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Improving capacity for advanced training in obstetric surgery: evaluation of a blended learning approach

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Abstract

Background Significant differences in outcomes for mothers and babies following obstetric surgical interventions between low- and middle-income countries and high-income settings have demonstrated a need for improvements in quality of care and training of obstetric surgical and anaesthetic providers. To address this, a five-day face-to-face training intervention was developed. When roll-out was disrupted by the COVID-19 pandemic, the course was redesigned for delivery by blended learning.

Methods This 3-part blended-learning course (part-1: 15 h self-directed online learning, part-2: 13 h facilitated contemporaneous virtual workshops and part-3: 10 h face-to-face delivery), was conducted in Kenya. We assessed the completion rate of part-1 (21 assignments), participation rate in parts 2 and 3, participant satisfaction and change in knowledge and skills. Additionally, we compared the cost of the blended delivery to the 5-day face-to-face delivery, in GB pounds.

Results Sixty-five doctors participated in part 1, with 53 completing at least 90% of the assignments. Sixty doctors participated in part 2, and 53 participated in part 3. All participants who completed an evaluation reported (n = 53) that the training was relevant, useful and would lead to changes in their clinical practice. Mean (SD) knowledge score improved from 64% (7%) to 80% (8%) and practical skills from 44% (14%) to 87% (7%). The blended course achieved a cost-saving of £204 per participant compared to the 5-day face-to-face delivery approach.

Conclusion We have demonstrated that a blended learning approach to clinical training in a low-resource setting is feasible, acceptable and cost effective. More studies are required to investigate the effectiveness of this approach on health outcomes.

Keywords Caesarean, Surgery, Training, Quality of care, Education, Blended learning

Background

Improving access to quality maternal and newborn health services, while addressing context-specific challenges, is critical to meeting the global maternal health Sustainable Development Goal target of less than 70 maternal deaths per 100,000 live births by 2030 [1]. Caesarean section (CS) is a life-saving major surgical procedure that, if performed when indicated, should reduce the risk of maternal and perinatal mortality. Boerma and colleagues

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reported in 2018 that 21.1% (29.7 million) of births that occurred globally in 2015 were by CS. There was an increasing trend in CS rates in some world regions while in others it was still suboptimal [2]. Population based CS rates above 20% have not been shown to improve perinatal or neonatal outcomes [3] and rates of less than 10%, as seen in many low-income and middle-income countries, indicate inadequate access to medically indicated CS [4]. Short and long-term risks to CS have been reported. The CS-related maternal mortality ratio in LMICs is 100 times more than in high income countries, and a high stillbirth rate associated with CS of 82.5 per 1, 000 has been reported [5–9]. In some cases, this may be due to inadequate fetal monitoring practices in labour or delay in performing CS in cases of identified fetal distress.

Interventions to reduce unnecessary CS must address the drivers of excessive and inappropriate use of CS at multiple levels including childbearing women, their families, communities and broader society, health professionals and health systems, financial reimbursements, organisational design and cultures. These interventions include clinical and non-clinical interventions to achieve meaningful reductions in the risk from CS [10]. The systematic review by Sobhy and colleagues [7] identified three themes to be addressed for optimal outcomes from caesarean sections: 1) access to safe surgery, 2) the management of perioperative complications in low- and middle-Income countries (LMICs) and 3) labour related complications related to the second stage of labour. Caesarean sections performed in the second stage of labour can be very challenging, especially for less experienced doctors. Assisted vaginal birth performed with a vacuum delivery device, when indicated, may be a safer option. In a multi-country review of assisted vaginal delivery, Bailey et al. [11] found that one of the prime reasons for low levels of assisted vaginal delivery in LMICs was a lack of staff training, underlining the need to provide enhanced training in this procedure.

The first Confidential Inquiry into Maternal Deaths in Kenya report, published in 2018, showed that 37% of deaths were associated with Caesarean section. Delays in starting treatment, inadequate clinical skills and inadequate monitoring were found to be the significant health workforce factors associated with these deaths [9]. Therefore, in 2018, we designed a training intervention to improve the quality of obstetric surgical care taking into account these factors, the key themes identified in a systematic review [7] and to address the lack of skills required to perform assisted vaginal birth. When the covid-19 pandemic rendered it impossible to continue with delivering this training face-to-face, we adapted the course delivery to suit a blended learning delivery model. Blended learning has been described as "learning that happens in an instructional context which is characterized by a deliberate combination of online and classroom-based interventions to instigate and support learning" [12]. Successful blended learning requires the integration of both virtual and face-to-face methods, rather than merely using the on-line component as an add-on to classroom teaching.

The objective of this paper is to describe and evaluate the blended learning version of Liverpool School of Tropical Medicine's (LSTM) Advanced Obstetric Surgical and Anaesthetic Care training package.

Methods

Study setting

We purposefully recruited 69 participants from Ministry of Health public hospitals in the five counties in Kenya (Garrisa, Taita Taveta, Kilifi, Usain Gishu and Vihiga) supported by the United Kingdom's Foreign and Commonwealth Development Office Maternal and Newborn Health (MNH) programme in Kenya delivered by LSTM. Planning and coordination for the training implementation was in consultation with County Health Directors. This was important to ensure that health services were not compromised during training and that trained staff were retained in the maternity units afterwards. All participants were medical doctors with experience ranging from first year interns (four) through to and residents in training (four) and consultants (eleven), but the majority were medical officers (MOs), four of whom had six or more years-experience. Forty-six MOs had been in post for between one and five years. In sub-county and county hospitals, medical officers are often responsible for providing obstetric care without consultant supervision.

The choice of the number of participants was pragmatic and based upon the availability of suitable obstetric surgical providers. Nevertheless, the confident limits with respect to the improvements from the start to the end of the course were not unduly wide.

Intervention

LSTM's Advanced Obstetric Surgical and Anaesthetic Course (AOAC) was created based on our experience designing, implementing and evaluating the LSTM Emergency Obstetric and Newborn Care training package [13–17]. Both courses are based on principles of adult learning and with a structured approach. [18].

The objectives of the AOAC are to improve capacity 1) for decision making, and leadership of maternity care teams, 2) to provide quality perinatal care, 3) to perform caesarean sections safely, and 4) to perform assisted vaginal birth, by addressing the topics listed in Table 1. Facilitator and participant manuals are provided to facilitate learning and standardise teaching [19, 20].

Table 1 Key topics covered in the LSTM AOAC course

- Improving decisions for operative obstetric births
- Labour ward leadership and management
- Improving interdisciplinary communication skills
- Safe surgery and anaesthesia
- Enhanced surgical skills for routine and complex caesarean surgery
- Advanced skills in assisted vaginal delivery and perineal trauma repair
- Detection and management of post-operative complications including use of obstetric early warning system
- Patient counselling skills, informed consent
- Improving quality of care, respectful maternity care
- Performing clinical audit, maternal death surveillance and response
- Action planning

This course, originally designed and delivered as an entirely face-to-face intervention for up to 28 participants, follows a journey. It commences with decision-making for operative birth, followed by patient consent and preparation for surgery and safe surgical and anaesthetic practices for Caesarean section. There is also an emphasis on assisted vaginal birth techniques and post-operative care, management of complications, patient counselling for future birth and the use of audit as a quality improvement tool. The training culminates with participants working in functional teams to develop implementation plans and strategies to put their preferred changes, based on their learning, into practice upon their return to work.

The standard 5-day AOAC package, developed and piloted in Cambodia, Nigeria and Kenya before the COVID 19 pandemic, consisted of brief lectures (31% or 10 h of the whole course) interspersed with interactive small group activities (39% or 13 h of the whole course) such as facilitator led interactive workshops, simulation-based learning (clinical scenarios and role playing) and practical skills sessions (30% or 10 h of the whole course) with the use of obstetric, anaesthetic and newborn care mannequins (Table 2).

The face-to-face course was attended by a multidisciplinary group of skilled health workers including obstetricians, medical officers and obstetric trainees, physician and non-physician anaesthetists and peri-operative care nurses. The obstetricians, medical officers and obstetric trainees attended for the full five days and anaesthetists/peri-operative nurses for three days. For two days participants from both specialities worked together and on one day they were provided with advanced skills training relevant to their respective specialities.

The training culminated with participants working together in facility teams to formulate action plans based on the training to improve their practice and quality of care provided afterwards.

For the blended learning version, we reduced the face-to-face component to a 1.5-day duration focused on skill acquisition using models. The course lectures were recorded and divided into smaller sections interspersed with on-line activities to encourage user participation, and clinical scenarios, role-plays and workshops were adapted for online discussion groups.

During the Covid pandemic training was provided purely to obstetric cadres because the anaesthetic trainers were not available due to Covid-related clinical commitments. The blended learning approach consisted of three basic components: self-directed learning consisting of recorded lectures (40% or 15 h of the whole course), workshops delivered through five real-time interactive small group facilitator lead learning discussions (33% or 12.5 h of the whole course) followed by 1.5 days of face-to-face practical skills training (27% or 10 h of the whole course). The blended-learning course takes slightly longer to complete (37.5 h versus 33 for the face-to-face version. This is due to an estimated longer period to complete the self-directed learning component of listening to the recorded lectures and accompanying activities (Table 1).

Table 2 Comparison of duration of each training approach and trainer requirement

	Duration in hours (% of total)		
	Learning approach	**Standard 5-day face-to-face approach**	**Alternative blended learning approach**
Knowledge (face-to-face, self-directed or virtual)	Lectures	10 (31%)	15 (40%)
	Workshops	13 (39%)	12.5 (33%)
Practical skills (face-to-face)	Simulation-based education, hands-on training	10 (30%)	10 (27%)
Total duration in hours (days)		33 h (5 days)	37.5 (5 days)
Facilitator/participant ratio for practical sessions		1:4	1:4
Total number of facilitators per practical session		8	6

We used the limited version of the Google® Classroom learning platform to pilot the self-directed component. The lectures from the original course were recorded and uploaded to YouTube®. To enhance concentration and interest, the 21 lectures were divided into short sections, mostly lasting between five to ten minutes, interspersed with a variety of participatory activities, including short videos and questions. To encourage engagement, at the end of each lecture participants were required to complete a short quiz. Once the quiz had been completed and submitted, participants were enabled to access the correct answers for the questions together with brief explanations regarding the rationale underlying these answers.

The interactive small group guided discussions lasted 2.5 h each with two facilitators leading participants through a pre-prepared script to guide the discussion. Topics covered included respectful care, decision-making skills for operative birth, informed consent, prioritisation and triage on the labour ward, use of the World Health Organisation (WHO) Safe Surgical Check List, safe operating procedures and recognition of the deteriorating patient intra- and post-operatively, managing post-operative patients using an obstetric early warning system, prevention, identification and management of intra- and post-operative haemorrhage and other post-operative complications, safe blood transfusion, analgesia, documentation, counselling for future births, audit and Maternal Death Surveillance and Response together with training on action planning.

The surgical skills selected for the abbreviated face-to-face training component included assisted vaginal birth, obstetric anal sphincter injury repair, insertion of B-Lynch sutures, improved techniques for knot-tying and uterine incision closure, extraction of an impacted fetal head, balloon tamponade after placenta praevia and venous cut-down, together with revision of airway assessment and management skills, and newborn resuscitation.

Participants were provided with funds for airtime to enable them to engage on the internet-dependent components of the course. They were provided with both written and video instructions explaining how to engage with the self-directed learning components of the course. A dedicated online education consultant provided support to any participant who found engagement with the online learning platform problematic.

For the online group discussions 18 volunteer faculty members were recruited in total, including six from Kenya and 12 from UK. Wherever possible, Kenyan and UK faculty members were paired to work together, putting the Kenyan members' greater contextual awareness to good advantage. Each 2.5-h session contained between four to six separate group discussions of between 20 and 50 min. Faculty members moved between groups for each discussion to provide participants with a range of pedagogical approaches. Fifty-three participants attended the face-to-face component. Subnational travel restrictions in place due to the Covid-19 pandemic and weather-related problems prohibited twelve participants from attending.

Study design and evaluation framework

We used a cross sectional study design and the adapted Kirkpatrick's training evaluation framework, as previously described, to evaluate the participants engagement, acceptance, reaction and immediate change in knowledge and skills (Kirkpatrick level 2) [12]. Additionally, we compared the cost in GB pounds per participant of the blended learning approach to the cost of the 5-day face-to-face training approach.

To evaluate participant engagement, we monitored completion of the self-directed learning. To evaluate the participant acceptance and reaction to the blended learning approach, they were invited to complete an on-line feedback evaluation, using a Likert-scale together with any free comments, at the end of the third component of the training.

Learning was evaluated by means of an overall multiple choice (MCQ) knowledge assessment taken before and after all the course elements. All participants who attended the face-to-face component took part in three objective structured clinical examinations (OSCEs) before and after that part of the training.

Data collection procedure

Authors were aware of participants' identities because they were teaching them and also conducting face-to-face objective structured clinical examinations as a part of the evaluation. Participants were issued with an ID number and no names were recorded on evaluation score sheets, only ID numbers. Data concerning results of the evaluations was entered onto a password protected file, accessible only to the educational consultant (AS) who was aware of the ID number of each participant. This was used to provide essential but confidential feedback to each participant regarding their performance as and when they requested it. Data concerning feedback and evaluation of the course by participants was collected after all three components of the course were completed and individual participant identity was not revealed to the authors. Participants were made aware of the evaluation component and that participation was entirely voluntary, at the start of the training and when invited to participate in the evaluation.

Data analysis

For each assessment tool, the raw scores were converted to percentage scores before analysis. Participants who did

not complete both assessments were excluded. Improvement in score was measured as a percentage of the possible improvement, e.g., if the pre-training score was 40% and after training it was 70%, then the improvement was half of the maximum potential improvement to 100% of 60%, making the improvement score 50%. Where the score decreased the change was relative to the maximum possible reduction. Relative percentage change scores were used to compare performance post-training with pre-training by using a one sample t-test with the null hypothesis that the mean change was zero. The 5% significance level was used to determine statistical significance.

All cost data were collected in GB pounds. Analysis was conducted in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). All costs for delivery of each version of the training were collected, these include direct participant costs as applicable (cost of travel for participants and faculty for face-to-face components, daily subsistence allowance, cost of meals during face-to-face training, cost of airtime and Kenya based faculty allowance). All UK faculty volunteered their time, so no cost was allocated to this. The cost of training equipment was not included, as the same set was used for both versions of the training. We modelled the cost for the full 5-day face-to-face approach assuming no UK faculty were required travel to support the Kenya-based faculty. We compared the mean cost per participant for both versions of the training.

Ethical considerations

All methods were carried out as per relevant guidelines and regulations. Delivery and evaluation of the course using both the traditional and the blended learning approaches was approved by the Kenya Ministry of Health and all participating counties. No institutional research and ethics review was sought, but informed consent to participate in the course and pre- and post-course assessment was obtained from all participants before the start of the training. Completing assessments before and after the training was considered part of the learning experience, but participants could opt out of the assessment and evaluation if they so desired after reviewing the information provided at registration and they were assured of anonymity concerning their results and comments. All participants were allocated unique identifying numbers and no participant identifying information was used to report the findings from this study. Data were not collected for research purposes but for routine training administrative purposes. All data were anonymous and this was part of the monitoring of implementation of in-service training to strengthen the capacity of obstetric surgical care providers and to identify areas for additional follow-up and support.

Results

Participant engagement

Sixty-five doctors engaged to some extent with the self-directed learning component of the blended training approach. Of these, 42 (64.6%) completed all 21 individual assignments and a further 11 (16.9%) completed 90% or more. Four (6.2%) participants completed more than half of the assignments and eight (12.3%) completed less than half.

In total, 60 participants logged on for all or part of the five on-line discussion groups, that took place daily over five days. Fifty-four (90%) of participants logged on for four or five days, with 38 (63.3%) present on all five occasions.

Just over a third (38.3%) of participants reported intermittent internet connectivity problems. More than half of all participants (56.6%) reported that they were called away to attend to emergency cases during the small group discussion sessions, although, despite this, 46.7% of the participants reported that they were able to concentrate on the sessions without distractions. Overall, 40 (66.7%) participants said it was difficult to take time away from work to join the sessions. Despite this, 45% expressed a preference for online learning. Participants considered that although face to face learning was good, online discussions were able to achieve equivalent results once they had become familiar with the process.

Several participants suggested that online sessions in the evenings might be easier to attend as compared to those held during normal working hours. It was apparent that many participants experienced a degree of conflict between concentrating on the sessions and the distraction of providing clinical care.

Participant satisfaction

The levels of satisfaction reported with all three elements of the blended learning were high throughout, and not significantly different from each other.

Sixty participants completed a questionnaire concerning their satisfaction regarding each facet of the course that they had attended.

Of those responding to the survey, 58 (96.7%) felt that the content of the self-directed learning assignments and 59 (98.3%) of those attending the facilitated workshops was useful for their work They considered the training to be clear, precise and useful.. They intended to revisit the online lectures as and when they felt in need of reminders.

All of those (53) who attended the face-to-face element of the course felt the training was relevant and useful and that they had learned things that would change their clinical practice. All intended to increase their use of assisted

vaginal delivery as a strategy to manage the second stage of labour in preference to performing a caesarean and all felt that their management of obstetric anal sphincter injuries would improve.

Across the three components of the course all participants reported that they were either extremely or very satisfied with the overall quality of the training and all would recommend it to other doctors. All participants agreed that the course was useful in improving the quality of care provided to patients.

Participants were asked to state the three most important things they had learned. Of those who had attended the face-to-face training, the three most commonly chosen aspects were assisted vaginal delivery techniques, newborn resuscitation and obstetric anal sphincter injury repair. Techniques for improved caesarean surgery, especially for delivering a deeply impacted fetal head, also scored highly, as did maternal resuscitation and techniques for performing venous cutdown. When asked what changes they would most like to implement, increasing the use of assisted vaginal delivery was by far the most popular, followed by consistent use of the WHO Safe Surgical Check List and a Maternal Early Obstetric Warning Scoring (MEOWS) chart using vital signs to aid prompt recognition of a deteriorating patient and track their progress in response to interventions. Several participants commented that they intended to train others in the techniques they had learned.

The participants who were unable to attend the face-to-face component reported a similar range of important lessons learned. Their choices for implementation included using the MEOWS chart, use of the WHO Safe Surgical Check List and implementation of regular standards-based clinical audits in their facilities.

Change in knowledge and skills

All participants were invited to take part in a pre- and post-course MCQ knowledge test online. Sixty-one participants completed both tests. All 53 participants who attended the face-to-face component took part in Objective Structured Clinical Examinations (OSCEs) before and after the two days of training. The OSCE topics used were maternal airway management, newborn resuscitation and assisted vaginal birth. Improvement in scores occurred in both the on-line knowledge tests and OSCEs. The improvements in OSCE scores were more marked for those participants starting from a lower baseline.

Before training the mean (95% CI) MCQ score was 67% (65%-68%), whereas the mean total OSCE score was only 41% (39%-43%). For each of the individual OSCEs the mean (95% CI) score was similar, ranging from 39% (37%-42%) for the airways OSCE to 43% (40%-46%) for the neonatal resuscitation OSCE (Table 3).

There were five instances of a reduction in score after training compared with before training. Four were for the MCQ and one for the AVB OSCE, otherwise all participants OSCE scores and MCQ scores increased. Figure 1 summarises the distribution of relative improvement scores.

After training there were statistically significant relative improvements ($p < 0.001$ in each case) for MCQs and for each OSCE, compared with before training (Table 3). For MCQs, which had a higher percentage score before training, the mean (95% CI) relative improvement was 50% (47%-54%). For OSCEs the relative improvements were higher, with the mean (95% CI) being 61% (57%-65%) for AVB, 76% (73%-78%) for maternal airway management and 83% (80%-86%) for neonatal resuscitation. As all participants in the training were assessed the sample size was pragmatic rather than designed. Confidence intervals are quite narrow, providing a good level of accuracy in the estimation of the impact of training on the knowledge and skills of trainees.

Comparison of cost of both approaches

The allowance for each Kenyan facilitator was in line with the Kenyan MoH guidelines, £56.10 per day for the face-to-face aspects of the training and £28.57 per day for the virtual workshop facilitation.

With regard to the practical skills training, in the blended approach six Kenya facilitators trained 53 participants in three groups, each group trained over two days. On the fully face-to-face course the same number of participants would have been trained in two groups, each

Table 3 Comparison of knowledge and skills percentage scores post training with pre-training

Tool	Mean (95% CI) score		Relative improvement (95% CI)	*p*-value
	Pre-training	Post-training		
MCQ	67 (65–68)	84 (83–85)	50 (47–54)	< 0.001
Total OSCE	41 (39–43)	85 (83–86)	74 (73–76)	< 0.001
Assisted Vaginal Birth OSCE	41 (38–43)	77 (75–80)	61 (57–65)	< 0.001
Neonatal resuscitation OSCE	43 (40–46)	91 (90–92)	83 (80–86)	< 0.001
Airway management OSCE	39 (37–42)	86 (84–87)	76 (73–78)	< 0.001

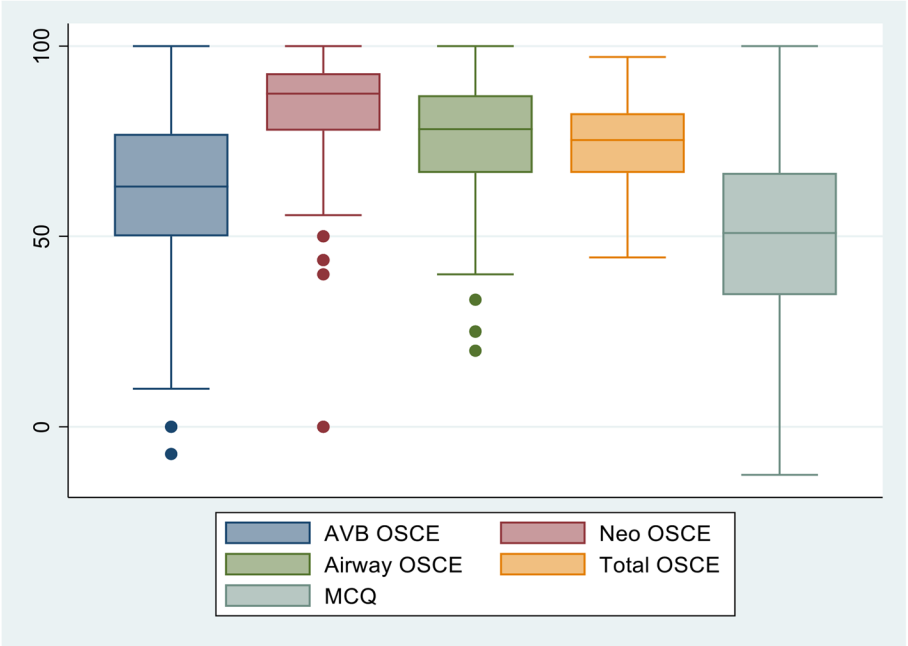

Fig. 1 Boxplots of the distribution of relative changes in scores for each assessment tool

trained over five days. The participant costs for the face-to-face component of the blending learning approach were £15,051 and the same cost for a full five-day face-to-face course would have been £25,844. Therefore, the cost-saving per participant for the blended training approach was £204 (assuming six facilitators and 53 participants for both courses) compared to the full 5-day face-to-face training approach.

Discussion

Various short courses have been created and delivered successfully by several providers and adapted for multi-disciplinary maternal health workers in LMICs. Examples include the SAFE Obstetric course developed by the World Federation of Societies of Anaesthesiologists, and the Advanced Life Support in Obstetrics course developed by the American Academy of Family Physicians. To the best of our knowledge, this is the first course specifically targeting the quality and provision of obstetric surgery that has been adapted from an entirely face-to-face course to delivery by blended learning.

We have demonstrated the feasibility of converting a five-day face-to-face advanced obstetric surgical course into a blended learning course in Kenya, reducing the face-to-face component to one and a half days. The training was well received by most participants and both knowledge and practical skills demonstrably improved following the course. The cost saving per participant for our course was £204 (USD 267, Euro 242) after considering hotel and conference centre costs and funding for airtime. This represents a cost saving of 40% as compared to our fully face-to-face course, excluding travel expenses, which would have been incurred with either method of course delivery. Our course also resulted in a 3-day reduction of the time that staff are away from their workplace. Similar cost savings have been reported in association with another blended learning training approach [21].

There is a growing body of literature evaluating the acceptability and outcomes of blended learning in healthcare training, although direct comparisons of effectiveness are complicated by the heterogenicity of the blended learning methods employed. A systematic review by Valée et al., comparing traditional learning methods to blended learning in medical education, concluded that blended learning demonstrated consistently better effects on knowledge outcomes when compared with traditional learning in health education [22]. However, of the 56 studies included in this review, only one was conducted in sub-Saharan Africa [23] and only one concerned midwifery or obstetrics [24].

The training we have described was introduced as a pragmatic solution to the challenges posed by the Covid-19 pandemic to in-service training, rather than as part of a study comparing the blended learning method of training to a fully face-to-face course. We therefore are not able to provide evidence as to whether the results we obtained from a blended learning delivery demonstrated

greater, the same or lesser improvement in knowledge and skills acquisition. Nevertheless, we have been able to demonstrate a highly significant relative improvement in both knowledge and skills of participants between before and after tests, with improvements comparable to a before and after study of knowledge and skills from a multi-country study of face-to-face emergency obstetric skills training [14].

Our choice of online platform for the self-directed component was made taking into consideration the need for sustainability. Although some bespoke platforms would have been easier to work with, we prioritised choosing a platform that was available at no cost because we wanted it to remain freely available in the future to participants. If courses such as this are to be available to health workers in low-resource settings maintaining access at zero or low cost is important. Following the pilot of the blended learning delivery approach, we have now hosted the self-directed learning component on the World Continuing Education Alliance (WCEA) platform (https://wcea.education). Health worker professional and regulatory bodies in much of sub-Saharan Africa have validated courses on this platform for continuous professional development (CPD).

One disadvantage of providing internet-based training remains the cost of purchasing airtime. Although the internet is widely available, many health workers in low resource settings may struggle to fund airtime for training unless provided with financial support. We did fund airtime for this course, but this would inevitably affect sustainability if funding was not provided. However, in several countries in sub-Saharan Africa CPD is increasingly becoming mandatory for health workers linked to practice license renewal. Policy makers need to make allowance for covering training costs as part of an overall strategy to ensure competent skilled birth personnel, a key strategy to achieving the SDG3 maternal mortality reduction target.

We provided participants with a document and video explaining platform navigation step by step to mitigate any difficulties with using an unfamiliar platform. This worked well for most of the participants, despite their lack of familiarity with the platform.

Tracking the extent to which participants engaged with the online components was key to our evaluation of this course. Some participants stated in feedback that they tended to avoid certain topics because they had judged that they already knew enough about these topics. Other participants explained that they had watched the videos throughout but had used the facility on the platform to watch at a faster than normal speed. The ability to pick and choose which aspects of the course to focus on could represent a good use of participant's time, although this does rely on the accuracy of their judgement as to the adequacy of their knowledge.

We had explained to participants that the self-directed component would take approximately 15 h to complete, and assignments were released to the participants two weeks prior to the online discussion group component. Nevertheless, some participants felt that they did not have sufficient time to complete all the assignments, commenting that they struggled to complete the lectures in between reporting daily for work and having very short times off duty due to staff shortages. Ten (15.4%) of the participants reported that the self-directed assignments took longer to complete than they had expected. Earlier release of the self-directed component to participants may reduce time pressures in future.

It was clear that a significant number of participants found it difficult to book time off from their work commitments to enable them to attend the online discussion groups. Learning in the discussion groups may have been compromised by participants becoming distracted by on-going clinical issues in the workplace. Although we ensured that only half of the doctors attending the discussion groups from any facility were booked for any given session, due to staff shortages it proved impossible for some doctors to give the groups their undivided attention. The 2.5-h duration of the sessions may have been a factor, as booking this time off work may have been more challenging when compared to booking an entire day or half day. This may have encouraged doctors to hope for the best regarding clinical workload and try to manage clinical commitments and attend the sessions simultaneously. A potential solution would be to run these sessions in the evening, depending upon acceptability to both participants and faculty. However, concerns have been expressed regarding the potential for on-line learning to invade participants' everyday lives suggesting evening sessions may not be suitable for all participants [25].

Running the discussion groups online enabled UK and Kenyan faculty members to work together without the need for either international or national travel. This enabled international collaboration whilst removing the requirement for travel, providing cost savings and environmental benefits. Faculty members from both settings enjoyed working in collaboration and learned from each other.

Although, in the context of the Coronavirus pandemic, converting 100% of the training to internet based would have been preferable, it was considered that it would have been very challenging for participants to acquire the necessary clinical skills in the absence of the opportunity for hands on practice that the face-to-face element provided. Some skills improvement may occur from watching video demonstrations, but supervised hands-on practice using

high fidelity models has a track record of success [14] and this was replicated here as evidenced by the improvement in OSCE scores.

Of concern were the low pre-course OSCE scores for basic clinical skills across all cadres. The medical officers' and interns' scores were low across all OSCEs. Medical officers form the backbone of service provision in many facilities, especially at sub-county level, where they provide obstetric care, usually without senior supervision. From our initial assessment, none of the medical officers were able to demonstrate basic clinical skills sufficient to safely manage a maternal airway and provide ventilation using an Ambu® bag and mask, and only one was able to demonstrate competency in newborn resuscitation. Similarly, only one medical officer had appropriate AVB skills. This may explain the reticence to conduct assisted vaginal birth seen in some Kenyan health facilities [26].

Although doctors in Kenya are expected to provide evidence of CPD, these findings would suggest that a more prescriptive approach to the nature of CPD activities would be of benefit, including regular clinical skills training for doctors at all levels, as is the case in some other countries where mandatory training includes regular updates on basic resuscitation skills.

This training has demonstrated a significant uplift is skills after a short intervention. Although we have not been able yet to demonstrate sustained improvement, previous evidence suggests that skills are retained for at least a year [15]. Participants themselves clearly recognised the need to improve the provision of assisted vaginal birth in their units, and to practice and teach improved resuscitation skills for both mothers and babies, as judged by their stated intentions on completing the training. The views of participants are reflected in a review by Lee et al. [27] highlighting differences in rates of second stage CS and assisted vaginal birth, with the ratio of second stage CS to assisted vaginal birth being particularly high in sub-Saharan Africa.

This was a descriptive study that elicited critical review on the blended learning delivery approach using electronic feedback deployed and managed by an educational consultant who was not part of the training team. This approach was essential to facilitate unbiased feedback by the participants.

Limitations

There were several limitations to this study. We acknowledge that it is not possible to report the exact degree of engagement with the online components of this training. However, even when sitting in a face-to-face lecture, it is possible for the participant's mind to wander, hence attention cannot be directly measured in either situation. This study did not measure comparative effectiveness between traditional face-to-face and blended learning teaching methods but rather the acceptability and feasibility of blended learning in the context described. We acknowledge that it will be important to compare the impact of both versions of the training on maternal and newborn health outcomes. We intend to undertake further studies evaluating behaviour change in clinical practice following attendance on this course.

Across the cadres, the majority of those recruited were medical officers, with smaller numbers of the other cadres and the results for these cadres may not be generalisable. While the content of the training was more suitable for medical doctors, midwives, nurses and non-physician anaesthetists are involved in peri-operative and postnatal care, and a multidisciplinary training is likely to facilitate change in practice and behaviour.

The study was conducted in Kenya and the findings may not be generalisable to other countries.

Conclusion

We have demonstrated that a blended learning approach to clinical training in a low-resource setting is feasible and sustainable, resulting in a reduction in time taken for face-to-face training, with this component being reserved for practical skills acquisition. We recommend that consideration is given to the development of a more structured approach to continued professional development for doctors providing obstetric services, to include mandatory clinical skills updates on a regular basis.

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Authors' contributions

HA, and CA drafted and revised the main manuscript text. SW and AS interpreted data. AS, IN, OE, MO, SK, SS, NS and EO contributed to acquisition of data. All authors reviewed the manuscript and approved the final version for submission.

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Data availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The programme that this course is a part of was an implementation programme with a robust Monitoring and Evaluation framework developed in partnership with The Kenya Ministry of Health and key stakeholders at the Moi University and University of Nairobi. This formative evaluation, was compliant with the Data Protection Act 2019 of the Republic of Kenya (https://www.kentrade.go.ke/wp-content/uploads/2022/09/Data-Protection-Act-1.pdf) and

the Data Protection Act 2018 UK (https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted) no personal information was collected and all participants were provided with information on what data will be collected and how it will be used. They had the opportunity not to participate at the various data collection points.
All methods were carried out as per relevant guidelines and regulations. Delivery and evaluation of the course using both the traditional and the blended learning approaches was approved by the Kenya Ministry of Health and all participating counties. No institutional research and ethics review was sought, but informed consent to participate in the course and pre and post course assessment was obtained from all participants before the start of the training. Completing assessments before and after the training was considered part of the learning experience, but participants could opt out of the assessment if they so desired after reviewing the information provided at registration.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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