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Ultrasound Scanning Competencies in Midwifery Education in Zambia: Findings from a Desk Review and Needs Assessment

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Abstract

Introduction: Ultrasound is an essential component of antenatal care. Midwives provide most of the antenatal care but they do not perform ultrasound as it has been beyond their scope of practice. This leaves many women in Low and Middle-Income Countries without access to ultrasound scanning. The aim of this study was to identify competencies in ultrasound scanning in midwifery education. **Methods:** A desk review and needs assessment were conducted between July and October 2023. Articles and curricula on the internet, Google scholar and PubMed were searched for content on ultrasound scanning competencies. A Google form consisting of 20 questions was administered via email and WhatsApp to 135 participants. Descriptive statistics were used to analyse data. **Results:** The desk review showed that it is feasible to train midwives in ultrasound scanning. The training programs for midwives in obstetric ultrasound were conducted for 1 week to 3 months with most of them running for 4 weeks. Content included introduction to general principles of ultrasound, physics, basic knowledge in embryology, obstetrics, anatomy, measuring foetal biometry, estimating amniotic fluid and gestational age. Experts like sonographers trained midwives. Theory and hands on were the teaching methods used. Written and practical assessments were conducted. Needs assessment revealed that majority of participants 71 (53%) knew about basic ultrasound training for midwives. All participants (100%) said it is necessary to train midwives in basic ultrasound scan in Zambia. Some content should include, anatomy, measuring foetal biometry, assessing amniotic fluid level, and gestational age determination. Most participants 91 (67%) suggested that the appropriate duration of training is 4 - 6 weeks. **Conclusion:** Empowering every midwife with ultrasound scanning skills will enable early detection of any abnormality among pregnant women and prompt intervention to save lives.

1. Introduction

The most widely utilized diagnostic technique in obstetrics is undoubtedly the ultrasound scan [1]. Around the world, ultrasound has grown to be an essential component of antenatal care (ANC) and is popularly regarded as safe, convenient, painless, and produces quick, extensive results [2]. Point-of-care ultrasound implementation is equally becoming common in resource-poor settings. Every trimester a woman may have an obstetric ultrasound examination to get precise data on gestational age, foetal health, and cervical length [3]. In order to assess the mother or her foetus and to help with clinical decision-making, ultrasound is also used at the point of treatment [4]. In Zambia, prenatal care is offered at different levels of care starting from the health posts up to the tertiary level of care. Midwives are responsible for most of the prenatal care in both the rural and urban areas. Despite midwives providing care to the majority of the pregnant women, it is not mandatory that they perform ultrasound as it has been beyond their scope of practice. Sonographers and radiologists perform ultrasound scanning in collaboration with the obstetricians. A targeted maternal ultrasonography education program was created for Zambian midwives working in a remote health region. During this program, twenty-one midwives documented 441 scans over the course of the six-month. The progam proved that basic obstetric ultrasonography performance influences clinical decision-making and can be taught to midwives in rural Zambia [5].

The World Health Organization (WHO) recommends that pregnant women have one ultrasound scan before 24 weeks of pregnancy to estimate the gestational age, enhance identification of foetal defects and multiple pregnancies, decrease the need for induction of labour for post-term pregnancies, and enhance a woman's pregnancy experience [6]. Despite the significance of the ultrasound scanning, many women in Low and Middle-Income countries (LMICs) do not have access to ultrasound services due to lack of ultrasound scanning machines and trained healthcare providers [7]. In order to increase access to ultrasound during pregnancy, training in ultrasound scanning has been incorporated into midwifery training in some settings. Consequently, different training techniques and duration have been used in ultrasound education and training programmes for midwives [8]. However, in some settings where ultrasound training has been implemented, staff have expressed concerns about competing priorities when trying to integrate ultrasound into everyday services. In addition, time for faculty to give and practitioners to attend training is highlighted as a major impediment [9] [10].

Lack of education and training programmes designed expressly for midwives

is another obstacle to the use of obstetric ultrasound [11]. Different countries have implemented different approaches to training midwives in ultrasound scanning. A prospective observational study conducted in Mojokerto, East Javaa, Indonesia revealed that following a 4-week ultrasound course, doctors, nurses, and midwives demonstrated a considerable increase in their knowledge and abilities [11].

In Kenya, a pilot project was conducted to train midwives to perform basic obstetric point-of-care ultrasound in rural areas using a tablet platform and mobile phone transmission technology. The primary objectives of the project were to determine the accuracy of images and reports generated by trained midwives performing basic obstetric ultrasound examinations at the satellite sites and to evaluate performance of a tablet-sized ultrasound scanner VISIQ (Philips Ultrasound, Inc., Bothell, WA, USA) as sole ultrasound system for the obstetric triage system. During the 4 weeks training period, lectures and longer hours of hands on practice were conducted followed by assessments. All midwives passed the final assessment on first attempt. The pilot project reviewed that training midwives to undertake routine focused obstetric scanning for identification of high-risk pregnancies is a very viable option [7]. Ultrasound training for midwives can also incorporate artificial intelligence (AI) and telemedicine to guarantee the quality of ultrasound images and assist in making therapeutic judgments. Artificial Intelligence and telemedicine have considerable potential in repetitive ultrasound examinations, such as those involving real-time picture quality assurance, prediction of gestational age (GA), and automatic positioning and identification of foetal features and can provide vital health services to settings with limited resources [12] [13].

Another study was conducted to develop and test a curriculum to train midwife sonographers via a tele-radiology innovation platform at a tertiary-level private university hospital as well as other three-outreach locations. This was an innovative Human Resource for Health (HRH) task sharing, Maternal Child Health (MCH), workforce training, and capacity building initiative. It was a collaboration between specialized radiologists, sonographers, and midwives. Throughout the 4-week training period and project implementation, direct control, support, and supervision of specialized radiologists and ultra-sonographers effectively handled issues of quality and safety among trainee midwife sonographers. Mentoring, role modelling, and hands-on practical experience supplemented the lectures. Written and practical exams were used for assessment, and an exit test required proof of competency in both written and practical formats. The study concluded that the development of midwife sonographers is a workable and effective solution in improving services for women currently unable to access ultrasound in pregnancy [14]. Interprofessional collaboration among maternity care providers is valuable for diagnosing and managing both normal and difficult pregnancies and childbirths. In addition, a pilot study to analyse and compare the views of pregnant women, midwives, and a women's panel on the value and use of ultrasound in labour reported that more service

users saw positive value in intrapartum ultrasound [15].

A study which explored the experiences and opinions of midwives who were trained in the provision of limited obstetric ultrasound services and served the community in health centres in rural parts of Ethiopia revealed that basic ultrasound training prepared and built the self-efficacy of midwives in executing their expected ultra sound scan competencies [16]. Additionally, having a dedicated space and availing essential supplies like paper towels, gel, and alternative power sources, facilitated conducting obstetric ultrasound scan services. Meanwhile, high workload on ultrasound trained midwives, interruption of essential supplies were identified as barriers for ultrasound services [16].

Literature on midwifery ultrasound training has documented a few differences and more points of agreement. For example, in one study reviewed, training methods included formal site-based training sessions, hands-on instruction, distance learning, and online training programmes. Additionally, a skills checklist, written learning objectives, and the supervision of practical competence were all incorporated [17]. Further, the study stated that although training regimens varied, they often covered similar topics such as equipment upkeep, ultrasound physics, the normal and pathological anatomy of the mother and unborn, picture storage, acceptable reporting techniques, and fundamental patient-healthcare worker communication skills [18]. The majority of training programmes teach midwives how to do simple obstetric ultrasonography scans. The integration of the end user's diagnostic capabilities and ethical obligations in training programmes is crucial for ensuring a diagnostic ultrasound service [19]. Short focused ultrasound training programmes of varying duration range from 1 week to 6 months have demonstrated to have good sensitivity and specificity [20]. It is strongly encouraged to do practical evaluations as part of training since it verifies that midwives have attained the knowledge and training necessary to work independently, enabling them to serve a larger population [8]. Additionally, continued mentoring was cited as a crucial component of midwives' sustainable training [10].

In Zambia, the Nursing and Midwifery Council has incorporated basic ultrasound imaging for the diploma in midwifery curriculum. Additionally, the 2023 revised BSc Midwifery curriculum at the University of Zambia has included content on obstetric ultrasound. This will require coordination and support among the University of Zambia, School of Nursing Sciences and key stakeholders in Midwifery training in Zambia, sonographers and obstetricians in order to optimally implement the curriculum. If all midwives possess obstetric ultrasonography expertise, mothers will have access to ultrasound scanning which helps in decision making and management. Further, referrals will decrease thereby easing the demand on the higher level healthcare systems and cost on mothers [21]. The aim of this review was to identify competencies in ultrasound scanning in midwifery education. The findings will form a basis for advocating for training of every midwife in Zambia in conducting ultrasound scanning.

2. Methods

This study utilised both primary and secondary data on ultrasound scan competencies in midwifery education. Secondary data was gathered through conducting a desk review while primary data was obtained by means of conducting a needs assessment. During the desk review, literature from published journal articles on google scholar and PubMed was reviewed in order to gather evidence on ultrasound scanning in midwifery education. Curricula were sampled and checked for content on ultrasound scanning training and implementation. The curricula reviewed included the Nursing and Midwifery Council of Zambia diploma in midwifery, the University of Zambia BSc, MSc midwifery as well as some from other international learning institutions. Of interest in the desk review was the place where the curriculum was implemented, duration, aims, content covered, target group and the number of ultrasound scans conducted.

The needs assessment was conducted through administration of an online google survey form which was shared via email and WhatsApp. Purposive sampling was used to select the study sites while simple random sampling was used to select the participants. The census method was used to arrive at a sample size of 135 participants. Participants included students as well as qualified midwives at different levels namely, Diploma, Bachelors and Master's degree. In addition, the study included two medical doctors at policymaking level at the Ministry of Health, Zambia. The survey consisted of 20 questions and was conducted between July and October 2023. The purpose of the study was explained to the participants. Consenting midwives were added to a WhatsApp group and were provided with a link to an online survey monkey. A self-administered questionnaire was administered online. The questionnaire consisted of 20 questions organized in four sections namely; socio-demographic characteristics, understanding of and need for basic ultrasound training for midwives, key components, competences/skills of basic ultrasound training for midwives and challenges, solutions and necessary education resources for this training. Participants who did not respond were reminded after two weeks.

Data on ultrasound scanning competencies and related training needs for inclusion in midwifery education was collected, organised and analysed by the team in order to gain an understanding of ultrasound scanning training practices. Descriptive statistics were applied in analysing data. The main variables included the institution one worked from, understanding the need of basic ultrasound training, competencies of basic ultrasound and challenges and solutions required for ultrasound training. Data was collected using a semi structured self-administered questionnaire and analyzed in STATA version 2.

3. Results

3.1. Desk Review

The desk review showed that it is within the scope of midwifery practice to perform ultrasound examinations. The five curricula from different training institu-

tions including Europe, Asia and Africa revealed common objectives of the obstetric ultrasound training, content, and duration. One curriculum in a university based in Asia reviewed that the training period for midwives in ultrasound scan was 4 weeks. The main aim of this program was to teach point-of-care ultrasound (POCUS) to physicians, nurses, and midwives in rural settings. One other curriculum at a University in Africa targeted to train 271 midwives in ultrasound scanning using online mode for 5 Weeks. The curriculum aimed at establishing a collaborative inter-professional partnership between the radiology department and rurally located midwives, identifying an appropriate pedagogical framework to guide development of a pilot curriculum and obtaining ethics approval to support shared learning via publication and dissemination of the program outcomes and lessons learned. The course content included introduction to general principles of ultrasound as well as physics and ultrasound specific to obstetrics. The training involved gradual introduction from week one in which basic training was done till week 5 in which a complete set up of remote desk top and scan facility, dummy run from remote set up and connectivity application using cell phone modem. During the training, midwives observed experienced sonographers conduct ultrasound and had hands on scanning on phantoms under direct observation and feedback and matters arising addressed in the lecture room. The midwives then wrote a final examination that was designed to test both written and practical skills. From this desk review, it can be proposed that training midwives in ultrasound scanning should be standardised to four weeks period. Midwives should be taught the basics of ultrasound scanning such as principles of scanning, machine components and setup, embryology and anatomy and physiology. Other components should include the procedure of imaging, examination and interpretation of normal/abnormal findings, sex identification, gestation age estimation and detection of multiple pregnancy. The competences and skills for the ultra sound training should include patient preparation, operating the machine, critical thinking and interpreting and reporting findings. The training should have both theory and hands on practice which should begin with observing experienced sonographers conduct ultrasound.

3.2. Needs Assessment

3.2.1. Demographic Characteristics

The majority of the participants 116 (85.9%) were under the Ministry of Health while slightly above a quarter 50 (37%) of the participants were registered and practicing midwives at the time of the needs assessment. Most of the participants 60 (45.8%) possessed a Bachelor's degree in nursing and slightly above half 70 (54.7) of the participants had more than five years of work experience (Table 1).

3.2.2. Understanding of and Need for Basic Ultrasound Training for Midwives

The majority of the participants 71 (53%) had heard about basic ultrasound

Table 1. Demographic characteristics (n = 135).

Characteristic	Category	Frequency (n)	Proportion (%)
Ministry/institution	Defence	3	2.2
	Ministry of Health	116	85.9
	Higher education	2	1.5
	Home Affairs	1	0.7
	NGO	2	1.5
	Parastatal	1	0.7
	Private sector	3	2.2
	Unidentified	7	5.2
Profession	Medical doctor	2	1.5
	Registered Midwife	50	37.0
	Registered nurse	36	26.7
	Nurse midwife	37	27.4
	Tutor	3	2.2
	Student midwives	7	5.2
Highest education qualification	Certificate	4	3.1
	Diploma	48	36.6
	Advanced Diploma	3	2.3
	Bachelor's degree	60	45.8
	Master's degree	14	10.7
	PhD	1	0.8
	Others Unidentified	1	0.8
Current position	Midwife	50	37.0
	Nurse in-charge	18	13.3
	Lecturer	7	5.2
	Nursing officer	12	8.9
	Tutor	15	11.1
	Registered nurse	10	7.4
	Others	23	17.0
Length of service in current position	Under 1 year	6	4.7
	1 - 2 years	13	10.2
	3 - 5 years	39	30.5
	Over 5 years	70	54.7

training for midwives. Approximately one third of the midwives 37 (52.1%) stated that the role of midwives was to assess the prognosis and identifying potential complications of pregnancy whereas 45.1% of the participants indicated that ultrasound facilitates basic assessment and interpretation of findings. All the

participants (100%) affirmed to the necessity of introducing basic ultrasound scan training for midwifery in Zambia. Further, this study showed that more than half (67.4%) of the respondents indicated that the appropriate duration of training would be 4 - 6 weeks and 54.9% of the respondents stated that three-quarters of the training period should be devoted to clinical and hands on practice. Most of the respondents (61.9%) indicated that hospitals with ultrasound facilities are the preferred clinical placement for basic ultrasound training and 38% of the participants preferred regular (face to face) and blended mode of training (Table 2).

Table 2. Understanding of and need for basic ultrasound training for midwives (n = 135).

Characteristic	Category	Frequency (n)	Proportion (%)
Heard about basic ultrasound training for midwives	Yes	71	53.0
	No	63	47.0
Role of a midwife with Basic Ultrasound competencies	Assessing the prognosis of pregnancy and identifying potential complications	37	52.1
	Facilitate/help with basic assessment and interpretation of findings	32	45.1
	Don't know	2	2.8
Necessity of basic ultrasound training in Zambia	Yes	135	100
Appropriate level of basic ultrasound training	Certificate only	12	8.9
	Diploma only	39	28.9
	Bachelor's degree only	22	16.3
	Masters' degree only	3	2.2
	PhD	1	0.7
	BSc and Diploma	11	8.2
	Diploma to masters	4	3.0
	BSc to PhD	6	4.4
	Diploma to PhD	13	9.6
	All levels	24	17.8
Appropriate length of training	1 - 3 weeks	26	19.3
	4 - 6 weeks	91	67.4
	7 - 12 weeks	3	2.2
	Over 12 weeks	15	11.1
Ideal institution to train midwives in Basic Ultrasound	Private	3	2.2
	Public	37	27.6
	Both private and public	94	70.2
Appropriate setup for training	College	61	45.5
	University	73	54.5

Continued

The best mode of training	Regular	52	38.8
	Online theory and practical on-site	29	21.6
	Distance or Regular	1	0.8
	Blended mode	52	38.8
The percentage of total training devoted to clinical practicum	Half of the period	47	35.3
	A third of the period	6	4.5
	A quarter of the period	6	4.5
	Three-quarters of the period	73	54.9
	The whole period	1	0.8
Preferred clinical placement for Basic Ultrasound training	Clinics	1	0.8
	Hospitals with ultrasound facilities	83	61.9
	UTH and other hospitals with ultrasound facilities	26	19.4
	UTH-WNBH radiology	24	17.9
The necessity of Licensure exams for the program	Necessary	72	53.3
	Not necessary	63	46.7

3.2.3. Key Components, Competences/Skills of Basic Ultrasound Training for Midwives

The participants stated that key components to be covered in the basic ultrasound scanning training for midwives should be basic knowledge in embryology, obstetrics as well as anatomy and physiology. The course should also cover basics of ultrasound scanning which include waves, machine components and setup, limitations, errors and types of ultrasound scanning such as routine, pelvic and abdominal scan. Other components of the course should be; the procedure of imaging, examination and interpretation of normal/abnormal findings, sex identification, gestation age estimation and detection of multiple pregnancy. The competences and skills for the ultra sound training should include patient preparation, operating the machine, critical thinking and interpreting and reporting findings (Table 3).

3.2.4. Challenges, Solutions and Necessary Education Resources for This Training

The common challenges that were anticipated by participants include lack or limited equipment and supplies, lack of consistent training plan and high cost of the training. Other challenges include role conflict with sonographers/radiologists and limited human resource which in turn shall lead to work overload for midwives and training facilities. Additionally, challenges related to the integration of ultrasound scanning into current practice, lack of interest among midwives, limited trainers and supervisors, quality assurance and control and lack of continued practice for staff from facilities with no equipment.

Table 3. Key components, competences/skills of basic ultrasound training for midwives (n = 135).

Key components to be covered in the Basic Ultrasound course
Basic knowledge: Embryology, obstetric anatomy and physiology
Ultrasound basics: waves, machine components and setup, limitations, errors, types (routine, pelvic, abdominal)
Procedure: Imaging, examination and interpretation (normal/abnormal, sex identification, gestation, multiple pregnancy)
Competences/skills for this program
Skills: Patient preparation, competently operate the machine (image acquisition/optimisation), critical thinking, interpreting (normal/abnormal) and reporting results

The participants suggested the following solutions to the challenges; procurement and lobbying for adequate equipment and supplies in all settings, identifying several training sites to ease congestion in the few available facilities and collaboration with relevant stakeholders (e.g. radiographers) before training can commence. Other suggested solutions include outlining a clear integration path for these trainees into the health system, ensure availability of personnel to service and repair the equipment, enough trainers, effective supervision, and continued professional development. Further, establishment of a clear training plan so as not to strain the system and the need for adequate infrastructure, quality assurance/control measures were other suggested solutions. Finally, participants suggested that the following educational resources must be availed for ultrasound scan training; models and posters of the pelvis, foetus, ultrasound scan machines, manuals, curriculum/course content, procedure manuals, evaluation books, standard operation procedures and learner's guide. There should be skilled and specialist trainers, eBooks, videos, projectors, presentations, pamphlets, texts books, laptops, stationery and infrastructure which includes the training sites/skills laboratory, clinical placements sites and library (Table 4).

4. Discussion

The majority of the participants 71 (53%) had heard about basic ultrasound training for midwives. This can be attributed to the fact that health facilities have adopted the World Health Organization ANC guidelines on positive pregnancy experience, which recommend that pregnant women should have one ultrasound scan before 24 weeks of gestation [6]. This is in order to determine gestational age, enhance the identification of multiple pregnancies and foetal abnormalities, lessen the need for induction of labour in post-term pregnancies, and enhance the overall pregnancy experience for the mother [6].

Healthcare providers as well as policy makers have started advocating for access to ultrasound scan for every pregnant women and training for midwives in ultrasound scanning [6]. Approximately one third of the midwives 37 (52.1%)

Table 4. Challenges, solutions and necessary education resources for this training.

Challenges of this program
1) Lack/limited equipment and supplies
2) Lack of consistent training plan and high cost of the training
3) Possible role conflict with sonographers/radiologists
4) Limited human resource (work overload for midwives) and training facilities
5) Integration into current practice
6) Lack of interest from midwives
7) Limited trainers and supervision
8) Quality assurance and control
9) Lack of continued practice for staff from facilities with no equipment

Suggestions of solutions to the challenges
1) Procurement/lobby for more ultrasound equipment and supplies in all settings
2) Identify several training sites to easy congestion on a few facilities
3) Collaborate with relevant stakeholders before commencement (e.g radiographers)
4) Outline a clear integration path for these trainees into the health system
5) Ensure available of personnel to service and repair the equipment
6) Availability of enough trainers and effective supervision
7) Establish a clear training plan not to strain the system
8) Need for continued professional development
9) Need for adequate infrastructure, quality assurance/control

Necessary education resources for this training
1) Pelvis models, foetal models, posters, ultrasound scans, manuals, curriculum/course content, procedure manuals, evaluation books, SOPs, learner's book
2) Skilled/specialist trainers
3) Modern ultrasound equipment and supplies
4) Online books, videos, projectors, presentations, pamphlets, recommended texts books, laptops, stationery
5) Infrastructure (training sites/skills lab, clinical placements, library)

stated that the role of midwives was to assess the prognosis and identifying potential complications of pregnancy whereas almost half 32 (45.1%) indicated that ultrasound facilitates basic assessment and interpretation of findings. This finding is affirmed by documentations on sonography foetal assessment, protocols, and interpretation which state that comprehending the various prenatal examinations and their indications during each trimester facilitates prompt identification and diagnosis of foetal abnormalities, hence enabling a multidisciplinary approach to care [6]. Further, all the participants (100%) affirmed to the necessity of introducing basic ultrasound scan training in Zambia. Similarly, a scooping review on obstetric ultrasound training programmes for midwives concluded

that in order to give expectant women appropriate and safe care, it is imperative that medical practitioners doing obstetric ultrasounds receive enough training [22]. Another online survey revealed that there was a need for a postgraduate program or a short training that should teach midwives how to effectively and securely scan for foetal presentation [22]. The study further stated that since ultrasound can be used in settings with limited resources, operators must have the right training to guarantee they have the required safety knowledge. Programs must meet the needs of the changing workforce and allow midwives to do specialist obstetric ultrasonography examinations [22]. Equally, in a study to explore Rwandan midwives' experiences and views of the role of obstetric ultrasound in relation to clinical management, including midwives, midwives advocated to have them trained in ultrasound scanning in order to improve the quality of maternity care [19].

This study further showed that more than half (67.4%) of the respondents indicated that the appropriate duration of training would be 4 - 6 weeks and most (54.9%) of the respondents stated that three-quarters of the training period should be devoted to clinical practice (Table 2). The respondents felt that this duration could give the trainees adequate time to practice and gain confidence. An analysis of an obstetrics point-of-care ultrasound-training program for healthcare practitioners in Zanzibar, Tanzania conducted an intensive 2-week antenatal ultrasound course consisting of lectures and hands-on practice followed by 6 months of direct supervision of hands-on scanning and bedside education in their clinical practice environment [23]. Many studies have shown that repetitions are required to achieve competence in obstetric ultrasound [24]. However, a scoping review, which focused on 12 studies across Africa, revealed that there is no standard duration for obstetric ultrasound scan training for midwives. The training duration across different countries ranged between 1 week and 3 months [25].

This study showed that most of the participants (38%) preferred regular (face to face) and blended mode of training. However, findings of a scoping review on the training of midwives to perform obstetric ultrasound scans in Africa reported that majority of the training programs included face-to-face lecturer methods, small group tutorials, audio-visual materials, and supervised clinical scanning. On the other hand, when teaching midwives, a research conducted in Kenya included an e-learning module in their curriculum [25].

Another study conducted in six sites in Malawi to evaluate a novel, context-specific education package to teach midwives basic obstetric ultrasound, including the determination of gestational age by measurement of foetal femur length found that, in only ten days of training, midwives can be taught to confidently and competently perform basic obstetric ultrasound scans [26]. The study also found that local teams can be virtually trained successfully to implement the program and proposed that focused training could improve the possibility of a broad and lasting implementation [26].

Most of the respondents (61.9%) indicated that hospitals with ultrasound facilities are the preferred clinical placement for basic ultrasound training (Table 3). Similarly, other studies have indicated that training midwives in ultrasound scanning take place in hospitals [27]. This is because hospitals have dedicated departments for sonography as well as qualified radiographers and sonographers for easy access to scanning machines and technical support during skill acquisition in ultrasound scanning. This study also revealed that about half (53.3% of the respondents felt that it was necessary to have licensure exams for the program. Though licensure has not been cited in other studies, most publications reviewed indicated that assessments, before, during and after training are cardinal. The assessment methods included written, oral and practical competency tests [28].

4.1. Key Components, Competences/Skills of Basic Ultrasound Training for Midwives

The study revealed key components to be covered in the basic ultrasound scanning training as basic knowledge in embryology, obstetrics as well as anatomy and physiology. The course should also cover basics of ultrasound scanning which include waves, machine components and setup, limitations, errors and types of ultrasound scanning such as routine, pelvic and abdominal scan. Other components of the course should be; the procedure of imaging, examination and interpretation of normal/abnormal findings, sex identification, gestation age estimation and detection of multiple pregnancy. The competences and skills for the ultra sound training should include patient preparation, operating the machine, critical thinking and interpreting findings and reporting results (Table 3).

Other studies reviewed stated that the material of the obstetric ultrasonography-training program for midwives varied although similarities existed. Normal anatomy, measuring foetal biometry, assessing amniotic fluid level, and gestational age determination were the most often taught topics in the standard curriculum for obstetric ultrasound scan training across the various nations [10] [16] [29]. In addition, the curriculum had content on how to diagnose foetal development disorders, detection of foetal heart activity, position, number of foetuses, and placental placement [10] [16] [29].

4.2. Challenges, Solutions and Necessary Education Resources for This Training

Many constraints make it difficult to provide ultrasound on a large scale, including cost, geography, human factors, and the capacity of healthcare institutions to handle these services [30]. The common challenges that the participants anticipated include lack/limited equipment and supplies, lack of consistent training plan and high cost of the training, possible role conflict with sonographers/radiologists and limited human resource which shall lead to work overload for midwives and training facilities. Other challenges include integration into cur-

rent practice lack of interest from midwives, limited trainers and supervision, quality assurance and control and lack of continued practice for staff from facilities with no equipment. Other studies showed that increased workload because of task shifting and expanded roles for midwives was the major challenge [24].

Lack of private rooms needed for obstetric ultrasound scans, the absence of electricity, the dearth of supplies, including ultrasound gel, memory sticks, and referral papers, needed to perform obstetric ultrasound scans on expectant mothers were cited as major challenges in other studies [16] [24]. In addition to illiteracy and poverty, a number of cultural beliefs and norms surround pregnancy and childbirth. For instance, some demand that only female health workers should attend to women during pregnancy and childbirth [31]. Therefore, ultrasound training programs should adapt to respect cultural beliefs and practices around pregnancy.

The cost implications associated with ultrasound training program poses a great challenge to its successful and sustained implementation. A study conducted in Malawi to evaluate the implementation of a novel education package to teach ultrasound-naive midwives stated that maintenance of ongoing support was challenging, and resulted in trainee dissatisfaction [32].

Participants in this review suggested the following solutions to the challenges; procurement/lobby for adequate ultrasound equipment and supplies in all settings, identifying several training sites to ease congestion on a few facilities and collaborate with relevant stakeholders before commencement (e.g. radiographers). Other solutions include outlining a clear integration path for these trainees into the health system, ensure availability of personnel to service and repair the equipment, enough trainers, effective supervision, and continued professional development.

Other suggested solutions include establishment of a clear training plan not to strain the system and the need for adequate infrastructure, quality assurance/control measures. In other studies, midwives appreciated the use of ultrasound to encourage early detection of problems and access to healthcare facilities as it allowed for prompt management. However, they had worries about the added workload brought on by job shifting and the expansion of midwives' scope of practice. They suggested that more midwives should be engaged to help cope with workload because of task shifting [16] [24].

The participants suggested the following educational resources for ultrasound scan training; Pelvis models, foetal models, posters, ultrasound scans, manuals, curriculum/course content, procedure manuals, evaluation books, Standard operation procedures and learner's book. There should be skilled/specialist trainers, modern ultrasound equipment and supplies, eBooks, videos, projectors, presentations, pamphlets, recommended texts books, laptops, stationery and infrastructure which includes the training sites/skills lab, clinical placements sites and library (Table 4). Participants in another study to explore Vietnamese health professionals' experiences and views of obstetric ultrasound in relation to clinical management, resources and skills, recommended, among other things

that availability of better quality ultrasound machines as a way of improving the utilisation of ultrasound [33].

5. Conclusion

It is clear from this study that ultrasound scanning is a vital skill for midwives to acquire since it facilitates prompt decision-making. Training midwives in ultrasound scan has the potential to increase access to scanning by women in resource-constrained areas. Based on the curriculum analysis, it is evident that the reasonable minimum duration for training in ultrasound scanning is 4 weeks. The program should include both theory and practical with more time to be allocated to hands on practice. Experts like sonographers must conduct the training.

What Is Already Know on This Topic

- Ultrasound scan is a key component of midwifery care.
- Access to obstetric ultrasound scanning is universal in developed nations but women in LMIC still do not routinely access ultrasound scanning due to limited equipment as well as trained providers.
- Duration of training ranges from a week to 5 weeks

What This Study Adds

- Midwives recognise the importance of them acquiring the skill and competence ultrasound scanning.
- Integration plan and resources to be in place before implementing the program if it can be successful.

Proposed Future Research Direction

Future studies to evaluate the efficacy of various ultrasound training programs in midwifery, and the incorporation of cutting-edge ultrasound technologies into midwifery practice.

Limitations of the Study

Limited articles and curricula reviewed during the desk review may not be representative enough of ultrasound scan training for midwives globally.

Authors' Contributions

All authors conducted the desk review, compiled results of the needs assessment and drafted plus proofread this manuscript.

Conflicts of Interest

The authors declare no competing interest.

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