



RESEARCH ARTICLE

REVISED **A mixed methods evaluation of Advanced Life Support in Obstetrics (ALSO) and Basic Life Support in Obstetrics (BLSO) in a resource-limited setting on the Thailand-Myanmar border [version 2; peer review: 2 approved]**

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Abstract

Background: Short emergency obstetric care (EmOC) courses have demonstrated improved provider confidence, knowledge and skills but impact on indicators such as maternal mortality and stillbirth is less substantial. This manuscript evaluates Advanced Life Support in Obstetrics (ALSO) and Basic Life Support (BLSO) as an adult education tool, in a protracted, post-conflict and resource-limited setting.

Methods: A mixed methods evaluation was used. Basic characteristics of ALSO and BLSO participants and their course results were summarized. Kirkpatrick's framework for assessment of education effectiveness included: qualitative data on participants' reactions to training (level 1); and quantitative health indicator data on change in the availability and quality of EmOC and in maternal and/or neonatal health outcomes (level 4), by evaluation of the post-partum haemorrhage (PPH) related maternal mortality ratio (MMR) and stillbirth rate in the eight years prior and following implementation of ALSO and BLSO.

Results: 561 Thailand-Myanmar border health workers participated in ALSO (n=355) and BLSO (n=206) courses 2008-2020. Pass rates on

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1

2

version 2

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report



version 1

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report



report

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skills exceeded 90% for both courses while 50% passed the written ALSO test. Perceived confidence significantly improved for all items assessed. In the eight-year block preceding the implementation of ALSO and BLSO (2000-07) the PPH related MMR per 100,000 live births was 57.0 (95%CI 30.06-108.3)(9/15797) compared to 25.4 (95%CI 11.6-55.4)(6/23620) eight years following (2009-16), $p=0.109$. After adjustment, PPH related maternal mortality was associated with birth before ALSO/BLSO implementation aOR 3.825 (95%CI 1.1233-11.870), migrant (not refugee) status aOR 3.814 (95%CI 1.241-11.718) and attending \leq four antenatal consultations aOR 3.648 (95%CI 1.189-11.191). Stillbirth rate per 1,000 total births was 18.2 (95%CI 16.2-20.4)(291/16016) before the courses, and 11.1 (95%CI 9.8-12.5)(264/23884) after, $p=0.038$. Birth before ALSO/ BLSO implementation was associated with stillbirth aOR 1.235 (95%CI 1.018-1.500).

Conclusions: This evaluation suggests ALSO and BLSO are sustainable, beneficial, EmOC trainings for adult education in protracted, post-conflict, resource-limited settings.

Keywords

Adult education, Kirkpatrick's framework, post-partum haemorrhage, maternal mortality, stillbirth, self-confidence, advanced life support in obstetrics training, post-conflict, resource-limited setting

Madison, USA

Any reports and responses or comments on the article can be found at the end of the article.



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REVISED Amendments from Version 1

The major difference between version 1 and 2 includes minor clarifications: a few extra details in the methods, some formatting of the layout e.g. number of decimal places in OR reporting, reformatted [Figure 3](#), correct numbering of the tables, addition of relevant references and the addition of uterine available in this limited resource-limited setting.

Any further responses from the reviewers can be found at the end of the article

Introduction

Skilled attendance at birth providing quality emergency obstetric and newborn care is an essential element for reducing the high burden of maternal and neonatal morbidity and mortality in resource-limited settings (RLS)^{1,2}.

A number of practical skills or “hands-on” short course courses are aimed at improving emergency obstetric care (EmOC)³. The Advanced Life Support in Obstetrics (ALSO) course developed by the American Academy of Family Physicians is one of the oldest commencing in 1991, is standardized and evidenced-based, and available in multiple languages^{4,5}. ALSO promotes inter-professional and multidisciplinary training to equip the maternity team (nurse midwives, registered nurses, physicians, residents and other members) to improve patient safety and positively impact maternal and newborn outcomes in obstetric emergencies. Positive ALSO evaluations from high-income countries^{6,7} and low-income and RLS (Colombia, Guatemala, Honduras, and Tanzania) report decreased in-hospital maternal mortality, episiotomy use, and post-partum haemorrhage (PPH); and active management of third stage of labour and vacuum-assisted vaginal delivery increased in frequency after ALSO training⁸. In 2010 a systematic review in low-resource environments suggested there was a lack of strong evidence of the effectiveness of emergency obstetric trainings⁹. In 2020 a global review reported improved provider knowledge/skills and change in clinical practice but evidence for a reduction in the number of cases of post-partum haemorrhage (PPH), case fatality rates, stillbirths and institutional maternal mortality were less strong³.

The ALSO approach to learning is adult based. Learning suits professionals working in government health systems where tertiary education and certification of health care training is the norm. Tertiary qualified staff may not be available in post-conflict and politically unstable RLS with broken education and health infrastructure¹⁰. Evidence for the type of learning and teaching suitable for healthcare workers in politically unstable and post-conflict settings is limited¹¹. ALSO requires a degree of health literacy that may challenge healthcare workers based in countries rebuilding education and health systems^{12,13}.

Basic Life Support in Obstetrics (BLSO) is complementary to ALSO but structured for pre-hospital health care

providers, first responders, and medical, nursing and physician assistant students¹⁴. The objective of BLSO is to improve the management of normal deliveries, as well as obstetric emergencies by standardizing the skills of frontline responders. BLSO is more difficult to compare internationally as there is more flexibility on topics included in the course, realizing the need for context appropriate training.

Reported success of training in emergency obstetric care in low-income countries within government health systems is commendable but are these replicable in post-conflict or politically unstable health care systems?^{10,15–18} Shoklo Malaria Research Unit (SMRU), a humanitarian and research organization on the Thailand Myanmar border, has provided antenatal care and childbirth facilities for refugees since 1986 and migrants since 1998. Facility based ALSO and BLSO training for Karen and Burmese healthcare workers was introduced in 2008. This was the first time the ALSO course has been held in a refugee camp. The objective of this analysis is to evaluate ALSO and BLSO as an adult education tool in emergency obstetric care, from the first course in 2008 to the most recently completed course in May 2020, in a protracted, post-conflict, RLS.

Methods

Study design

This mixed methods study collates several data sources to evaluate ALSO and BLSO as an adult education tool over the time period of 2008 to 2020. Before each course participants provided information about themselves using a standard form. Change in perceived confidence was measured before and after the course, and a sub-cohort (of the 2008 course) had a 12-month evaluation. The course theory and skill results were summarized. Course strengths were evaluated through an open-ended question. Finally, obstetric indicators including PPH related maternal mortality and stillbirth in the eight year block preceding the implementation of ALSO and BLSO and in eight years after were sourced from routine surveillance data.

Setting

Maternal and child health care. Refugees from Myanmar have lived in camps on the Thailand side of the border since 1984 with primary health care provided by a coalition of non-government organizations (NGO). Shoklo Malaria Research Unit (SMRU) was established in Shoklo Refugee Camp in 1986 conducting research and providing humanitarian care. SMRU commenced maternal health operations outside the camps with border migrant populations in 1998. Mae Tao Clinic (MTC) established in 1988 provides humanitarian care to Karen and Burmese in Mae Sot. SMRU and MTC clinics provide similar maternal and child health services including antenatal care (ANC), birthing services, post-natal care and special care baby units. SMRU, MTC and NGO services do not have capacity for advanced interventions including caesarean sections. If caesarean section is indicated women are transferred to the nearest Thai Public Hospital, 30–90 minutes away depending on the clinic ([Figure 1](#)).

Initially, *P. falciparum* infection accounted for the largest proportion of maternal mortality (estimated at 1,000 per 100,000 live births in 1985–1986¹⁹) and was the focus of activity for the first two decades. In 1994 basic tools such as the World Health Organization (WHO) partogram in labour and essential medications such as magnesium sulphate for eclampsia and severe pre-eclampsia were introduced. To standardize interventions for common obstetric emergencies and medical complications SMRU produced a three language (Karen, Burmese and English) ‘Manual of Obstetrics’ in 1998, which has subsequently been revised three times (English only). As post-partum haemorrhage (PPH)²⁰ replaced malaria as the largest cause of maternal mortality, the need further training in obstetric emergencies was recognized.

Participants

Human resources. There are significant barriers to displaced persons in Thailand (refugees or migrants) obtaining formal training and certification as health workers in either Thailand or Myanmar. For more than three decades healthcare work by NGOs and humanitarian organizations on the border including SMRU and MTC have been provided by local Karen and Burmese from the community trained to work as medics, nurses, midwives, sonographers or counsellors as defined here:

Medics: A ‘medic’ takes the role of doctor by doing clinical examinations, ordering laboratory tests, making the diagnoses and prescribing treatment. They have normally received a minimum of 6–12 months of theory training and a further 6–12 months of on the job practical training^{12,13}.

Nurse: A ‘nurse’ works in the same capacity as nurses in developed countries and have normally received 3–6 months of theory and 3–6 months of practical training.

Midwife: A ‘midwife’ (or skilled birth attendant) provides antenatal and delivery care services. SMRU developed its first curriculum in 1994, with the current course taking a minimum of 15 months (30 deliveries)²¹.

Sonographer: SMRU trains local staff in ultrasound gestational age assessment. They have the hardest entrance test compared to the other health staff and the quality of their work is reported elsewhere²².

Counsellor: A ‘counsellor’ provides antenatal care counselling particularly in explaining screening for pregnant women (blood tests, gender-based violence, mental health, nutrition).

Myanmar doctors: SMRU employs doctors to support the health workers and some come from Myanmar.

All these health workers were invited to participate on courses as they were offered.

ALSO and BLSO

With support from ALSO Australasia, it was decided to launch the program at SMRU and MTC. The initial course was supported by four instructors from Australia. The ALSO course includes a syllabus to be studied in advance of the course, an

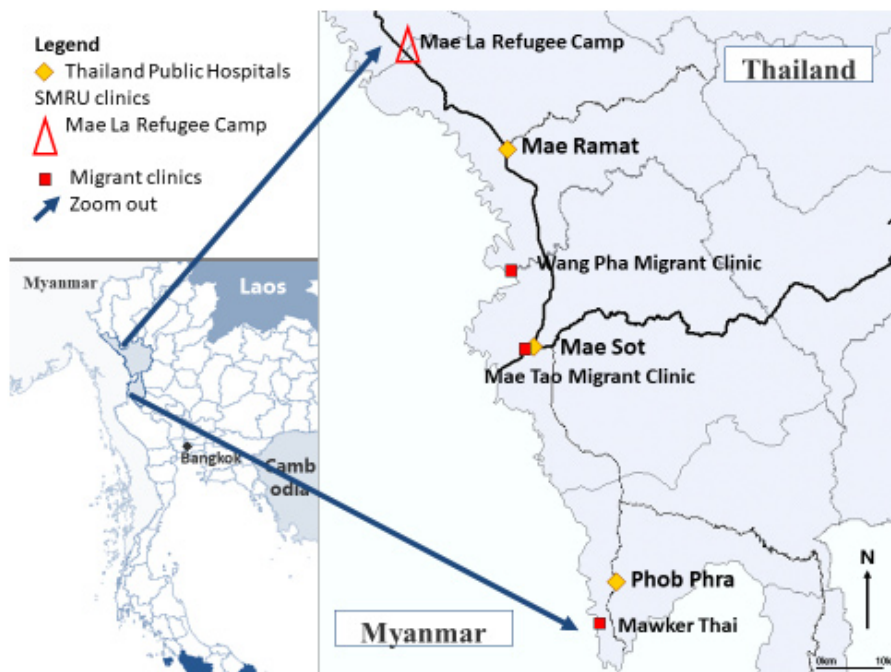


Figure 1. Map of the area and location of clinics where ALSO and BLSO were conducted.

intensive two-day course reviewing obstetric emergencies, and an examination of theory and skills (Table 1). The BLSO course is conducted in one to two days, context adapted for front line responders (Table 1), with the emphasis on skills.

Instructors for ALSO and BLSO. ALSO and BLSO instructors must have successfully passed both ALSO and the ALSO Instructors course, detailed elsewhere but briefly a short intensive training of the ALSO teaching methods^{4,5}. A range of languages are used in the clinics with most local staff speaking one or two dialects of Karen (Sgaw Karen or Pho Karen), Burmese and English as a 2nd, 3rd or 4th language. Following the first course, local staff were selected as Instructors based on qualities such as being a good team player, performing well on the actual ALSO course and languages spoken²³. Courses on the border retain the recommended participant to instructor ratio as 4:1.

ALSO for the Thailand-Myanmar border. SMRU course organizers reduced the volume and complexity of the English course material to reflect the baseline education of the group and to ensure the content was relevant to the local setting e.g. including malaria and sepsis as a cause of maternal mortality (Table 1). While the Thailand-Myanmar border commenced with ALSO, the Global ALSO manual has emerged as the most relevant tool to adapt the ALSO course to local circumstances, especially in resource limited settings²⁴. ALSO course teaching was structured into two parts: the preparation phase and the standard two day intensive course. The preparation phase reviewed one to two chapters per week, mostly in English (60–120 minutes, led by a doctor). A study group for 2–3 hours later in the week, mostly in Karen and Burmese language led by a senior midwife or medic included practice of skills using donated mannequins. The total preparation phase took approximately 12–16 weeks.

Table 1. Situations taught in the ALSO and BLSO course on the Thailand-Myanmar Border.

ALSO	BLSO
Safety in Maternity Care	Safety in Maternity care/Universal precautions
	Normal labour
Intermittent auscultation (as opposed to Intrapartum fetal surveillance)	Emergent/Urgent prenatal assessment (no electronic fetal monitoring option)
Labour dystocia	
Forceps and Vacuum -assisted births	
Shoulder dystocia	Shoulder dystocia
Pre-eclampsia/Eclampsia	Pre-eclampsia/Eclampsia
Vaginal breech births/malpresentation	Breech, Twin gestation, Cord Prolapse and other malpresentation
Umbilical cord prolapse	
Preterm labour (PTL)	PTL and Preterm, premature rupture of membranes (PPROM)
Antepartum haemorrhage (APH)	Haemorrhage (1st trimester, APH and PPH)
Postpartum haemorrhage (PPH)	
First-trimester bleeding	
Maternal resuscitation	Maternal resuscitation
Maternal venous thrombosis [^]	
Severe malaria and sepsis [^]	
Neonatal resuscitation (NNR) ^{^^}	Neonatal resuscitation (NNR)
Perinatal loss/Birth crisis	

[^]As maternal venous thrombosis mortality in the area is much lower than mortality from severe malaria and sepsis; it was de-emphasized while severe malaria and sepsis were included from 2008.
^{^^}USA and Australasia deviate slightly on content in different editions of ALSO so the 9th Edition USA does not include neonatal resuscitation but it is retained on the Thailand-Myanmar border as no alternative course is available.

The ALSO written exam was also modified for relevance and clarity, removing difficult English e.g. double negatives, and intrapartum (electronic) fetal surveillance, leaving 50 questions. The exams were available in Burmese starting in 2008 and Karen in 2013. Translation verification included back translation. Courses and exams were updated regularly, and numerical scores were given to participants.

BLSO for the Thailand-Myanmar border. BLSO was directed at frontline staff in border clinics who might encounter pregnant women or neonates in their work. English literacy was a recognized barrier to learning for these staff. Student midwives with little or no clinical experience were also encouraged to participate in BLSO before the end of the first year of training to promote confidence in the workplace and familiarity with some emergencies.

BLSO does not have a preparation phase for participants, the content and the assessment all took place in a two-day course. Material was prepared in English and taught in Burmese and Karen, with a 12-page handout (>50% pictures) provided.

The BLSO was assessed by 10 short answer questions and was available in four languages (Burmese, Karen, Thai and English). The practical component assessed emergencies that were likely to be seen in the community and scored as pass or fail.

Course fees and size. Sustainability in high-income countries comes at a cost to the participant. In this RLS both ALSO and BLSO were conducted by SMRU without cost to the participant. Doctors were asked to pay for the cost of copying the materials. Course size was limited by mannequins to a maximum of eight per group and three groups i.e. 24 participants at a single course.

Evaluation of adult education effectiveness

Kirkpatrick's framework for assessment of effectiveness of adult education includes four levels of data: (level 1) participants' reactions to training, (level 2) change in knowledge and/or skills, (level 3) change in behaviour or clinical practice and (level 4) change in the availability and quality of EmOC and in maternal and/or neonatal health outcomes²⁵. In this analysis data on level 1 and level 4 were measured.

All level 1 data was voluntary following a verbal explanation to participants at course orientation. Two measures were included: perceived confidence and self-reported strengths of the course. Prospective repeated-measures surveys at three time periods on perceived confidence: pre course, immediate post course and in a sub-cohort from the original ALSO course in 2008, at 12 months post baseline. The survey tool was adapted with permission from ALSO courses in the USA^{6,26}.

Self-reported strengths of the course were measured for ALSO participants by response to an open-ended survey question: "What are the strengths of the course?". Answers in native language were encouraged with responses in Karen and Burmese translated to English.

Level 4 data were extracted from the routine birth facility data curated by SMRU, and measured pre and post ALSO and BLSO in two equal year blocks: before (2000-2007) and after (2009-2016) implementation. The eight year time frame was chosen as all archived data were cleaned and data checked, while more recent data was not.

Variables

Participant characteristics included age, gender, profession, years of practice, workplace, high school and university attendance, and theory and skills results (as a percentage).

For qualitative analysis perceived confidence to manage the obstetric emergency situations covered in the ALSO or BLSO curriculum (detailed in [Table 1](#)) was measured using a four-point [1 terrified, 2 scared, 3 coping, 4 comfortable] rank-ordered response Likert scale.

For quantitative analysis extracted variables related to maternal mortality and stillbirth included: status (migrant/refugee), parity, smoking, underweight (<40 kg), four or less antenatal consultations, anaemia the first antenatal visit (haematocrit < 30%) and falciparum malaria confirmed by microscopy by active and frequent screening in pregnancy.

Statistical analysis

The analysis was conducted using [SPSS 23.0](#) for Windows. Participant characteristics such as gender were summarized mostly by proportions (n, %) while age and scores on the course were summarized using the median (interquartile range). The Likert scale responses were summarized by median, interquartile range (IQR) or range (minimum-maximum (min-max)), or proportions, as appropriate. The 95% confidence intervals of proportions were calculated using Wilson's method²⁷. The comparison of confidence scores was based on individual paired testing using the Wilcoxon signed rank test.

Qualitative data were analyzed using conventional content analysis to identify major themes²⁸. Two authors independently and manually reviewed printed transcripts of the data and suggested possible codes. After discussion, and analysis of the relationship between proposed codes, three common themes were agreed on for the final analysis. Data review was repeated and content was summarized into these three themes. Each reviewer independently chose exemplary comments for each of the three themes and final inclusion was based on discussion and by mutual agreement.

A word cloud was developed using free online software [Voyant Tools](#) (<https://voyant-tools.org/>), to examine the most commonly used words from all the responses to the open-ended question.

The odds ratio (OR) and confidence interval (CI) for factors associated with the binary outcomes, PPH related maternal mortality (yes/no) and stillbirth (yes/no), were calculated by univariate analysis. The outcome of interest, birth before ALSO and BLSO implementation (yes/no) was retained in the models, as were factors with a $p < 0.10$ in univariate analysis.

These factors were entered in their respective logistic regression model, and were included in the relevant tables, along with adjusted odds ratios (aOR) and 95% CI.

Bias

The participants include all those who participated to the ALSO and BLSO courses reducing selection bias. The qualitative data was analyzed by two of the local instructors who support the course and therefore are at risk of 'positive' bias however they are not responsible for the numerous volunteered responses from the participants. The quantitative data is limited to what data was available and at risk of not being able to account for factors that can affect maternal mortality and stillbirth. For example 'socio-economic status' was not available and may have contributed to improvements although refugees and migrants have remained marginalized populations over the entire period.

Ethical approval

As part of standard procedure in this setting the details of this project were presented, discussed and approved by the local Community Advisory Board (TCAB-311-12,016), Mae Sot Thailand. No ethical approval was sought for the education evaluation data which was fully anonymized and previously collected. Oxford University Ethics Committee, ethical approval reference code OXTREC 28-09 was obtained for extraction of PPH related mortality and stillbirth data from anonymized hospital records.

Results

First ALSO in a refugee camp and migrant clinics

In 2008, ALSO training took place for the first time in a refugee camp with 18 participants from Maela Camp; and in Wang Pha clinic where 19 participants came from three border clinics (Wang Pha, Maw Ker Thai and Mae Tao Clinic in Mae Sot). The majority of participants were midwives 78.4% (n=29/37), 73.0% (n=27/38) had five or less years of work

experience²⁶. Only 16.2% (n=6/37) had been to university in Myanmar and none had the opportunity to study courses related to medical health care. In total, 94.7% (n=35/37) passed the practical exam while only 29.7% (n=11/37) successfully passed the theory component to ALSO standards. Eleven participants were invited to become instructors to facilitate future courses in local languages.

Subsequent ALSO and BLSO courses

From 2008 to 2020, 561 health workers participated in courses conducted at SMRU and MTC: 355 in ALSO and 206 in BLSO (Figure 2).

Local participant characteristics included (Table 2) young age (median <30 years), female predominance 84.8% (476/561) with a majority with five or less years of practice. There was a high uptake to the courses by midwives (none were male), and a variety of workplaces (all non-tertiary) were involved. Less than four years high school was reported by one in four participants and university attendance (not completion) in less than one in five participants

The main written and spoken language of participants confirmed that no one language was available to all participants (Table 3).

Results of the ALSO and BLSO courses

Results on the skills component of ALSO have been consistently high, with a median score of 93 [35-100], and 98.6% (n=350/355) passing on first attempt. This contrasts to the theory component with a median score 66 [11-96], with 26.8% (95/355) passing on the first attempt, and one in two participants passing on a retake (50.6%; n=43/85). Retakes were not offered in 2008.

Pass rates for the less demanding BLSO course were high for both the practical (91.7%; n=189/206) and the theory (93.2%; n=192/206).

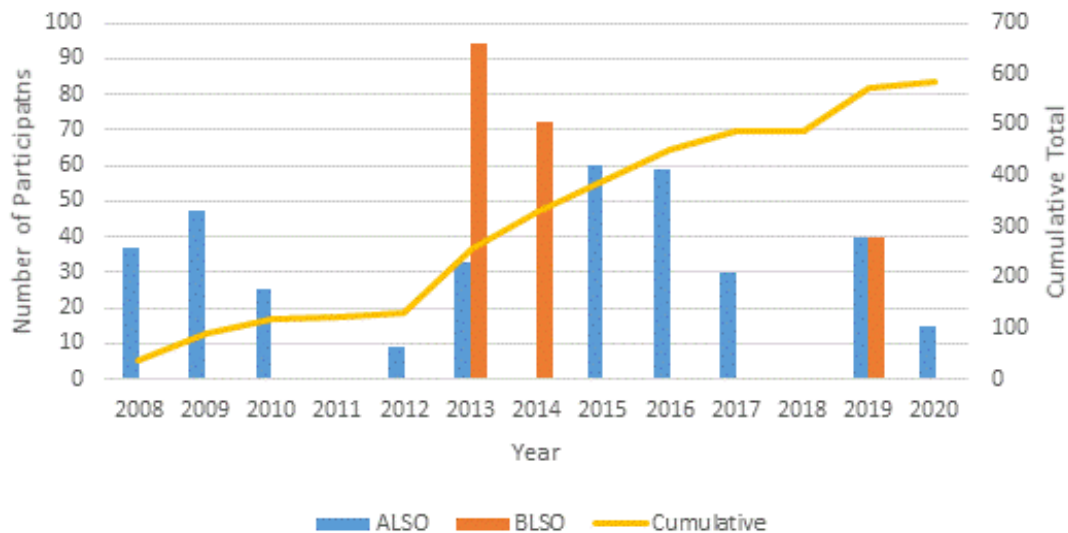


Figure 2. Time frame of the conduct of ALSO and BLSO courses on the Thailand-Myanmar border 2008-2020 including numbers of participants. ALSO=Advanced Life Support in Obstetrics; BLSO=Basic Life Support in Obstetrics.

Table 2. Characteristics of participants on the ALSO and BLSO courses.

Characteristics		ALSO	BLSO
		n=355	n=206
Age	median [min-max]	29 [19–54]	25.5 [18–59]
Female		88.2 (313)	79.1 (163)
High school	less than 4 years	28.5 (101/355)	20.4 (41/201)
Myanmar University	attended (degree maybe incomplete)	18.3 (64/349)	14.9 (30/201)
First time on course		75.2 (267)	97.6 (201)
Health profession	medic	18.3 (65)	26.2 (54)
	nurse	13.5 (48)	23.3 (48)
	midwife	62.8 (223)	35.9 (74)
	doctor (Myanmar)	2.5 (9)	0
	Sonographer	0.8 (3)	4.9 (10)
	Counsellor	1.1 (4)	2.4 (5)
	Other e.g. pharmacist	0.3 (1)	4.9 (10)
	not recorded	0.8 (3)	2.4 (5)
Years in practice	≤1	20.0 (71)	63.1 (130)
	2–5	38.6 (137)	21.8 (45)
	6–10	25.9 (92)	8.7 (18)
	11–15	11.8 (42)	2.9 (6)
	≥16	3.4 (12)	1.0 (4)
	missing	0.3 (1)	3 (1.5)
Work place	Maela Refugee camp	33.2 (118)	57.3 (118)
	WPA and MKT migrant sites	32.1 (114)	22.3 (46)
	Mae Tao Clinic Mae Sot	15.5 (55)	0
	IRC Myanmar doctors	2.5 (9)	0
Theory results (%)	score median [min-max]	66 [11–96]	80 [35–100]
	passed 1st attempt	26.8 (95)*	93.2 (192)^
	passed on retake	50.6 (43/85)	70.0 (7/10)
Skills results	score median [min-max]%	93 [35–100]	n.a.
	passed 1st attempt	98.6 (350)	91.7 (189)

*≥70%, ^≥60%

Data in % (n), or otherwise indicated, Missing data: ALSO age n=1, BLSO age n=3

Abbreviations: ALSO=Advanced Life Support in Obstetrics; BLSO=Basic Life Support in Obstetrics, AMI Aide Médicale Internationale, IRC International Rescue Committee, MKT Maw Ker Thai, MRML Mae Ra Mu Wang, MTC Mae Tao Clinic, WPA Wang Pa

Table 3. Languages spoken and written by participants on the ALSO and BLSO courses.

	Language	ALSO	BLSO
Spoken	Poe Karen	15.2 (53/348)	11.2 (23/203)
	Sgaw Karen	91.7 (319/348)	92.1 (187/203)
	Burmese	98.0 (34/348)	98.0 (199/203)
	English	69.3 (241/348)	70.4 (143/203)
	Thai	13.5 (47/348)	18.2 (37/203)
	other	3, (Lisu, Mon, Shan)	1, (Karenni)
Written	Poe	10.3 (36/348)	8.4 (17/203)
	Sgaw	80.2 (279/348)	85.2 (173/203)
	Burmese	96.6 (336/348)	96.6 (196/203)
	English	87.1 (303/348)	78.6 (162/203)
	Thai	10.3 (36/348)	10.8 (22/203)
	other	1 (Lisu)	1 (Karenni)

ALSO=Advanced Life Support in Obstetrics; BLSO=Basic Life Support in Obstetrics.

Missing data: n=7 ALSO, n=3 BLSO

Overall, 88.9% (8/9) doctors passed both practical and theory but all attended tertiary education.

Changes in perceived confidence

Complete data was available for 97% (n=345/355) of ALSO participants for pre- and immediate post-course paired testing of perceived confidence. For all items there was a strong and significant signal for an increase of median perceived confidence, with $p < 0.001$ for all comparisons (median scores not shown). The proportion of participants who were terrified, scared, coping or comfortable were summarized and breech, vacuum, shoulder dystocia and neonatal resuscitation showed the greatest improvement in the proportion 'comfortable' from baseline (Figure 3, Panel A).

Of 36 participants from the first ALSO cohort in 2008, 32 had a 12-month post-course evaluation: perceived confidence remained significantly higher than baseline for 8 of 13 situations; and was significantly lower for 5 of 13 situations at 12 months compared to the immediate post ALSO course evaluation (Table 4).

There were 89.3% (184/206) of participants on BLSO who completed pre- and immediate post-course evaluation. BLSO perceived confidence at baseline was low except on universal precautions; and the median post evaluation scores were significantly higher for all items (data not shown) $p < 0.001$. The proportion of participants who were terrified, scared, coping

or comfortable were summarized (Figure 3, Panel B). Despite improvements most were still 'scared' of normal delivery at the end of the course.

Thematic analysis course strengths

Almost all (97.7%; n=347/355) ALSO participants responded in their language of choice to the survey "What are the strengths of the course?": Karen (21%), Burmese (16%) and English (63%). The most common themes to emerge from the responses were: "Improved knowledge", "I can do it" and "Teamwork".

Improved Knowledge. Improved knowledge emerged as the strongest theme with nearly half the respondents including a statement on knowledge:

"I'm so happy to attend this ALSO training. I have learned many things I haven't heard of before and improved my knowledge." [midwife, migrant site, 2009],

"I know how to protect mothers from mortality and so we can reduce mother mortality. Before the course we never knew or heard of these things for the mother. Now we know." [midwife, rural Myanmar, 2020].

"I got more knowledge on this ALSO course. The teaching was systematic for theory and practice so I can understand and appreciate it. I am happy and want to say thank you [midwife, refugee camp, 2008]

I can do it. The words "I can..." in relation to the skills taught on ALSO were also frequently mentioned in the responses. Participants transmitted a strong sense of being empowered to solve obstetric problems because of the skills:

"I can do the skill. I cannot do it before the course. I am not afraid whereas before I was afraid." [midwife, Mae Tao Clinic, 2008]

"I can apply and use the ALSO material on the patient. I have much less fear and more courage because I know how to handle the problem step by step." [medic, migrant clinic, 2008]

"I learned more than just about safe delivery. I am just one person, but I think I can save the life of Karen women and children by this course. I feel useful." [midwife, refugee camp, 2008]

Teamwork. Participants also provided insights into the relationship of their skills and knowledge and their role, or sense of control in the team:

"With this training I have increased time awareness for emergencies. It helped me to have better teamwork because I can see how we organize and manage our team in the emergency." [medic, migrant site, 2013]

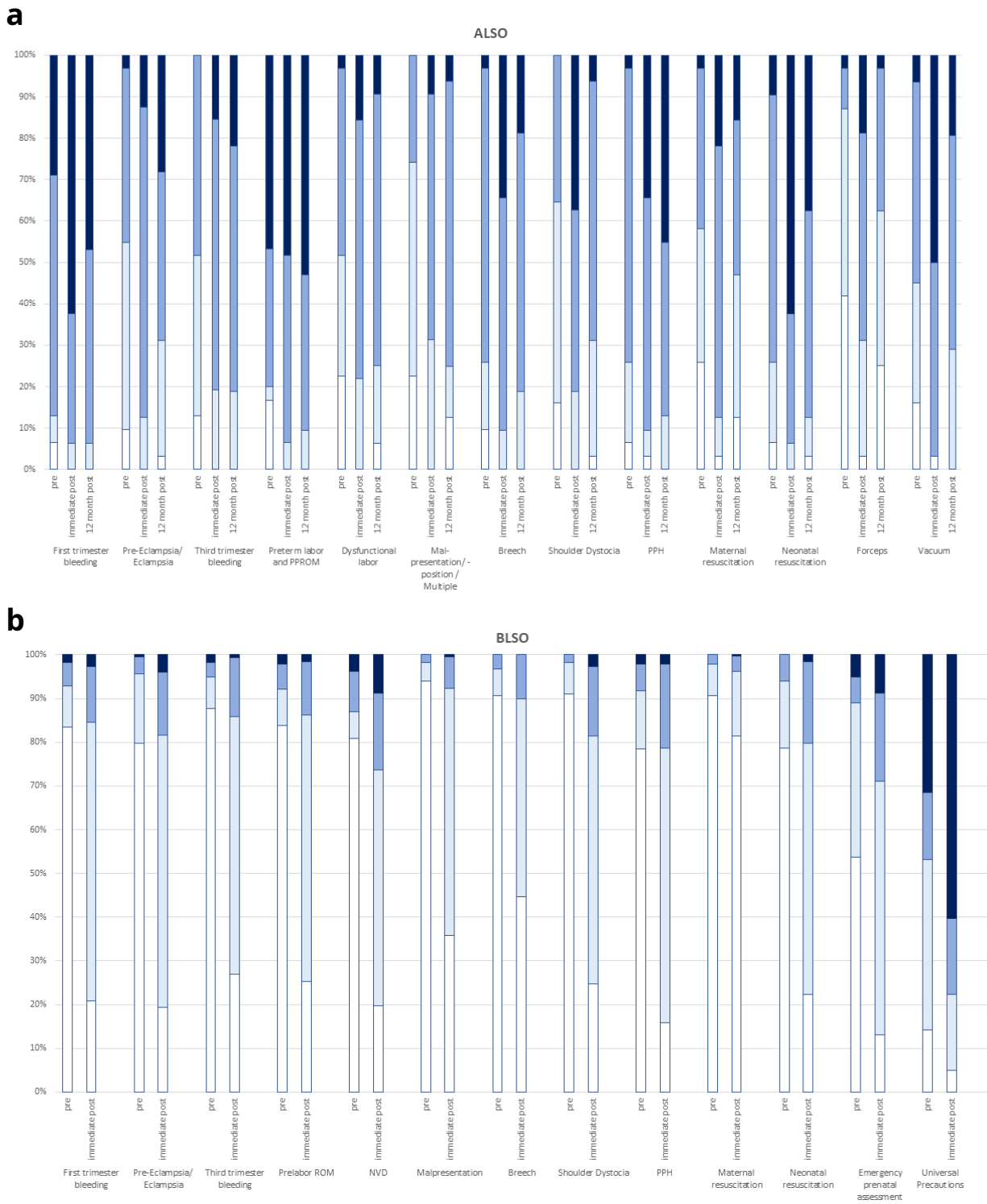


Figure 3. Evaluation of perceived confidence pre and post course evaluation. Panel **A**: ALSO in 345 participants. Panel **B**: BLSO in 184 participants. Bar color represents scores of 1 terrified, 2 scared, 3 coping or 4 comfortable.

Table 4. Perceived confidence of the first ALSO cohort on the Thailand-Myanmar border at baseline, immediately post course and at 12 months post baseline (n=32).

Obstetric Situation	Pre		Immediate post		P-value ^a	12 Months Post			
	Median	IQR	Median	IQR		Median	IQR	P-value m12 vs baseline ^b	P-value m12 vs immediate post ^c
Bleeding in first trimester	3	[3-4]	4	[3-4]	0.001	3	[3-4]	0.059	0.275
Pre-eclampsia/ Eclampsia	2	[2-3]	3	[3-3]	<0.001	3	[2-4]	0.005	0.670
Bleeding in 3rd trimester	2	[2-3]	3	[3-4]	<0.001	3	[3-3]	<0.001	0.433
Preterm labour and PROM	3	[3-4]	3	[3-4]	0.068	4	[3-4]	0.073	1.000
Dysfunctional labour	2	[2-3]	3	[3-3]	<0.001	3	[2-3]	0.002	0.251
Malpresentation / Malposition/ Multiple	2	[2-3]	3	[2-3]	<0.001	3	[2-3]	0.001	0.577
Breech	3	[2-3]	3	[3-4]	0.005	3	[3-3]	0.060	0.059
Forceps	2	[1-2]	3	[2-3]	<0.001	2	[1-3]	0.062	0.006
Vacuum	3	[2-3]	4	[3-4]	<0.001	3	[2-3]	0.009	0.007
Shoulder Dystocia	3	[2-3]	3	[3-4]	<0.001	3	[2-3]	0.003	0.010
Post-partum Haemorrhage	3	[2-3]	3	[3-4]	0.003	3	[3-4]	0.003	0.582
Maternal resuscitation and trauma	2	[1-3]	3	[3-3]	<0.001	3	[2-3]	0.123	0.015
Neonatal resuscitation	3	[2-3]	4	[3-4]	<0.001	3	[3-4]	0.007	0.027

Scores 1 terrified 2 scared 3 coping 4 comfortable

^a Wilcoxon Signed Ranks Test paired data Immediate post compared to baseline

^b Wilcoxon Signed Ranks Test paired data 12 month post compared to baseline

^c Wilcoxon Signed Ranks Test paired data 12 month post compared to Immediate post

“ALSO improved my skills in working together in a team and at the same time the importance of communication for the patient.” [midwife, refugee camp, 2009]

“I know what I am doing. I can help the team now.” [student midwife, refugee camp, 2010]

A summary of the most common terms from all the comments on the strength of the course from all participants were collated in a word cloud (Figure 4).

PPH related maternal mortality and stillbirth

There were 39,900 total births from 2000-2016 (excluding 2008) and there were 15 PPH related maternal deaths (PPH-related maternal mortality ratio (MMR) per 100,000 livebirths: 38.1 (95% CI 23.1-62.8), (15/39417). In the eight-year block preceding the implementation of ALSO and BLSO (2000-07) the PPH-related MMR was 57.0 (95% CI 30.06-108.3) (9/15797) and in eight years after (2009-16) was 25.4 (95% CI 11.6-55.4) (6/23620), p=0.109. There were 483 stillbirths, a stillbirth rate

per 1000 total births of 12.1 (95% CI 11.1-13.2), with 18.2 (95% CI 16.2-20.4) (291/16016) before implementation and 11.1 (95% CI 9.8-12.5) (264/23884), p=0.038, after.

The proportion of PPH related mortality and stillbirths with associated factors were summarized (Table 5). After adjustment, birth before ALSO and BLSO was implemented (aOR 3.825, 95% CI 1.1233-11.870), having migrant (not refugee) status (aOR 3.814, 95% CI 1.241-11.718) and attending four (or less) consultations (aOR 3.648, 95% CI 1.189-11.191) were all associated with PPH related mortality. Seven of the eight factors including birth before ALSO and BLSO was implemented (aOR 1.235, 95% CI 1.018-1.500) were associated with increased odds of stillbirth (Table 5).

Discussion

This evaluation of ALSO and BLSO as education tools for health care workers mostly without tertiary qualifications in a post-conflict RLS demonstrates that they can achieve excellent

Table 5. Odds of PPH related maternal mortality and stillbirth before (2000-07) and after (2009-2016) the implementation of ALSO.

		% (n) PPH maternal mortality	Odds Ratio (95%CI)	P value	Adjusted Odds Ratio (95%CI)	P value	% (n) Stillbirth	Odds Ratio (95%CI)	P value	Adjusted Odds Ratio (95%CI)	P value
Before ALSO implemented	No	0.025 (6/23884)	Referent		Referent		1.1 (219/23884)	Referent		Referent	
	Yes	0.056 (9/16016)	2.24 (0.80-6.29)	0.127	2.95 (1.01-8.63)	0.015	1.4 (219/16016)	1.24 (1.04-1.49)	0.019	1.24 (1.02-1.50)	0.033
Migrant	No	0.022 (5/23174)	Referent		Referent		1.2 (287/23174)	Referent		Not included	
	Yes	0.060 (10/16726)	2.77 (0.95-8.11)	0.063	3.58 (1.19-10.81)	0.021	1.2 (196/16726)	0.95 (0.79-1.14)	0.548		
Parity >4 (grand multiparity)	No	0.077 (12/36017)	Referent		Not included		1.1 (387/36017)	Referent		Referent	
	Yes	0.033 (3/3883)	2.32 (0.65-8.22)	0.192			2.5 (95/3883)	2.33 (1.86-2.93)	<0.001	1.985 (1.56-2.52)	<0.001
Smoking in pregnancy	No	0.055 (10/30647)	Referent		Not included		1.0 (321/30647)	Referent		Referent	
	Yes	0.033 (5/9123)	1.68 (0.57-4.92)	0.344			1.8 (160/9123)	1.69 (1.39-2.04)	<0.001	1.27 (1.03-1.56)	0.025
Underweight (<40 kg)	No	0.037 (14/37621)	Referent		Not included		1.2 (440/37621)	Referent		Referent	
	Yes	0.045 (1/2212)	1.22 (0.16-9.24)	0.851			1.7 (38/2212)	1.48 (1.06-2.06)	0.022	1.59 (1.13-2.25)	0.007
Antenatal consultations ≤4	No	0.029 (10/34291)	Referent		Referent		1.0 (344/34291)	Referent		Referent	
	Yes	0.089 (5/5609)	3.06 (1.05-8.95)	0.041	3.78 (1.26-11.37)	0.018	2.5 (139/5609)	2.51 (2.06-3.06)	<0.001	2.53 (2.05-3.12)	<0.001
Anaemic first ANC visit (HCT <30%)	No	0.034 (12/35242)	Referent		Not included		1.1 (380/35242)	Referent		Referent	
	Yes	0.068 (3/4382)	2.19 (0.57-7.13)	0.279			2.3 (101/4382)	2.16 (1.73-2.70)	<0.001	1.69 (1.34-2.14)	<0.001
Falciparum malaria in pregnancy	No	0.037 (14/37444)	Referent		Not included		1.2 (434/37444)	Referent		Referent	
	Yes	0.041 (1/2455)	1.09 (0.14-8.29)	0.934			2.0 (49/2455)	1.74 (1.29-2.34)	<0.001	1.45 (1.06-1.98)	0.020

Missing data (n): includes parity (1), underweight (67), anaemia (278), falciparum (1)

Abbreviations: CI=confidence interval; ALSO=Advanced Life Support in Obstetrics; ANC=antenatal care; HCT=haematocrit; PPH= post-partum haemorrhage.

part be addressed by improved access to family planning³⁴. SMRU implemented the WHO partogram in 1994 and while the stillbirth rate of 12.1 (95%CI 11.1-31.2) per 1000 total births is at the global target, like maternal mortality it may well be under-estimated³⁵.

ALSO sets a standard. In protracted conflict and post-conflict settings where education as well as health are neglected reaching standard levels of practice are critical^{29,36}. Standards are the main reasons for the minimal modifications of ALSO on the Thailand-Myanmar border, limited to only those situations that are extremely rare or skills requiring equipment that is unavailable. This long and positive evaluation with improved outcomes while ALSO and BLSO have been the only emergency obstetric courses on offer in SMRU clinics and where the level 4 data was reviewed, supports their benefit³⁷⁻³⁹ and sustainability in RLS⁴⁰.

Limitations

This is an evaluation of a single emergency obstetric course, although many exist, and the comparison for PPH related maternal mortality and stillbirth is historical which is acknowledged as imperfect⁴¹. Deeper analysis into the factors associated with each case of PPH related mortality e.g. timeliness of uterotonics; and stillbirth e.g. pre or intrapartum; would also be helpful to understand if ALSO skills could have prevented the adverse outcome⁴². ALSO relies on mannequins for the practical component and is a burden for most RLS to purchase or maintain but invaluable in visualization of emergency obstetric skills. A complete cost analysis has not been conducted but the cost of replacing mannequins far exceeds other facility-based course costs as instructors work on a voluntary basis⁴³.

Conclusion

The best obstetric emergency course for RLS is unknown, however ALSO and BLSO are clearly feasible, effective and sustainable for adult education.

Data availability

Underlying data

Oxford University Research Archive: ALSO and BLSO evaluation Thailand Myanmar border. <https://doi.org/10.5287/bodleian:ErmK5jpO726>.

The project contains the following source data:

- ALSO Eval upload (ALSO raw data)
- BLSO Eval upload (BLSO raw data)

PPHMD_SBUplodv2 (Data for the quantitative analysis of maternal death from post-partum haemorrhage and stillbirths pre and post ALSO (8 year blocks))

Extended data

Oxford University Research Archive: ALSO and BLSO evaluation Thailand Myanmar border. <https://doi.org/10.5287/bodleian:ErmK5jpO726>.

The project contains the following extended data:

- ALSO.docx (ALSO evaluation tool)
- BLSO.docx (BLSO evaluation tool)

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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I reviewed the updates edits and seems good. No further comments

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I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

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Thank you for this valuable addition to research documenting the value of the Advanced Life Support in Obstetrics (ALSO) and Basic Life Support in Obstetrics (BLSO) courses. While previous studies have documented increased confidence level with the ALSO/BLSO course, this is the first

study to do so in an area of protracted conflict.

The model for studying the syllabus as a group over time is creative and effective. It may be a helpful model in other resource limited settings.

The analysis in the context of Kirkpatrick's framework is helpful. The level 4 data on the course's impact of maternal mortality ratio (MMR) and stillbirth rates is especially interesting. While the MMR decreased from 57.0 to 25.4 pre to post-ALSO/BLSO, the change is not statistically significant since the confidence intervals overlap (30.06-108.3) and (23.1-62.8), respectively. The decrease in stillbirth rate was statistically significant (16.2-20.4) vs (9.8-12.5).

As the authors acknowledge, the study design (pre-post analysis) has limitations. Changes noted may be due to factors other than the ALSO/BLSO course. A future study with a control group could better analyze the impact of ALSO/BLSO alone.

For the Odds Ratio, I believe fewer digits would be appropriate. Could report to 100th (2 decimal places) rather than 10,000th (4 decimal places).

Page 4, last paragraph:

Effect of malaria interesting

Great to have in Karen, Burmese and English.

Page 6, table 1:

Normal labor taught in BLSO; not in ALSO – would leave ALSO column blank on the row containing Normal labor in BLSO column.

ALSO teaches “Intrapartum fetal surveillance” BLSO has basics in “Emergent/urgent prenatal Assessment” chapter with optional “electronic fetal monitoring” section for medical students in the “Normal labor” chapter.

BLSO also teaches Pre-eclampsia/Eclampsia

BLSO chapter is titled “Breech, Twin Gestation, Cord Prolapse, and Other Malpresentations”; Covers these topics, just in a more basic manner than in ALSO. Prehospital personnel may need to attend emergent breech delivery. ALSO main focus is also on emergent (not planned) vaginal birth

Neonatal resuscitation is not included in the 9th edition of ALSO; Most providers in the US take the neonatal resuscitation program course instead; Neonatal resuscitation is still in the BLSO course

ALSO starts its course with Safety in Maternity Care; BLSO does not have safety in maternity care chapter; it has a short section in normal labor chapter recommending universal precautions

9th edition of ALSO has a Maternal Sepsis chapter but there is little material on Malaria. There is a full chapter on Malaria in Global ALSO Manual.

Page 6 “ALSO for the Thailand-Myanmar border”

Adaptations are appropriate; the Global ALSO manual is available to help with adapting ALSO courses to local circumstances, especially in resource limited settings

Nice creative model of reviewing ALSO chapters over time in preparation for in person course especially given language and other barriers in study setting.

Page 10 Love the comments and the word cloud!

Page 10 last paragraph

Would cut "(95% CI)" on the 4th line of the paragraph and add "95%" before "CI 23.1-62.8"

Would add studies by Sorensen:

Sorensen B, Rasch V, Massawe S, Nyakina J, Elsass P, Nielsen B. Impact of ALSO® training on the management of prolonged labor and neonatal care at Kagera Regional Hospital, Tanzania. *Int J Gynaecol Obstet.* 2010;111(1):8-12.¹

Sorensen B, Rasch V, Massawe S, Nyakina J, Elsass P, Nielsen B. Advanced Life Support in Obstetrics (ALSO®) and post-partum hemorrhage: a prospective intervention study in Tanzania. *Acta Obstet Gynecol Scand.* 2011;90(6):609-614.²

And Bower:

Bower D, Wolkomir M, Schubot D. The effects of the ALSO® course as an educational intervention for residents. *Family Medicine.* 1997;29(3):187-193.³

Thank you again for this important, well written article!

References

1. Sorensen BL, Rasch V, Massawe S, Nyakina J, et al.: Impact of ALSO training on the management of prolonged labor and neonatal care at Kagera Regional Hospital, Tanzania. *Int J Gynaecol Obstet.* 2010; **111** (1): 8-12 [PubMed Abstract](#) | [Publisher Full Text](#)
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3. Bower DJ, Wolkomir MS, Schubot DB: The effects of the ALSO course as an educational intervention for residents. *Advanced Life Support in Obstetrics. Fam Med.* 1997; **29** (3): 187-93 [PubMed Abstract](#)

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Family Medicine Obstetrics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 18 Jun 2021

Rose McGready, Mahidol-Oxford Tropical Medicine Research Unit, Faculty of Tropical Medicine, Mahidol University, Mae Sot, Thailand

Thank you for this valuable addition to research documenting the value of the Advanced Life Support in Obstetrics (ALSO) and Basic Life Support in Obstetrics (BLSO) courses. While previous studies have documented increased confidence level with the ALSO/BLSO course, this is the first study to do so in an area of protracted conflict.

The model for studying the syllabus as a group over time is creative and effective. It may be a helpful model in other resource limited settings.

The analysis in the context of Kirkpatrick's framework is helpful. The level 4 data on the course's impact of maternal mortality ratio (MMR) and stillbirth rates is especially interesting. While the MMR decreased from 57.0 to 25.4 pre to post-ALSO/BLSO, the change is not statistically significant since the confidence intervals overlap (30.06-108.3) and (23.1-62.8), respectively. The decrease in stillbirth rate was statistically significant (16.2-20.4) vs (9.8-12.5).

As the authors acknowledge, the study design (pre-post analysis) has limitations. Changes noted may be due to factors other than the ALSO/BLSO course. A future study with a control group could better analyze the impact of ALSO/BLSO alone.

For the Odds Ratio, I believe fewer digits would be appropriate. Could report to 100th (2 decimal places) rather than 10,000th(4 decimal places).

Amended

Page 4, last paragraph:

Effect of malaria interesting

Thank you for noticing (most wouldn't). This is of great concern locally given the current deterioration in the health system in Myanmar.

Great to have in Karen, Burmese and English.

Most of the staff still prefer to have two languages available to read during the exam time and Karen, which does not have the same broad vocabulary as Burmese and English, takes more printed pages but these approaches have not been systematically documented.

Page 6, table 1: *Thank you for being prescriptive here for corrections to this table.*

Normal labor taught in BLSO; not in ALSO – would leave ALSO column blank on the row containing Normal labor in BLSO column.

Agree. Amended

ALSO teaches “Intrapartum fetal surveillance” BLSO has basics in “Emergent/urgent prenatal Assessment” chapter with optional “electronic fetal monitoring” section for medical students in the “Normal labor” chapter.

Electronic fetal monitoring is not available. The table is amended so that this perspective is clarified.

BLSO also teaches Pre-eclampsia/Eclampsia

Amended

BLSO chapter is titled “Breech, Twin Gestation, Cord Prolapse, and Other Malpresentations”; Covers these topics, just in a more basic manner than in ALSO. Prehospital personnel may need to attend emergent breech delivery. ALSO main focus is also on emergent (not planned) vaginal birth

Amended

Neonatal resuscitation is not included in the 9th edition of ALSO; Most providers in the US take the neonatal resuscitation program course instead; Neonatal resuscitation is still in the BLSO course

Neonatal resuscitation has been retained. There are no alternative courses in the area; and we have noted this by a new footnote to table 1.

As an aside, we have published previously on this topic as no assisted ventilation is possible at the field sites (see: doi: 10.1371/journal.pone.0190419 and ALSO ® is mentioned in the methods section).

ALSO starts its course with Safety in Maternity Care; BLSO does not have safety in maternity care chapter; it has a short section in normal labor chapter recommending universal precautions

Agree, amended – table order amended.

9th edition of ALSO has a Maternal Sepsis chapter but there is little material on Malaria.

There is a full chapter on Malaria in Global ALSO Manual.

*Differentiating malaria and sepsis and eclampsia is important. The management and especially the drugs are different. In low transmission settings such as the Thailand-Myanmar border, there is no protective immunity and pregnant women are at increased risk of mortality. A pregnant woman with convulsions due to *P. falciparum* can mostly be managed by appropriate drug treatment (+/- blood transfusion) without the need to deliver; unlike eclampsia where the role of urgent delivery is high on the management agenda. Time is spent during a case untangling eclampsia, sepsis and malaria, all of which can increase maternal and fetal mortality and morbidity. The trade-off to spending extra time on diseases that are important causes of morbidity and mortality in the local setting was less time spent on causes of maternal morbidity and mortality that cannot be readily diagnosed or treated in this setting, or contribute to a small*

percentage of maternal deaths compared to high income settings (e.g. thromboembolic disease).

See the next response too please.

Page 6 "ALSO for the Thailand-Myanmar border"

Adaptations are appropriate; the Global ALSO manual is available to help with adapting ALSO courses to local circumstances, especially in resource limited settings

Thank you. A comment is now included in the methods in relation to this and the above comment and the reference to Rojas-Suarez et al., 2017 (as below).

Nice creative model of reviewing ALSO chapters over time in preparation for in person course especially given language and other barriers in study setting.

Thank you.

Page 10 Love the comments and the word cloud!

Thank you – it expresses a different view of what low resource setting participants value. We were afraid it would not get well reviewed.

Page 10 last paragraph

Would cut "(95% CI)" on the 4th line of the paragraph and add "95%" before "CI 23.1-62.8"
Amended.

Would add studies by Sorensen:

Sorensen B, Rasch V, Massawe S, Nyakina J, Elsass P, Nielsen B. Impact of ALSO® training on the management of prolonged labor and neonatal care at Kagera Regional Hospital, Tanzania. *Int J Gynaecol Obstet.* 2010;111(1):8-12.¹

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And Bower:

Bower D, Wolkomir M, Schubot D. The effects of the ALSO® course as an educational intervention for residents. *Family Medicine.* 1997;29(3):187-193.³

These relevant references have been included. I hope the editor remains agreeable as the journal recommends a maximum of 40: we are now at 43.

Thank you again for this important, well written article!

- **Is the work clearly and accurately presented and does it cite the current literature?**

Yes

- **Is the study design appropriate and is the work technically sound?**

Yes

- **Are sufficient details of methods and analysis provided to allow replication by others?**

Yes

- **If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

- **Are all the source data underlying the results available to ensure full reproducibility?**

Yes

- **Are the conclusions drawn adequately supported by the results?**

Yes

References

1. Sorensen BL, Rasch V, Massawe S, Nyakina J, et al.: Impact of ALSO training on the management of prolonged labor and neonatal care at Kagera Regional Hospital, Tanzania. *Int J Gynaecol Obstet.* 2010; **111** (1): 8-12 [PubMed Abstract](#) | [Publisher Full Text](#)
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Competing Interests

No competing interests were disclosed.

Reviewer Expertise

Family Medicine Obstetrics

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

We appreciate the time the reviewer has taken to improve the quality of this manuscript. The suggestions were constructive and supportive.

Competing Interests: No competing interests were disclosed.

Reviewer Report 07 June 2021

<https://doi.org/10.21956/wellcomeopenres.18295.r44114>

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Shahla Y. Namak

¹ Department of Family and Community Medicine, Wake Forest School of Medicine, Winston Salem, NC, USA

² American Academy of Family Medicine, Society of Teachers of Family Medicine, Leawood, KS, USA

I believe it is a very good study and report to be published.

The article addresses improved confidence in clinical performance hands on skills and knowledge after receiving training in ALSO and BLSO Obstetrics Emergency Courses. In a post-conflict limited resource setting Thailand-Myanmar border. Other outcomes studied were the rates of MMR and stillbirth comparing the intervals pre-course from 2000-2007 and post-course 2008-2020.

Methods including participants, who were eligible for the ALSO and BLSO courses, the structure of the courses were reported and the assessment of the educational effectiveness qualitative, quantitative then chart review.

It is unclear in the methods page 6/16, the first paragraph under Table 1 the ALSO course was standard 2 day course but the mentioned the preparation phase reviewed 1-2 chapters per week (60-120) minutes. (Question: How many days/weeks took for the preparation of the chapters) the ALSO course is designed as a 2 day course.

How many questions were used for the ALSO written examination? you mentioned BLSO using 10 questions.

Results: Results were clear in regard to passing rates for both ALSO and BLSO. the clinical assessment hands on were high rate passing >90%, but the written exam was 50% passing for ALSO evaluation. the reported self assessment of the participants was showing clear confidence in 8/13 situations which seems to persist after 12 months.

The comparison of the outcome related to PPH caused mortally pre-course and post-course were positive results. although I agree with the limitation mentioned here that they did not look at the reasons/ etiology/risk factors for PPH if preventable or not, the availability of uterotonic in a resource limited area. And I think another limitation included: researchers did not have the chance to study if the participants in these PPH scenarios had received the ALSO course training? Did they implement what they learned and used a team based approach?

The stillbirth result was reported well with a good conclusion.

The tables numbering are incorrect:

- Table 3 is mentioned twice
- Page 12/16, table 3 needs to change to table 4- correct link to this table on page 8/16
- Table 4 on page 13/16 needs to change to Table 5 and the link to this tale needs to be corrected on page 11/16.

Thank you for allowing me to review this review. I enjoyed reading it.

Shahla Namak, MD Associate Professor, Family and community Medicine at Wake Forest School of Medicine.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

No source data required

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal health, global health, as an American Academy of Family Medicine and an Advanced life support of Obstetrics instructor I teach and published about this course in a LMIC. Refugee health and challenges.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 18 Jun 2021

Rose McGready, Mahidol-Oxford Tropical Medicine Research Unit, Faculty of Tropical Medicine, Mahidol University, Mae Sot, Thailand

Reviewer 1

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Methods including participants, who were eligible for the ALSO and BLSO courses, the structure of the courses were reported and the assessment of the educational effectiveness qualitative, quantitative then chart review.

Thank you

It is unclear in the methods page 6/16, the first paragraph under Table 1 the ALSO course was standard 2 day course but the mentioned the preparation phase reviewed 1-2 chapters per week (60-120) minutes. (Question: How many days/weeks took for the preparation of the chapters) the ALSO course is designed as a 2 day course.

Thank you. It is correct that it is designed as a 2 day course and we run the 2 day course.

However due language and education typical of the border area we also spend a pre-course preparation phase predominantly in support of the theory component which is explained in the

next paragraph, under table 1, cut and pasted here for clarity:

"ALSO course teaching was structured into two parts: the preparation phase and the standard two-day intensive course. The preparation phase reviewed one to two chapters per week, mostly in English (60-120 minutes, led by a doctor). A study group for 2-3 hours later in the week, mostly in Karen and Burmese language led by a senior midwife or medic included practice of skills using donated mannequins. The total preparation phase took 12-16 weeks."

How many questions were used for the ALSO written examination? you mentioned BLSO using 10 questions.

We do 50 – there are some questions e.g. on electronic fetal surveillance that are not applicable in this setting. The sentence has been amended as follows: "The ALSO written exam was also modified for relevance and clarity, removing difficult English e.g. double negatives, and electronic fetal surveillance, leaving 50 questions".

Results: Results were clear in regard to passing rates for both ALSO and BLSO. the clinical assessment hands on were high rate passing >90%, but the written exam was 50% passing for ALSO evaluation. the reported self assessment of the participants was showing clear confidence in 8/13 situations which seems to persist after 12 months.

The comparison of the outcome related to PPH caused mortally pre-course and post-course were positive results. although I agree with the limitation mentioned here that they did not look at the reasons/ etiology/risk factors for PPH if preventable or not, the availability of uterotonic in a resource limited area.

The uterotonics available in this area at the time of this evaluation have been added in the discussion section for clarity: Changes were unrelated to availability of uterotonics - syntocinon, methergyn, and misoprostol have been available since before 2000 and tranexamic acid was not introduced until 2017.

And I think another limitation included: researchers did not have the chance to study if the participants in these PPH scenarios had received the ALSO course training? Did they implement what they learned and used a team based approach?

This important point has been included in the discussion.

The stillbirth result was reported well with a good conclusion.

Thank you

The tables numbering are incorrect: Table 3 is mentioned twice

Page 12/16, table 3 needs to change to table 4- correct link to this table on page 8/16

Table 4 on page 13/16 needs to change to Table 5 and the link to this tale needs to be corrected on page 11/16. *Thank you for pointing this out. It is our error and has now been amended.*

Thank you for allowing me to review this review. I enjoyed reading it.

Shahla Namak, MD Associate Professor, Family and community Medicine at Wake Forest School of Medicine.

- **Is the work clearly and accurately presented and does it cite the current literature?**

Yes

- **Is the study design appropriate and is the work technically sound?**

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- **Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

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No source data required

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Maternal health, global health, as an American Academy of Family Medicine and an Advanced life support of Obstetrics instructor I teach and published about this course in a LMIC. Refugee health and challenges.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

We appreciate the time taken by the reviewer to read this manuscript in detail and provide constructive feedback.

Competing Interests: None to disclose.