260% within facility access to the service as pregnant mothers will no longer need to travel out of their community to get a scan.

The participating facility was either a MOU or a CHC. MOU's are day clinics providing routine ANC services while the CHC's are 24 hours comprehensive emergency obstetrics and newborn care CEMoNC facilities. We demonstrated that case management plan and subsequent referral action can be influence both by the ultrasound findings, warranting a change in care plan by the provider and by the functionals layout of service capability of the health facility. In figure 7, only 50% of complications detected by ultrasound was referred. This was so because most identified conditions where be manage within the health facility. MOU's been day clinics would refer all complications regardless. Patient preference and the facility limitation to take delivery also suggested that third trimester with normal scan were equally referred out. Given both scenarios and to elicit the benefit of ultrasound introduction at PHC level of care, we advocate that a tested referral policy be implemented alongside deployment of the program. Our referral protocol was guided by the DOH referral policy guidelines Tshwane health district (2012). Base on the policy, we adopted 3 essential elements. i.e Triaging, referral in or out of facility and community-based service model of ultrasound service delivery. In addition,

infer that the AM use of ultrasound strengthened outputs based on the DOH referral guiding principle of improving patient accessibility to appropriate services based on identified complications or ultrasound triaging, at the appropriate level of competence in care delivery and until the patient is integrated back into normal daily life (DOH, Tshwane Health District 2012).

## 5. Conclusion

Our pilot program infers a connection between Advance midwives competence in limited obstetrics ultrasound with facility referral behaviour due to obstetrics complications detected by ultrasound. Ultrasound performed by trained midwife at the primary health centre will trigger an appropriate referral. We advocate that a LOU services be built on a guiding referral policy where available, if not, a purpose-built referral protocol be created and adopted. Advance midwives in south Africa can expand their competence into limited obstetrics ultrasound, engage redundant decision-making capability to improve pregnant mother outcomes through appropriate ultrasound induce change in clinical decision making and appropriate referral irrespective of the functional set up of service provided in the health facility. Their LOUT can be benchmarked with internationally recognised ultrasound credential this means that the DOH can plan to retain their skill, scale and appropriately compensate the new service capability.

## Abbreviation

AM	advance midwives
ANC	antenatal care
CHC	community health centre
GDOH	Gauteng Department of Health
LOU	Limited Obstetrics Ultrasound
LOUT	Limited Obstetric Ultrasound Training
MMR	Maternal Mortality Rate
MOU	maternal outpatient unit
PHC	primary healthcare
SADH	South Africa Health Survey
WHO	World Health Organisation

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We appreciate the Gauteng department of Health under the leadership of MEC..... (2016) for leading the initiative, providing administrative governance and their approval. The General Electric healthcare (PTY) LTD, South Africa, provided their scan access battery powered portable ultrasound equipment for the duration of the program. The General Electric Primary and referral care Education team also provided their Limited Obstetric Ultrasound Training LOU© manual and program implementation guidelines for ratification by the GDOH and use for Advance midwives training. They provided the resource to complete training, monitoring and infield program monitoring.

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