

Research Article

Emergency obstetrics knowledge and practical skills retention among hospital and clinic staff following advanced life support obstetrical training in Cameroon, Africa

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Abstract

Background: Although worldwide rates have decreased, maternal mortality remains a major public health challenge in many resource limited countries. In 2015, Cameroon had the 10th highest maternal mortality rate ranking in the world. The “three delays” model identifies common barriers to accessing emergency obstetrical care (EmOC): 1. a delay in the decision to seek emergency care; 2. a delay in reaching emergency care; and, 3. a delay in being providing safe and adequate emergency care in the health facility. This study addresses the 3rd delay: providing safe and appropriate EmOC in the health care facility.

Method: The Advanced Life Support in Obstetrics (ALSO) is an internationally recognized course which provides training for health care workers (HCW) to manage emergency obstetrical conditions. The ALSO course was made available by the Cameroon Baptist Convention Health Services to any health care facility who wished to send their HCW's for emergency obstetrical training. This study investigates the retention of knowledge and skills among these HCW's, 6-31 months, after completing the course.

Results: From May 2012 to December 2014, 156 HCW's completed the ALSO training course with 99 (64.5%) participating in this knowledge and skill retention study. The HCW's perceived the training to be beneficial (95.9%) and identified utilizing some of the skills taught (90.8%). The skill maintenance was measured by the HCW's ability to pass the ALSO practical skill retest. The HCW skill pass rate decreased from 65.4% at the initial training to 34.6% on retest ($P=0.006$). Skill maintenance was associated with individual motivation, and the HCW's ability to use the skills in their work environment. There was no association with time since the training course and skill maintenance. The primary predictor of failing the retest was a failing score on the initial testing.

Conclusion: This study showed that ongoing “refresher courses” and the ability to practice skills are required to maintain the quality of EmOC. Facilities should be evaluated to identify the appropriate level of emergency care with the EmOC training tailored to meet the staff and facilities capacity.

Abbreviations: MDG: Millennium Development Goals; MMR: Maternal Mortality Rate; EmOC: Emergency Obstetric Care; SSA: sub-Saharan Africa; CBCHS: Cameroon Baptist Health Service; ALSO: Advanced Life Support in Obstetrics; AAFP: American Academy of Family Practice; BLSO: Basic Life Support in Obstetrics; C-BLSO: Community Basic Life Support in Obstetrics; PPH: Post-Partum Haemorrhage; IHC: Integrated Health Centre; MgSO₄: Magnesium Sulfate; HCW: Health Care Workers

Introduction

In 2000, eight Millennium Development Goals (MDGs) were established by the United Nations. The fifth MDG was to decrease maternal mortality (WHO defines a maternal death as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes”) by 75% between 1990 and 2015. To date, worldwide maternal deaths have dropped by 45%. Presently, almost all maternal deaths (99%) take place in resource limited countries with more than one-half of these deaths occurring within sub-Saharan Africa [1].

A recent WHO systematic analysis of the causes of 60,799 maternal deaths, between 2003 and 2009, found that almost 73% of maternal deaths were due to obstetrical causes with 27.5% secondary to indirect causes [2]. Direct obstetrical causes of deaths included haemorrhage, hypertensive disorders, sepsis, abortion, embolism, and other obstetrical complications including obstructed labour. Over one-half of these obstetrical deaths were due to hemorrhage, hypertensive disorders, and sepsis which occurred during labor and delivery and post-delivery. However, more than a quarter of all maternal deaths were due to pre-existing conditions aggravated by the pregnancy, including HIV/AIDS, malaria, hypertension, diabetes, and obesity. This study exhibits the continued burden of infectious diseases, as well as the growing impact of non-communicable diseases upon women's

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health.

The global Maternal Mortality Ratio (MMR) has decreased from 380 deaths/100,000 live births (1990) to 210 deaths/100,000 live births [3]. Yet, the MMR remains the highest in sub-Saharan Africa (SSA) at 510 deaths/100,000 live births [3]. If present trends continue, it is anticipated that SSA will reach a MMR of 128-357/100,000 live births in 2030, which is more than double the time in other world regions [4].

Multiple strategies are required to reduce the maternal mortality. One of these strategies is to make Emergency Obstetric Care (EmOC) acceptable, accessible, and available to women and their families. Three barriers to obtaining EmOC have been described [5-10] including:

1. *A delay in the decision to seek maternity care:* the woman and family delay accessing obstetrical care secondary to financial constraints, poor understanding of pregnancy complications, and community/cultural beliefs which may reinforce delays or promote alternate treatments.

2. *A delay in reaching maternity care:* no available or accessible transportation, poor roads, and geography.

3. *A delay in receiving adequate maternity care:* inadequate facilities, lack of medical equipment and supplies, poor referral systems, and inadequately trained, skilled and motivated medical and nursing staffs.

WHO estimates that 50-70% of maternal deaths could be prevented with access to good obstetrical emergency care [11]. This study focuses upon the 3rd delay: receiving adequate EmOC at the health care facility.

Background

In Cameroon, recent data indicates that the MMR has increased from 430 deaths/100,000 live births (1998) to 782/100,000 live births (2011) with an estimated 5,000 to 7,000 pregnant women dying every year [12]. Therefore, as of 2015, Cameroon has exhibited no progress toward meeting the 5th MDG. Additionally, this rate places Cameroon as the nation having the 10th highest MMR ranking in the world [13]. In May 2014, the Cameroon Government launched a “*Multisectoral Programme to Reduce Maternal and Child Mortality (2014-2018)*” [13]. This programme is coordinated by the Ministry of Health and includes a wide range of government, civil organizations, and private sector stakeholders, with the program goal to decrease the MMR by 25% within 5 years. In Cameroon, gaps in obstetrical services have been identified, including limited EmOC services which are often of inadequate quality [14]. To date, concerns continue that many public and private health care facilities lack adequately trained staff with limited accessibility to and availability of the equipment and supplies required for EmOC [15].

In an effort to improve the quality of maternity care, the Cameroon Baptist Convention Health Services (CBCHS) introduced the Advanced Life Support in Obstetrics (ALSO) Training Course as an ongoing obstetrical staff educational effort. The ALSO Program is an “evidence-based, hands-on clinical content, team work, patient safety and treating obstetrical emergencies, for maternity care providers, including physicians, nurse midwives and registered nurses” [16]. There is a second course, the Basic Life Support in Obstetrics (BLSO) which is a training to “manage normal labor and Perinatal emergencies for pre-hospital teams” [16]. In 1991, the ALSO program was developed in the United States by University of Wisconsin physicians to provide medical and nursing staffs the knowledge and skills to manage urgent and emergency obstetrical conditions. In 1993, the responsibility for

ALSO training was assumed by the American Academy of Family Physicians (AAFP). ALSO training was so successful that it has been expanded internationally, with modifications made to meet the relevant needs and resources of developing countries [17,18]. In an effort to bring lifesaving skills to a broader audience of health care workers (HCW), the BLSO has been further modified as the Community-Based Life Support in Obstetrics (C-BLSO). The C-BLSO training focuses upon low tech solutions to the most common obstetrical emergencies and can be used to train skilled birth attendants, community nurses, nursing assistants, birth attendants, and community members who attend deliveries in resource challenged settings [19].

The CBCHS is a private, faith-based health care system consisting of six hospitals, 29 health centres, and 50 primary health centres, almost all of which provide maternity care. In 2014, the CBCHS obstetrical care workload included 9876 live births, 271 preterm births, 41 neonatal deaths, 80 babies born before arrival to the facility, 183 still births, and 171 abortions [20].

With the concurrence and approval of the Cameroon Regional Delegates for Health, the ALSO Training Course was initiated by the CBCHS within the Northwest and Southwest regions of Cameroon. The CBCHS, government, and private facilities were invited to send staff to an ALSO training session. Multiple trainings were scheduled with participants limited to 5 per each instructor (ALSO criteria). No course or registration fee was requested, with the required teaching tools, including mannequins, equipment, supplies, and manuals, provided through private donations. The participants’ sponsoring institutions were responsible for funding the cost of travel, lodging, and food. ALSO Approved Instructors from the US and Kenya taught the initial training course.

The AAFP ALSO training includes the administration of a standardized written test and practical testing exercise at course completion. Upon passing this testing, an *ALSO Provider* status is awarded and valid for 5 years. Current ALSO Providers are qualified to attend an ALSO Instructor course enabling them to become an *ALSO Approved Instructor*.

In Cameroon, an ALSO instructor course (“Train the Trainers”) was held immediately following the initial ALSO training with continued instructor courses offered at intervals. Those ALSO Providers with teaching capabilities are encouraged to consider becoming ALSO instructors. This process has enabled a cadre of local staff to qualify as instructors and provide ongoing ALSO training which assures program sustainability

Studies have raised concerns about the retention of knowledge and skills after completing emergency medical training, as well as the need for refresher courses [21-24]. This study was performed to identify the retention of emergency obstetrical knowledge and skills, 6-31 months, after completing an ALSO course.

Objectives

The study objectives were to:

1. Evaluate the self perception of knowledge and skill retention of ALSO trainees 6 to 31 months following completion of the course.
2. Identify factors which may influence the participant’s knowledge and skill retention following emergency obstetrical training.
3. Determine the relationship of participant’s self-confidence and demonstrable skills in managing obstetrical emergencies.

The CBCHS Institutional Review Board granted approval for this study and gave permission for publication of the findings. In addition, approval was granted by the Institutional Research and Ethical Committee of Moi University, Kenya. Finally, the study received approval from the CBCHS Director.

Methods

This study consisted of:

- A comparison of the participant's initial ALSO practical skills testing results to repeat (study) ALSO practical skills testing results,
- Administration of the ALSO questionnaire with modifications to include the participant's self-assessment of their confidence of managing obstetrical emergencies, and
- Completion of a checklist of ALSO recommended equipment and supplies to identify availability within their facility.

The ALSO tests and equipment check lists are standardized tools with proven validity and reliability. The ALSO questionnaire was modified to meet the additional needs of this study. The continued validity of the modified questionnaire was ascertained by having international experts review the additions with their suggestions incorporated into the questionnaire. The questionnaire was then pilot tested by 10 individuals who had completed the ALSO training within 6 months of the scheduled study testing. Based upon their responses, some minor modifications were made to the questionnaire.

The primary author and the Programme Manager first administered the ALSO practical skill tests to 9 volunteer ALSO Instructors. Upon completion of the repeat testing, these instructors then received training which enabled them to serve as research assistants and administer the questionnaire and practical skills test to the other study participants.

An invitation letter from the CBCHS Director was sent to all ALSO trainees eligible to participate in the study. This letter included information concerning the study, the study consent form, and the equipment check list. Central locations were identified which would facilitate participation with transportation provided to the most accessible study location.

All volunteers were asked to sign a written consent prior to study participation. Anonymity was assured with each participant being assigned a special code which was securely maintained with access only by the primary investigator. Data were entered into Microsoft Excel and Epi-Info (Centers for Disease Control and Prevention) software for analysis. Study participants could select to answer or not answer any question and to complete the equipment listing as they wished.

The primary author attempted to reach non-responsive ALSO trainees by telephone to personally invite them to participate in the study. Fifty seven (36.5%) trainees did not participate for a number of reasons, including being out of country, in school, on leave, having difficult personal circumstances, or having no phone contact. Only three eligible trainees declined to participate.

Every effort was made to perform an accurate and objective evaluation of each participant's practical skill retest. This consisted of the primary author and research assistants observing the participants skill test, reviewing the performance of each participant, discussing their findings, and coming to a consensus as to the correct skill rating of each participant.

From May 2012 to December 2014, 156 HCW's completed an

ALSO training course with 22 of the attendees becoming ALSO instructors, including the primary author. In 2015, 99 ALSO trainees (63.5%) voluntarily participated in this study, which included 15 ALSO instructors.

Results

Study participant's demographics and work characteristics

Table 1 presents the study participants demographics and work characteristics. More participants were over 40 years of age (60.6%) with an average age of 41 years (range 26-60 years). Almost 60% of participants had 1-10 years of experience with an average work experience of 10.5 years (range 1 to 41 years). Ninety-three (93.9%) participants met the WHO criteria of a Skilled Birth Attendant with 46.4% being trained midwives. Most participants (73.7%) were actively providing maternity care. Over half (51.5%) of the study participants worked in hospitals, with all but 3 hospitals having C-Section capability. The participants included 78 (78.8%) CBCHS staff, 13 (13.1%) government staff, and 7 (7.1%) private facility staff.

Table 1. Participant's demographics and work characteristics.

ALSO practical skills retention participants demographics & work characteristics		
	Number	Percent
Gender		
Male	33	33.3%
Female	66	66.7%
Total	99	
Age		
26-29	4	4.0%
30-39	33	33.3%
40-49	49	49.5%
50-60	11	11.1%
Not Identified	2	2.0%
Total	99	
Profession		
Trained Midwife	46	46.5%
Nursing Assistant With Ob Training	30	30.3%
Registered Nurse	11	11.1%
Md-General Practitioner	6	6.1%
Nursing Assistant	5	5.1%
Other	1	1.0%
Total	99	
Years of Experience		
1 to 10 years	58	58.6%
11 to 20 years	32	32.3%
21 to 30 years	6	6.1%
31 and more years	3	3.0%
TOTAL	99	
Working in Maternity Care		
Yes	73	73.7%
No	26	26.3%
Total	99	
Work Place		
Hospital	51	51.5%
Integrated Health Center	45	45.5%
Other	3	3.0%
Total	99	
Work Site		
Urban	71	71.7%
Rural	28	28.3%
Total	99	

Study participant's perception of ALSO training

The ALSO training was perceived by the participants to be beneficial with 94 (95.9%) saying the training increased their knowledge, and 89 (90.8%) saying they had used one of more of the emergency skills learned since their training. Most participants expressed confidence in their ability to manage the 9 complications (70.1%-90.7%) and 3 procedures (63.8%-84.2) which are addressed within the course (Table 2).

However, when matched to the retest skill scores, fewer participants (44% to 50%) were able to demonstrate adequate practical skills to manage the complications and procedures by passing the retest.

In response to questions regarding specific complications, the study participant's identified Post-Partum Haemorrhage (PPH) and Shoulder Dystocia as the most common obstetrical emergencies managed in their clinical practice. Eighty (80.8%) participants thought that their management of PPH had improved since the ALSO training with 77.1% estimating a decrease in patient blood loss after the training. During the past year, 77 (77.8%) participants said they had managed at least one patient with PPH, with the 3 most identified interventions being fundal massage (Number=64; 83.1%), IV fluids (Number=63; 81.8%), and cytotec administration (Number=56; 72.7%).

During the past year, 55 (55.6%) participants identified they had encountered a Shoulder Dystocia during at least one delivery (1 to "many times") with 44 (44.4%) participants saying they had never seen a Shoulder Dystocia. The 3 most common maneuvers used to deliver these patients were McRoberts maneuver (Number=42; 76.4%), suprapubic pressure (Number=31; 56.4%), and turning the patient to their hands/knees for delivery (Number=22; 40.0%). Thirty-six of the participants, who delivered patients identified to have Shoulder Dystocia, worked in hospitals while 15 worked in Health Centre's.

Three procedures are taught which are used in obstetrical emergency care: vacuum-assisted deliveries, maternal resuscitation, and neonatal resuscitation. The percent of retest participants who identified confidence in performing these procedures were: vacuum delivery (63.8%), maternal resuscitation (77.7%), and neonatal resuscitation (84.2%). Of the participants, who identified their skill confidence, 43.8%-45.2% passed the skill retest.

In the past year, 66 (66.7%) study participants said they had not

Table 2. Self-identified confidence in managing obstetrical emergencies and retest skill scores.

Participants self-assessment of comfort in managing pregnancy complications and retest score			
		Percent	Percent
Complication of Pregnancy	Comfortable with Care	Comfortable with Care	Comfortable & Retest Pass
Postpartum Hemorrhage (n=97)	88	90.7%	37.5%
Multiple Fetuses (n=98)	83	84.7%	44.6%
Third Trimester Bleeding (n=96)	75	78.1%	49.3%
First Trimester Bleeding (n=95)	75	78.9%	48.0%
Preeclampsia/Eclampsia (n=96)	73	76.0%	50.7%
Shoulder Dystocia (n=96)	73	76.0%	50.7%
Preterm Labor & PROM (n=93)	73	78.5%	50.7%
Labor Dystocia (n=96)	71	74.0%	47.9%
Malpresentation (n=97)	68	70.1%	50.0%
Procedures			
Vacuum Delivery (n=94)	60	63.8%	53.3%
Maternal Resuscitation (n=94)	73	77.7%	45.2%
Neonatal Resuscitation (n=95)	80	84.2%	43.8%

performed a vacuum-assisted delivery, with 33 participants performing 1-15 vacuum extractions. Twenty-seven of the participants performing vacuum extractions worked in hospitals with 6 working in health centres. All participants performing 6 or more vacuum-assisted deliveries worked within hospitals. Complications encountered by participants at vacuum assisted deliveries included: cephalhematoma (33.3%), infant bruising (4.2%), vaginal lacerations (66.7%), excessive blood loss (16.7%).

Study participant's initial and repeat pass/fail score results

By ALSO criterion, a test score of 70 and more is considered a passing score. Sixty-five (65.6%) study participants passed their initial practical training test with 34 (34.4%) failing (mean score=72.9, range 12-97). Forty (40.4%) passed the study practical retest with 59 (58.6%) failing (mean test score= 55.6, range 0-98). The decrease in the pass rate from the initial ALSO training to the retest was statistically significant (P=0.006). Of the 65 study participants who passed the initial ALSO Training, 35 (53.9%) passed the retest and 30 (46.1%) failed the re-test. Eighteen of the 35 participants who passed the retest increased their score while the remaining 17 had decreased (yet passing) scores. Of the 34 study participants who failed the initial training, 21 (61.8%) also failed the retest with a decreased score; 13 participants increased their failing score with 5 achieving a passing score.

Table 3 presents the initial ALSO practical training PASS Rates compared to the retest PASS Rates by work characteristic. There was a decrease in PASS rates in all categories with the p-values of statistically

Table 3. PASS Rates Comparison by Work Categories.

ALSO practical skills retention initial and retest scores of practical skill evaluation						
	Initial Evaluation			Retest Evaluation		
	Group	Total		Total		P-value
		Total	Passing	Pass rate	Passing	
Cadre of Worker						
Physician	6	6	100.0%	4	66.7%	
Trained Midwife	46	32	69.6%	19	41.3%	0.015*
Nursing Assistant with OB Training	30	21	70.0%	12	40.0%	0.037*
Registered Nurse	11	3	27.3%	3	27.3%	
Other	6	3	50.0%	2	33.3%	
Years Experience						
1 to 10 years	58	35	60.3%	21	36.2%	0.015*
11 to 20 years	32	27	84.4%	18	56.3%	0.027*
21 to 30 years	6	2	33.3%	0	0.0%	
31 years and over	3	1	33.3%	1	33.3%	
Work Place						
Hospital	51	35	68.6%	25	49.0%	
Health Centre	45	29	64.4%	15	33.3%	0.005**
Other	3	1	33.3%	0	0.0%	
Working in Maternity						
Yes	73	52	71.2%	31	42.5%	0.008***
No	26	13	50.0%	9	34.6%	
Work Site						
Urban	70	49	70.0%	36	51.4%	0.037*
Rural	29	16	55.2%	5	17.2%	0.005**
Time Since Initial ALSO Training						
25-31 Months	33	29	87.9%	23	69.7%	
13-24 Months	34	24	70.6%	13	38.2%	
6-12 Months	31	12	38.7%	4	12.9%	

*p-value significant; **p-value very significant; ***p-value extremely significant

significant decreases presented in the final column.

A significant decrease in the retest scores was exhibited by those participants working in Health Centre's and Rural Work sites. The time (since ALSO training) category did not demonstrate a loss of skill with time passed with the least decrease occurring with the first groups trained. Fifty-five (55.6%) participants identified having computer access with no association with passing or failing at the retest.

The sub-set of 15 instructors passed both their initial training test and the retest. Most (13) were trained at the first ALSO course which occurred 31 months prior to the study. The other 2 instructors had their initial ALSO training 15 months previous to the retest. Nine were Trained Midwives, 4 Physicians, and 2 Nursing Assistants having special obstetrical training. Thirteen worked in urban areas and 2 in rural areas with 11 serving in hospitals and 4 in Health Centres. Eleven of the instructors increased their score on the re-test.

Availability of ALSO recommended equipment and medications

The ALSO course includes a section which identifies the equipment and supplies necessary to provide emergency obstetrical care. Study participants were asked if they thought their facility had adequate emergency equipment and supplies. Eighty-two (86.6%) responded that there was adequate equipment/supplies in their facilities with 11 (13.4%) identifying inadequate equipment/supplies. Participants were also asked if they experienced any difficulty in obtaining obstetrical emergency equipment and/or supplies. Eighty-one (81.8%) participants responded with 48 (59.3%) saying they experienced no difficulty while 33 (40.7%) identified difficulty in obtaining equipment and supplies.

All participants were sent the ALSO recommended equipment/medication check list and asked to review the adequacy and availability of each item in their facility by checking YES, NO, Do Not Know with return of the listing at their retest. Ninety-one (91.1%) returned the equipment listing, with many participants submitting an incomplete listing by selecting not to respond to some of the items. Table 4 presents the responses of those who checked either the YES or NO answer. The number of YES/NO respondents are identified in parenthesis after the named equipment and supplies, with the responses to each item ranging from 61 (61.6%) to 97 (98.0%).

Magnesium Sulphate (MgSO₄) is an important emergency obstetrical medication and was identified to be available within 66 facilities. Study participants said that both 20% and 50% MgSO₄ vials were available in 26 facilities, with 20 facilities having only 20% MgSO₄ and 20 facilities having only 50% MgSO₄. Of those facilities with MgSO₄, 51 (77.3%) also had Calcium Gluconate available.

Discussion

A systematic search of the literature identified that the 5 most "commonly cited barriers" to obstetrical emergency care in developing countries included: "inadequate training/skills mix (86%), drug procurement/logistics problems (65%), staff shortages (60%), lack of equipment (51%), and low staff motivation (44%)."⁷ This study has identified these same barriers.

Study participants included a population of HCW's who were motivated to improve the emergency obstetrical care they provide as shown by their positive perceptions of the training benefits (95.9%) and use of the emergency skills (90.8%). This motivation is also exhibited

Table 4. ALSO practical skills retention.

Participant identification of available equipment and supplies in their facility				
	Has equipment and supplies			
	YES	Percent	NO	Percent
Medications				
Oxygen (With Tubing) (N=96)	73	76.0%	23	24.0%
IV Fluids (With Tubing) (N=96)	85	88.5%	11	11.5%
Pitocin (Oxytocin) (N=97)	91	93.8%	6	6.2%
Cytotec (Misoprostol) (N=97)	85	89.5%	10	10.5%
Magnesium Sulphate (20%) (N=82)	46	56.1%	36	43.9%
Magnesium Sulphate (50%) (N=75)	46	61.3%	29	38.7%
Ergometrine/Ergonovine (N=82)	30	32.6%	62	67.4%
Calcium Gluconate (1 Mg, 10%, 10cc) (N=90)	58	64.4%	32	35.6%
Nefedipine (N=95)	89	93.7%	6	6.3%
Neonatal Resuscitation Equipment				
Ambu Bags (N=96)	75	78.1%	21	21.9%
Infant Mask-Inflatable Cushion				
Preterm (N=91)	40	54.8%	33	45.2%
Term (N=76)	43	56.6%	33	43.4%
Toddler Mask (N=73)	32	43.8%	41	56.2%
Laryngoscope (N=91)	49	53.8%	42	46.2%
Miller Blade "0" (N=64)	23	35.4%	42	64.6%
Miller Blade "1" (N=54)	20	37.0%	34	63.0%
Endotracheal Tube "2.5" (N=84)	42	50.0%	42	50.0%
Endotracheal Tube "3" (N=52)	25	48.1%	27	51.9%
Endotracheal Tube "3.5" (N=45)	23	41.8%	32	58.2%
Delee Suction (N=74)	25	33.8%	49	66.2%
Intrapartum Equipment				
Vacuum Delivery VR Omni Cups (N=96)	75	78.1%	21	21.9%
Pudendal Block (Iowa Trumpet) (N=61)	4	6.6%	57	93.4%
Maternal Resuscitation				
Adult Ambu Bag (n=89)	65	73.0%	24	27.0%
Adult Face Mask (cushion bed) (n=89)	57	64.0%	32	36.0%
Adult Endotracheal Tubes (n=84)	39	46.4%	45	53.6%
Adult Face Mask (Mouth-to-Mouth) (n=80)	28	35.0%	52	65.0%
Suction Catheters (7.5) (n=79)	40	50.6%	39	49.4%
Suction Catheters (8) (n=63)	30	47.6%	33	52.4%
Incomplete Abortion				
MVA Syringe (n=83)	57	68.7%	26	31.3%
Cannulae (7 mm-12 mm) (n=78)	48	61.5%	30	38.5%
Needle Extender (paracervical block) (n=63)	17	27.0%	46	73.0%
Cervical Dilators (7-12) (n=75)	38	50.7%	37	49.3%

by almost half of study participants increasing their test scores from the initial training scores.

The study findings indicate that many of the HCW's thought they maintained their knowledge; however, some were not able to demonstrate the skills required to perform the tasks. The loss of practical skills was confirmed with the ALSO testing failure rates increasing from 34.4% to 59.6% on the retest. Many studies indicate that most skills decrease with time. In this study, it would seem that skills could be expected to decrease, because the initial testing was done at the end of the training course when the information was first learned. However, there was no association with time passed and a decrease in skills, with the highest grades occurring in the HCW's who first completed the course. Instead the decrease in skills was primarily associated with the HCW's ability to practice or use the skill, as shown by the skill maintenance of the instructors and by those staff working where there were more opportunities to perform the skills. These study findings support the need to provide ongoing "refresher" training

to all obstetrical staff for skill maintenance. We believe that there is also a second benefit to refresher courses which can help provide motivation and maintain interest, especially in those facilities where these emergencies occasionally occur.

It is concerning that just over one-third of the trainees failed the initial practical skills testing. Additionally, the primary predictor of failing the study retest was a failing score on the initial test. No associations for this were evident within the study findings. We hypothesize that this finding may be secondary to the individual's incomplete or insufficient knowledge base leading to persistent difficulties in understanding the course lessons. The ALSO program requires that a pretest be given prior to starting the training which was done. However, the ALSO courses proceeded based upon the assumption that the participants had an adequate knowledge base to fully benefit from the training. The focus of this study was to assess the participant's knowledge and skill retention after completing the ALSO course. Therefore, the pretest scores were not included within the study data collected and analyzed. We plan to review the study participant's pretest and compare their scores to the initial course test and retest. Accomplishing this comparison may reveal a participant's readiness to attend the ALSO training with some of these study participants better served by being triaged to an alternate emergency training, such as BLSO or C-BLSO training.

The study findings did reveal some inconsistencies with commonly described clinical activities. The quoted incidence of Shoulder Dystocia is less than 1.0% of births [25]. Attending at least one delivery with a Shoulder Dystocia was identified by 55.6% of participants which is greater than expected. The maneuvers used will not harm either the mother or baby and should be continued whenever Shoulder Dystocia may be suspected. Yet, if the occurrence of Shoulder Dystocia is greater than expected, further evaluation is required to identify if this is an increased complication in this population, the result of a conservative practice, or some other cause.

In some facilities, the use of a Vacuum Assisted Deliveries seemed to be more than commonly cited. Additionally, some complications identified seemed higher than anticipated. For instance, 33% of participants had encountered cephalohematomas with vacuum deliveries; the commonly identified incidence of cephalohematomas is 14-16% [26]. With adequate training and careful patient selection, a vacuum-assisted delivery can be a valuable tool for the delivery of the women with obstetrical complications and the at-risk fetus. Yet, the potential risks and benefits of a vacuum-assisted delivery must be weighed against the available alternatives, including continued expectant management, oxytocin augmentation, and cesarean delivery. Ongoing monitoring of the use of vacuum extraction for delivery commonly occurs in most obstetrical facilities as part of a quality assurance process. In those facilities where vacuum deliveries occur, a review of each vacuum delivery performed, including indication, should be considered as part of a quality improvement review.

Although extremely rare, instances of overdosing especially with the use of 50% Magnesium sulfate ($MgSO_4$) have been described which have resulted in maternal respiratory depression and arrest [27]. The responses of the participants concerning $MgSO_4$ were so variable that concerns are raised regarding the participant's understanding of $MgSO_4$ dosages and protocols. It is suggested that the available $MgSO_4$ dosage be evaluated in each facility. Once an accurate assessment is completed, a decision can be made regarding the $MgSO_4$ dosages and protocol. Regardless of the findings, whenever $MgSO_4$ is available,

it is essential that Calcium Gluconate also be available if maternal respiratory complications occur.

Over 85% of study participants identified having adequate equipment/supplies with 60% of those responding saying they had no difficulty in obtaining equipment and supplies. However, this could not be confirmed in the equipment lists submitted by the study participants. When the ALSO course was begun, funds were available to provide the recommended equipment and supplies to some, but not all, of the facilities. However, a process was put into place to facilitate the procurement and to restock emergency equipment and supplies. The authors have encouraged the staff to obtain emergency equipment and supplies and to maintain them within each facility's obstetrical care area. Protocols have been made available to regularly check the equipment/supplies, and ascertain that the equipment and supplies are available, maintained, and replaced. Yet, following these recommendations has been inconsistent.

Limitations

This study addressed a small sampling of HCW's who voluntarily attended a special emergency obstetrical training course in Cameroon. Therefore, the findings may or may not be typical of or generalizable to other HCWs or obstetrical units in Cameroon.

All ALSO course attendees came to the training on a voluntary basis, and it is probable that they were motivated to attend by their special interest in emergency obstetrical care, as indicated by the number of participants whose scores increased on the retest. Therefore, these study participants may be a biased sampling secondary to their interest in improving their knowledge and skills. It is not known if the same interest in EmOC would be shown by other HCWs in Cameroon.

Every effort was made to encourage ALSO trainees to participate in this study. Yet, it was hoped that more than 99 trainees would participate. Concerns were raised that this small number of study participants may bias the findings and not be reflective of the population of HCW's attending ALSO courses. On review, this number of study participants would give a confidence level of 90% with a 5% margin of error. Therefore, we believe that the number of study participants is acceptable and that the findings do reflect the true values of the total ALSO course attendees.

Recommendations

This study has shown that ongoing "refresher" courses are necessary to maintain the quality of obstetrical emergency care. Dedicated and strong leadership is required to maintain staff motivation and interest to address the "3rd Delay" barrier. It is recommended that the program be continued under the ALSO Program Manager with the institution of an Advisory Board consisting of ALSO Instructors and Obstetrical Head Nurses. This Advisory Board should meet 1-2 times a year to establish program guidelines (i.e. selecting appropriate training for participants, duration between refresher courses, number of yearly trainings, and periodic auditing of the management of EmOC at each facility) and to discuss the EmOC and a way forward to cope with any identified challenges.

The ALSO Program cannot be successful without the full investment of each facilities' obstetrical staff. Consideration should be given to monitoring the capability of each facility to provide EmOC consistent with the level of care of the facility. This could include on-site supervisory visits by the Program Manager, ALSO instructors, and Obstetrical Head Nurses. In addition, each facility could submit

a simple self-assessment of their emergency care capability yearly for Advisory Board review. Finally, weekly case presentations of all obstetrical emergency cases should be held in labor and delivery units by the head nurses and/or ALSO instructors to enable the staff to learn from each case and improve their management. The final goal would be that any staff providing obstetrical care would have EmOC training appropriate to their capabilities and work environment.

The 2006 to 2014 CBCHS Activity Reports have identified that 148 women died while in maternity care at CBCHS facilities; this averages to 1-2 maternal deaths occurring monthly in CBCHS facilities. This number of deaths is not acceptable. Yet, no data has been gathered as to why these deaths are occurring, and if, or how, these deaths can be prevented. It is recommended that a system of Maternal Mortality Reviews be developed to identify the causes of and contributors to each Maternal Death with the findings presented in a yearly report to CBCHS administration, obstetrical care providers, and other interested partners. This report would be very helpful to identify activities which could be implemented to avoid preventable deaths and develop community educational efforts.

Authorship and contributorship

Each author contributed to the study conception, design, analysis, and interpretation of the data. Each author participated in the writing the manuscript, reviewing, and revising the manuscript. Each author has approved the manuscript for submission for publication.

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Competing interest

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