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Brief Report

Assessing behavioural influences and behavioural changes following Safer Anaesthesia From Education (SAFE) Obstetrics training in Africa and Asia

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ABSTRACT

Background: There is a need for continuing professional development in obstetric anaesthesia in low- and middle-income countries to reduce maternal and newborn mortality and morbidity. The Safer Anaesthesia From Education (SAFE) Obstetrics training course was developed to meet this need and has been delivered to over 3,355 healthcare providers in 40 countries. The impact the training course has on behavioural influences and behaviour change is not known. The study aimed to evaluate the impact on behaviour and behavioural influences following the SAFE Obstetric training course in four new locations across Africa and Asia (Tanzania, Zimbabwe, Nepal and Bangladesh).

Methods and results: Participants knowledge, skills and behavioural influences (perceptions of capability, opportunity and motivation) were explored via a questionnaire and skills assessments at three different time points; baseline, post-training and at follow-up (3–9 months). A subset of participants were observed in their own workplace at follow-up using a structured checklist to assess any changes in behaviour. Three-hundred and sixty-one participants completed the behavioural influences assessments, knowledge and skills both improved after the course and improvements were maintained at follow-up. Other behavioural influences did not show change over time. Completion of behaviours in a subset of 78 participants to SAFE standards varied widely, ranging from 10% for performing inflation breaths to 96% for measuring blood pressure before administering spinal anaesthetic.

Conclusions: There is evidence of efficacy of the course to increase capabilities. However, for conclusions to be drawn about behavioural influences and behaviour change, more resources need to be made available for robust data collection.

Introduction

The Safer Anaesthesia From Education Obstetric training course (SAFE Obstetrics) is a three-day training programme developed in 2011 to train health workers to provide safe and effective maternal care in low-and middle-income countries (LMICs).[1] Evidence has shown positive outcomes following SAFE Obstetrics including learner satisfaction, improvement in knowledge and skills.[2–4] However, whilst there are

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improvements in knowledge and skills, behavioural science tells us that if someone has the knowledge and the skills to perform a particular clinical behaviour this does not mean they will perform that behaviour.[5] Therefore, the overall aim of the study was to evaluate the impact of SAFE Obstetrics on behaviour change and behavioural influences in four countries across Africa and Asia (Tanzania, Zimbabwe, Nepal and Bangladesh). The study objectives were as follows:

1. To assess changes in the knowledge, skills and behavioural influences, including capability, opportunity and motivation on the specified SAFE Obstetrics behaviours (e.g. administering intravenous antibiotics), before and after the SAFE Obstetrics training.
2. To examine what behaviours were performed to a standard acceptable to the SAFE Obstetrics training or not, in practice after training.

Methods

Participants

Participants were SAFE Obstetrics course attendees, who were anyone with anaesthesia provision in their roles.

To assess knowledge, skills and behavioural influences including capability, opportunity and motivation, the research team aimed to include all participants attending the SAFE Obstetrics course in the four countries (Tanzania, Zimbabwe, Nepal and Bangladesh).

To assess behaviour, the research team aimed to recruit a sub-sample of participants using a convenience sampling framework aiming for 25 participants from each country.

Outcome measures

Twenty behaviours and four core behaviours (classed as the most important of these 20) were identified by the research team (Table 1).

– Measures of behavioural influences

Knowledge was tested with a standard SAFE Obstetrics short multiple-choice test and perceptions of capability, opportunity and motivation were assessed via a questionnaire (Supplementary Table 1). Capability, Opportunity and Motivation[5] is split into six domains (Table 2).

Skills were assessed via four stations: 1) maternal cardiopulmonary resuscitation; 2) neonatal resuscitation; 3) management of an eclamptic seizure; and 4) rapid sequence induction.

Trainees were presented with a scenario, given the appropriate equipment, and asked to demonstrate how they would deal with the situation.

– Measures of behaviour

Behaviour was assessed by observations at their place of work using a checklist. Trained observers were asked to note when each behaviour was expected (depending on what they were observing), whether it was observed and, if observed, whether it was performed to SAFE Obstetrics standards.

Procedure and recruitment

All SAFE Obstetrics course participants were asked to complete the skill station test and questionnaires at the beginning of day one of the SAFE Obstetrics course (baseline) and again at the end of day three (post-course). Between three and nine months later, the sub-sample of participants were asked to complete the above again and were observed in practice by SAFE Obstetrics Fellows (follow-up).

Table 1
Identified target key behaviours and core behaviours in the behavioural questionnaire and observation checklist.

Behaviour Group	Additional specification of behaviours in the checklist (if required)
Effective communication (2 behaviours)	
1. Assign assistant or someone to help prior to induction of anaesthesia	Ask a colleague to help during induction of general anaesthesia
2. Call for help in an obstetric emergency	
Preoperative and intraoperative care (9 behaviours)	
1. Prepare airway equipment	
2. Ensuring a vasopressor is available*	
3. Conduct a pre-operative assessment	
4. Conduct an airway assessment	
5. Discuss urgency with the surgeon or obstetrician	
6. Give prophylactic IV antibiotics during a caesarean section*	
7. Taking regular blood pressure	Measure blood pressure before giving spinal Measure blood pressure at regular intervals after spinal
8. Using WHO/surgical checklist	Use a surgical safety checklist (for neuraxial anaesthesia) Use a surgical safety checklist (for general anaesthesia)
9. Use a left lateral tilt when lying patient down	Apply left lateral tilt after anaesthesia or during obstetric emergencies
Performing spinal anaesthesia (3 behaviours)	
1. Measure height of spinal block	
2. Cleaning patient's back	
3. Prepare general anaesthetics drugs	
Post-operative care (1 behaviour)	
1. Regular blood pressure and pulse oxygen monitoring before ward transfer*	
Caring for babies (3 behaviours)	
2. Be involved in resuscitation	
3. Use bag mask ventilation before suction**	
4. Perform inflation breaths	
Obstetric emergencies (2 behaviours)	
1. Use an Airways, Breathing, Circulation (ABC) approach in an obstetric emergency*	
2. In preeclampsia discuss management with obstetrician/surgeon	

Note.
* core behaviours; 24 examples of the 20 core behaviours included.
** if no thick secretion.

Table 2
Definitions of Capability, Opportunity and Motivation[5].

COM-B component	Elements
Physical capability	Physical strength, skill, or stamina
Psychological capability	Knowledge or psychological strength, skill, or stamina
Physical opportunity	Opportunity afforded by the environment (e.g. time, resources, location)
Social opportunity	Opportunity afforded by social factors (e.g. cultural norms, social cues)
Reflective motivation	Reflective brain processes (e.g. plans and evaluations)
Automatic motivation	Automatic brain processes (e.g. desires, impulses, inhibitions)

Data analysis

Measures of behavioural influences

All measures were reported as medians and interquartile ranges. For the analysis of knowledge and skills a Wilcoxon Signed Ranks Test was used to test the null hypothesis that the population mean ranks were the same at each time point. For these linked data, numbers of people whose knowledge and skills scores had increased, decreased or stayed the same were also reported. We reported the effect sizes with Wilcoxon Signed Ranks and Kruskal-Wallis tests.

Measures of behaviour

Observations were calculated as percentages of expected behaviours that were observed as per SAFE Obstetrics standards. Missing data were not imputed. All analyses were conducted in IBM SPSS Statistics version 27.

Data were collected to evaluate the SAFE Obstetrics and not subject to ethics approval; data was collected in accordance with local and UK ethical principles. This paper reports on a secondary analysis of those evaluation data. The Chair of the Ethics Committee at the University of Manchester deemed that ethical approval was not required for this secondary analysis providing data were collected in line with ethical principles. We ensured that this was the case, by asking for approval from the participants for evaluation data to be used for research purposes.

Results

Three hundred and sixty-one participants consented for their data to be used for research purposes. One hundred sixty-seven participants disclosed their professional status (Table 3).

Knowledge

Most participants completed both the pre-course (98%) and post-course (97%) knowledge tests. Follow-up participation varied by country, ranging from 0% in Zimbabwe (due to political unrest) to 45% in Nepal. Baseline knowledge was already high (median 76%) but improved post-course (median 84%) and was sustained at follow-up (median 86%). Statistical analysis, a Wilcoxon Signed Ranks tests confirmed significant improvements from pre- to post-course ($Z = -13.077$, $P < 0.001$, ES = -0.70) and from pre-course to follow-up ($Z = -5.181$, $P < 0.001$, ES = -0.53). Overall, 80% of participants improved their scores immediately post-course, and 72% showed improvements at follow-up.

Skills

Most participants completed the skills assessments both pre-course (98%) and post-course (98%). Follow-up participation varied, from 11% in Tanzania to 45% in Nepal, with no data from Zimbabwe again due to political unrest. Median skill scores improved substantially from 50% at baseline to 90% post-course and were sustained at 85% at follow-up. Statistical analysis, a Wilcoxon Signed Ranks tests confirmed significant improvements from pre- to post-course ($Z = -14.618$, $P < 0.001$, ES = -0.78) and from pre-course to follow-up ($Z = -3.912$, $P < 0.001$, ES = -0.44). Overall, 87% of participants improved their skills immediately after the course, and 68% showed improvement at follow-up.

Table 3
Overview of participants profession (n = 361).

Profession	Number
Nurses/nurse anaesthetists	63 (17%)
Anaesthetic assistants	34 (9%)
Clinical officers/clinical anaesthetic officers	3 (1%)
Doctors	66 (18%)
Not specified	1 (0%)
Did not disclose professional status on the questionnaire but were healthcare workers	194 (54%)

Perceptions of capability, opportunity and motivation

Self-report questionnaires about the trainees' perceptions of capability, opportunity and motivation for four key behaviours were completed in 167/361 (46%) of participants at baseline, in 44/361 (12%) at post-course and 127/361 (35%) at follow-up. From observation of the results the behavioural influences, social opportunity was consistently lower than other factors, ranging from 73–83% at baseline, 68–100% post-course, and dropping to 36–39% at follow-up. In contrast, capability, reflective motivation and automatic motivation were all higher (78–99% at baseline, 83–100% post-course, and 33–39% at follow-up). Physical opportunity was high before the course and remained unchanged.

Assessment of behaviours

Observations were performed on 78/100 (78%) intended participants in total with 21/25 (84%) in Tanzania, 25/25 (100%) in Nepal, 22/25 (88%) in Bangladesh and zero from Zimbabwe (political unrest made travel impossible at the time).

Completion of behaviours to SAFE Obstetrics standards varied widely, ranging from 10% for *performing inflation breaths* to 96% for *measuring blood pressure before administering spinal anaesthetic*.

Four key behaviours were observed to SAFE Obstetrics standards in over 90% of cases: 1) Measuring blood pressure before spinal anaesthesia; 2) Ensuring vasopressor availability before spinal; 3) Discussing urgency with the surgeon or obstetrician; and 4) Conducting a preoperative airway assessment before anaesthesia.

In contrast, five behaviours were completed to SAFE Obstetrics standards in fewer than 50% of observations: 1) Using a WHO/surgical checklist before spinal and general anaesthesia, 2) Giving five inflation breaths, 3) Using bag-mask ventilation, 4) Administering a further five inflation breaths if the heart rate remained < 00 beats per minute and 5) Applying an Airway, Breathing, Circulation approach during obstetric emergencies.

Discussion

The overall aim of the study was to evaluate the impact on behaviour and behavioural influences following the SAFE Obstetrics in four countries across Africa and Asia. Knowledge and skills were improved by SAFE Obstetrics, replicating the findings from previous SAFE Obstetrics studies and extending into four new countries.[2] For other behavioural influences: perceptions of capability, opportunity and motivation, very few changes were found over time. Specifically, physical opportunity stayed consistently the same over the three timepoints, this is likely due to no changes in their environment (e.g. time or resources) taking place. Social opportunity was much lower than other factors at follow-up which reflects maybe the lack of training for the whole multidisciplinary team. Ensuring the whole multi-disciplinary team receive the training not just medical doctors is crucial for implementing change into practice.[6] Capability and both reflective and automatic motivation did increase following training but dropped at follow-up. This is likely due to the common issue that whilst training and education can include active ingredients aiming to target other behavioural influences, other factors such as a supportive work environment and having the correct equipment are also crucial to enable behaviour change in the long-term.[6].

Many behaviours were attempted and performed following SAFE Obstetrics training, however, it is not clear to what extent these

behaviours were already being performed before the course. Assessing change in behaviours, by conducting pre-course behavioural observations is the gold standard[7] and should be a target for future studies. Previous studies have found similar issues when assessing behavioural influences and behaviours in LMICs.[8] Embedding high quality and localised evaluations within these healthcare settings is needed to help collect robust and timely evidence.[6].

This study has limitations. We had considerable missing data and low response rates to follow-up questionnaires, due to difficulties in data collection across four countries, some sites being rural, and political unrest within one country. This is a key point for researchers to consider in future research when carrying out international research, that there may be barriers in some countries that hinder data collection more than others such as resources, data sharing challenges, lack of information technology infrastructure or like in this case political unrest. These differences may also impact upon the delivery and thus impact of training and education interventions in different countries. Secondly, we did not assess the behaviour(s) prior to the SAFE Obstetrics, so whilst this study found that many behaviour(s) were attempted and performed to the SAFE Obstetrics standard after SAFE Obstetrics, it was not clear to what extent these behaviour(s) were already being performed before the course. Assessing change in behaviours, by conducting pre-course behavioural observations, should be a target for future studies. Thirdly, we analysed the results grouping together the countries rather than presenting the results from each individual country. Our analysis plan would have benefited from looking at the countries individually and to compare and contrast any similarities or differences.

Conclusion

This study aimed to evaluate the impact on behaviour and behavioural influences following the SAFE Obstetrics in four countries in Africa and Asia. Changes in knowledge and skills were seen following the training and maintained, however, perceptions of behavioural influences such as motivation did not change following the training. Optimising training and education with behavioural science is an important future step to aim to elicit behaviour change following training and education.

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CRediT authorship contribution statement

R.R. Turner: Writing – review & editing, Writing – original draft. **J. K. Hart:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **E. Sanga:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **A.B. Shrestha:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **T. Gurung:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **P. Murambi:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **R.R. Shrestha:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **M.A. Rahat:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **I. Walker:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **E.R. Bull:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **N. Dharni:** Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **M. Lilaonitkul:** Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **D. Snell:** Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **L.M.T. Byrne-Davis:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: We are grateful to the Laerdal Foundation for funding this study. ML is the SAFE Obstetric Lead. IW was the SAFE Project Lead and trustee of the Association of Anaesthetists and is now retired.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijoa.2025.104703.

References

1. Grewal A, Bhatia N. Training initiatives for safe obstetric anesthesia care. *J Obs Anaesth Cri Care.* 2018;8(2):63–65.
2. Boyd N, Sharkey E, Nabukenya M, et al. The safer anaesthesia from education (SAFE) (®) paediatric anaesthesia course: educational impact in five countries in east and Central Africa. *Anaesthesia.* 2019;74(10):1290–1297.
3. Moore JN, Morriss WW, Asfaw G, Tesfaye G, Ahmed AR, Walker IA. The impact of the safer anaesthesia from education (SAFE) obstetric anaesthesia training course in Ethiopia: a mixed methods longitudinal cohort study. *Anaesth Intensive Care.* 2020;48(4):297–305.
4. Lilaonitkul M, Mishra S, Pritchard N, Andhoga J, Olang' P, Kibet EB, et al. Mixed methods analysis of factors influencing change in clinical behaviours of non-physician anaesthetists in Kenya following obstetric anaesthesia training. *Anaesthesia.* 2020;75(10):1331–1339.
5. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci.* 2011;6:42.
6. Dharni N, Byrne-Davis LM, Sanga E, Hart J, Shrestha AB, Gurung T, et al. Using behavioural science to explore impact and implementation of obstetric anaesthesia training in Tanzania, Nepal and Bangladesh: a qualitative evaluation study with obstetric anaesthesia providers. *Psychol Health.* 2024;39(10):1451–1465.
7. Hrisos S, Eccles MP, Francis JJ, et al. Are there valid proxy measures of clinical behaviour? a systematic review. *Implement Sci.* 2009;4(1):37.
8. Turner RR, Epuru Reddy S, Byrne-Davis LMT, Bull ER, Hart J. An interview study to explore applied psychologists' experiences of implementing health psychology in global health partnerships: the change exchange. *Br J Health Psychol.* 2023;28(4):1076–1096.