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Rater training for standardized assessment of Objective Structured Clinical Exams in rural Tanzania

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3 Rater training for standardized assessment of Objective Structured Clinical Exams in rural
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5 Tanzania

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30 approve the submitted version and agree to be accountable for aspects of the work related to
31 accuracy or integrity of any part of the work.
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47 integrity are examined and resolved.
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5 related to accuracy or integrity are examined and resolved.
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Abstract:**OBJECTIVES**

To describe a simulation rater training curriculum for Objective Structured Clinical Exams (OSCEs) in Tanzania.

BACKGROUND

Rater training for OSCE evaluation is widely embraced in high income countries (HIC) but not well described in low and middle-income countries (LMICs). Helping Babies Breathe (HBB), Essential Care for Every Baby (ECEB) and Bleeding after Birth (BAB) are standardized training programs that encourage OSCEs evaluations. Reports of the reliability of these assessments is rare, making score inferences vulnerable.

METHODS

Training using these programs was conducted over three days. Healthcare providers scored selected OSCEs role played using standardized learners and low fidelity mannikins; proficiency levels were determined *a priori*. Zabar's review criteria guided rater feedback in score review. Descriptive statistics and Fleiss' kappa provided information about rater agreement. Challenges were tracked with field notes.

RESULTS

Six healthcare providers scored 42 training scenarios. Fleiss' kappa value shows moderate levels of rater agreement with 'poor' and 'acceptable' proficiency across all OSCEs ($\kappa=0.508$, $p<0.001$). Kappa values increased with HBB ($\kappa=0.28$ to 0.48), and ECEB ($\kappa=0.42$ to 0.77) by Day 3 of training but not with BAB ($\kappa=0.58$ to 0.33). Raters identified average proficiency 50% of the time. OSCE items with multiple steps challenged our in-country raters.

CONCLUSION

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3 Our study shows in rural, Tanzania, training of in-country raters is feasible and effective. All
4 countries and regions should have their own trained OSCE raters. Rater training is critical to
5 ensure that the potential of training programs translates to improved outcomes for mothers and
6 babies.
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Confidential: For Review Only

BACKGROUND

Helping Babies Breathe (HBB) and Essential Care for Every Baby (ECEB), from the Helping Babies Survive Program[1,2] and the Bleeding after Birth (BAB) from the Helping Mothers Survive (HMS) program[3,4] are examples of standardized health provider training programs designed by expert clinicians and educators from high income countries (HIC) with input from low and middle income countries (LMICs) for use in LMICs. The HBB training course reviews skills related to newborn resuscitation; ECEB focuses on newborn routine care and danger sign identification; BAB reviews management of maternal hemorrhage. All three courses and others in the HMS, HBS series, use low-fidelity mannequins, hands-on simulation practice of common case scenarios and emphasize compliance with algorithm-based 'Action Plans'. Course content addresses common gaps that lead to some of the highest sources of global maternal[5,6] and newborn mortality. [1,2]

Helping Babies Breathe, ECEB and BAB workshop participants are frequently assessed using Objective Structured Clinical Exams (OSCEs). A number of studies in a variety of LMIC settings have demonstrated improvements in provider competency managing relevant obstetric and neonatal cases post training.[6-16] However, few of these studies provide details OSCE assessment reliability.[10,15,16] Furthermore, only one study used in-country OSCE raters;[15] others rely on external (from outside the country of study) development and academic partners serving in rater roles.[9,16]

Training of raters to serve as OSCEs assessors is widely embraced in HIC,[17-25] but rater training has not been well described in LMICs. Reisman and colleagues refer to standardized OSCE training but do not report details.[15] Formal pre-OSCE training for assessors aims to minimise sources of measurement error, [17-25] increasing confidence that a participant's OSCE

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3 score truly reflects their competence. With OSCE administration, sources of error can arise from
4 the OSCE structure and/or rater objectivity.[17,19,22,25] Facilitator materials for HBB, ECEB
5 and BAB courses provide clear guidelines to minimise measurement error with the OSCE
6 administration. For example, Jhpeigo provides information on quality assessment³ for their HMS
7 training series, but there are no guidelines for training OSCE raters or evaluating rater agreement.
8 The importance of reporting on the reliability and validity of scores with OSCE administration has
9 been well described,[17-25] with only one study providing information on rater agreement using
10 in country assessors in an LMIC.[10] The purpose of our study was to describe a simulation-based
11 OSCE rater training curriculum and assessment of subsequent levels of rater agreement with
12 administration of OSCEs in rural Tanzania using locally trained healthcare providers as raters.
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26 **METHOD**

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28 This study was embedded within a Simulation Enhanced Maternal Newborn Health training
29 workshop. The study was approved by Catholic University of Health and Allied Sciences Ethics
30 Board (#CREC/070/2015), the Tanzania National Institute for Medical Research (NIMR)
31 (#MR/53/100/525), and University of Calgary Science and Ethics Board (#REB15-1919).
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38 **Patient and Public Involvement**

39 Patients were not involved in this study.
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42 **Setting**

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44 The study was conducted in Kwimba District located in Mwanza Region, Tanzania over two days
45 in April 2018 and one day in May 2018.
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49 **Participants**

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51 Raters were recruited from amongst rural health facilities in the district where training was to
52 occur. Selection was based on their demonstrated proficiency in previous Newborn Maternal
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3 training workshops and their experience as obstetrical health providers. All selected participants
4 provided informed consent to be involved in the study. Rater characteristics and Rater OSCE
5 scores for each OSCE scenario were collated under a master tracking number to ensure rater
6 anonymity. Following three days of rater training, participants were involved as raters for OSCE
7 evaluations to assess workshop learners pre and post training, at 6 and at 12 months. The rater
8 training curriculum was led by a team comprised of clinician researchers from Catholic University
9 of Health and Allied Sciences (CUHAS) and University of Calgary.

19 **Design**

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21 This study used a descriptive study design (Figure 1). Scenario proficiency (poor, acceptable and
22 excellent) was decided *a priori*, and role modelled by clinician research team members to create a
23 mock scoring context. Each participant selected to be a rater independently scored each scenario.
24 Raters made their own judgements of observed behaviours without consulting colleagues.
25 Checklists were collected and collated on an MSExcel spreadsheet on a research dedicated
26 computer. Field notes were used to track challenges. SPSS version 26 was used to analyse rater
27 data. Descriptive statistics were used to provide information about mock scoring and raters
28 abilities to identify the three categorical levels of proficiency. All raw scores indicating excellent
29 levels of proficiency (Table 2) were also analyzed as acceptable (Table 3) to align with training
30 program guidelines; two categories of proficiency. Fleiss' Kappa was calculated to provide
31 information about the level of rater agreement.²⁷ Kappa values of <0.20, 0.21-0.40, 0.41-0.60 and
32 0.61-0.80 and 0.81to 1.00 are considered poor, fair, moderate, good, and very good
33 respectively.[27]

51 **Evaluation Tools**

The OSCEs used were drawn from training program materials.[1-4] There were 24 pass/fail items on the HBB OSCE, 15 items on the ECEB OSCE and 14 items on the BAB OSCE. All raters were familiar with the OSCE checklists and relevant training course content as they had recently participated in the same courses themselves as learners. Poor proficiency, often referred to as ‘red’ in reported studies was identified by a score of <71%; 0-17, 0-10, and 0-9 on the HBB, ECEB and BAB OSCE, respectively. Learner scores >70% identified an ‘acceptable’ level of proficiency or ‘green’ in reported studies; >17, >10, & >9 on HBB, ECEB and BAB respectively.¹⁻⁴ The Research team added a third category, a candidate’s score of >22, >13 and >12 identified excellent proficiency for HBB, ECEB and BAB OSCEs, respectively.

The Rater Curriculum

The conceptual framework (Figure 2) and Zabar’s review criteria[28] provides details about elements of the curriculum and the iterative nature of the training process. Three physical OSCE stations were set up to facilitate learner transition between each testing station.

RESULTS

Raters ($n=6$) included physicians ($n=1$), midwives ($n=4$) and nurses ($n=1$); all study participants completed the three full days of rater training. They scored a total of 42 scenarios over the three days of training. Table one provides details about scenario scoring for HBB, ECEB and AMSTL over the three days.

Table 1. Kappa values with significance ($p<0.05$)

Training Program	Proficiency Level	n	Average		Day 1 (n=16)		Day 2 (n=14)		Day 3 (n=12)	
			Fleiss' K	p value	Fleiss' K	p value	Fleiss' K	p value	Fleiss' K	p value
HBB		15	0.43	$p<0.05$	0.28	$p<0.05$	0.58	$p<0.001$	0.48	$p<0.001$
	Poor	2	0.32	$p<0.001$						
	Acceptable	13	0.32	$p<0.001$						
ECEB		12	0.61	$p<0.05$	0.42	$p<0.001$	0.70	$p<0.001$	0.77	$p<0.001$

	Poor	2	0.63	p<0.001					
	Acceptable	10	0.63	p<0.001					
BAB		15	0.46	p<0.05	0.58	p<0.001	0.19	NS	0.33
	Poor	6	0.42	p<0.001					
	Acceptable	9	0.38	p<0.001					
All OSCEs		42	0.508	p<0.05					

The time needed for each OSCE station with score review was longer for average proficiency levels (30-40 minutes) when compared to 'excellent' and 'poor' proficiency levels (15-20 minutes). Fleiss' Kappa values (Table 1) showed that there was a moderate level of rater agreement in identifying 'poor' and 'acceptable' proficiency across all OSCEs ($\kappa=0.51$ $p<0.001$). Kappa values improved over the three days moving from 'fair' to 'moderate' for the HBB OSCE and 'moderate' to 'good' for the ECEB OSCE. The kappa value for BAB was 'moderate' Day 1 but decreased to 'fair' Day 2 and Day 3. Except for the kappa value for BAB Day 2, all kappa values were statistically significant ($p<0.05$). Information about rater abilities to correctly identify proficiency levels is described in Table 2 and 3.

Table 2. Proficiency level identification with excellent category (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	18	8 (44%)	9 (50%)	9 (50%)	5 (28%)	8 (44%)	8 (44%)
	Excellent	14	10 (71%)	7 (50%)	10 (71%)	8 (57%)	11 (79%)	10 (71%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	3	2 (66%)	0 (0%)	0 (0%)	0 (0%)	2 (66%)	2 (66%)
	Excellent	6	3(50%)	1 (17%)	3 (50%)	2 (33%)	5 (83%)	3 (50%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	6	0 (0%)	3 (50%)	3 (50%)	1 (17%)	2 (33%)	3 (50%)
	Excellent	4	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	9	6 (67%)	6 (67%)	6 (67%)	4 (44%)	4 (44%)	3 (33%)
	Excellent	4	3 (75%)	2 (50%)	3 (75%)	2 (50%)	2 (50%)	3 (75%)

Table 3. Proficiency level identification for training program categories (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	32	18 (56%)	16 (50%)	19 (59%)	14 (44%)	19 (59%)	18 (56%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	9	5 (55%)	1 (11%)	3 (33%)	2 (22%)	7 (78%)	5 (66%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	10	4 (40%)	7 (70%)	7 (70%)	5 (50%)	6 (60%)	3 (50%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	13	9 (69%)	8 (62%)	9 (69%)	6 (46%)	6 (46%)	6 (46%)

Raters were more accurate in identifying 'poor' and 'excellent' compared to average. Raters identified average proficiency 50% of the time (Table 2 and 3). Information detailing challenges from field notes are presented in Table 4. These include differing perceptions in expected standard of practice, rater fatigue, and multi-step items.

Table 4. Rater Challenges from Field Notes

Challenge	HBB	ECEB	BAB
Differing perceptions of practice standard		How to stimulate baby with back rubs Sequence used to dry the baby	How to massage uterus to stop bleeding How to check for bleeding Item 14: Checks mother for bleeding for 2 hours: changed to checks mother for bleeding every 15 minutes for 2 hours
Tracking multi-step OSCE items	Item 1. Prepares area for delivery Added boxes for: towels, suction, ventilation bag and oxytocin	Item 7: Improves thermal care; Added tracking boxes for removes wet clothing, adds layer of clothing/hat, positions skin to skin, raises room temperature	Item 7: Applies counter pressure when performing controlled cord traction with a contraction: added tracking box for position of hands and one for action occurring with a contraction

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32 OSCE
33 English
34 Words

Hypothermia- did not interpret candidate saying mother was cold as co hypothermia

Hypertension- did not interpret candidate saying mother had high blood pressure as hypertension

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37 Actions
38 without
39 verbalizing

Candidate took actions to make the baby warmer but rater marks incomplete for recognizes hypothermia

46 DISCUSSION

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48 This is the first the study to describe an OSCE rater training curriculum and present evaluation of
49 the curriculum showing levels of rater agreement for HBB, ECEB and BAB training courses in an
50 LMIC. Quality rater training and subsequent reliability analysis is especially important in LMIC
51 context because of the limited quality assurance monitoring patient safety in the system and
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3 resources.[29-31] Our results suggest that the moderate levels of rater agreement, coupled by
4 notable challenges in discriminating ‘acceptable’ versus ‘poor’ performance, exposes a potential
5 for either overestimating or underestimating competence. Additionally, raters were challenged in
6 discriminating ‘excellent’ versus ‘average’ performance. This has consequences for the
7 individual, the training program, and the system. If country resources are directed to those who
8 do not need it (overestimated) or miss those who do need it (underestimated), practising clinicians
9 operate with less skilled health providers because some are away at training. Underestimation
10 means that the process may have missed identifying healthcare providers who are providing unsafe
11 care to mothers and babies. Poor competence impedes quality care.[27-29] The system uses
12 participant scores to make decisions about training priorities, continued employment and
13 allocation of resources, which are limited.[26,29-31] This creates further strain in an already
14 vulnerable system.[26,29-31] The programs may need to implement a further strategy such a
15 global health rating scale, which is common practice in the developed world,[17-19,22-25] to help
16 define the borderline healthcare providers who need more training, and healthcare providers who
17 have demonstrated excellent proficiency with training content to be future raters.[27,28] The
18 challenge incurred in discriminating between borderline performance is not isolated to an LMIC
19 context but reported universally.[32-34]

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42 The best practices for OSCE rater training curriculum that we identified through this study
43 reflect similar recommendations from HIC rater training experience. Globally, good practice is
44 for OSCE raters to have relevant content expertise, be well orientated to the OSCE checklist and
45 use a validated rating scale.[22-25] A quality rater training curriculum includes standardized mock
46 scenarios where raters practise with a variety of expected learner proficiency levels demonstrated
47 and practice scored. In a study by Reid and colleagues,[34] the sole use of a satisfactory proficiency

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3 level mock for practice limited generalizability of findings to other proficiency levels. A solid
4 rater curriculum incorporates a framework such as Zabar's (Figure 2) to guide new rater feedback;
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6 this is especially important in a setting where the concept of rater training is novel. In our study,
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8 Zabar's framework was simple and easy to use as evidenced by a decreased level of external
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10 coaching each day.
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15 A study strength was the achievement of a level of rater agreement similar to the few
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17 published training course reports for ECEB and HBB. In our participant group, the 'moderate to
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19 good' kappa for the ECEB OSCE was as reported by Kassick and colleagues in Ghana, the only
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21 other ECEB reported study to include in-country evaluators; a regional and national evaluator.¹⁰
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23 In the HBB OSCE, our findings demonstrated 'fair to moderate' kappa value which was similar to
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25 the 'fair to good' kappa value reported by Reisman and colleagues in Tanzania[15] whose raters
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27 included two external evaluators and one country based evaluator. Comparable studies for kappa
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29 value results for raters scoring the BAB OSCE module are not reported.
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34 In training raters, certain challenges were noted. There was unanticipated variance in rater
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36 perceptions of the expected practice standard. Raters were recruited by clinician researchers based
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38 on recollections of which previous participants from recent HBB, ECEB, and BAB trainings had
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40 performed well; no objective strategy had been employed in their selection. This may contribute
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42 to the unanticipated variance in new rater proficiency.
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46 Rater trainees were challenged by OSCE items where scores incorporated multi-steps for
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48 their achievement; this was consistent with experiences described by Seto and colleagues who also
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50 identified lower rater agreement for HBB OSCE multi-step items.[16] For example, in our study,
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52 one HBB OSCE 'item' requires the learner to 'prepare the area for delivery'. To achieve a point
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54 and 'pass' this item, the learner must complete all four of: (1) place towels at bedside; (2) place
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3 suction at bedside; (3) place a bag and mask at bedside; and (4) place oxytocin at bedside. This
4
5 ‘item’ created confusion amongst rater trainees; during mock session review, several participants
6
7 had ‘passed’ the mock scenario learner on this item despite not having seen all steps yet having
8
9 observed at least one step. To address this gap, we added sub-item tracking boxes; the use of this
10
11 strategy warrants further study.
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15 Our study was limited by lack of formal training and experience in role-playing by
16
17 simulated patients. Our ‘actors’ were not professionally trained (but rather clinicians!) and
18
19 scenarios and levels were de novo; ideally, with more resources and time, mock scenarios would
20
21 be formally scripted and/or video-captured to optimize standardization. Additionally, time
22
23 constraints necessitated working three long days; rater fatigue was likely. This was especially true
24
25 for one pregnant rater-trainee who participated for the first two days then arrived with newborn in
26
27 hand on Day 3.
28
29

30 31 **CONCLUSION**

32
33 Our study shows in rural, Tanzania, training of in-country raters is feasible and effective.
34
35 This is the first study of its kind in Africa. We hope our experience encourages program developers
36
37 nationally and internationally to scale up in-country rater training. For LMIC simulation-based
38
39 training programs to be sustainable, all countries and regions should have their own trained OSCE
40
41 raters.
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45 Rater training is critical for administering OSCE based learner assessments to maximize
46
47 reliability and validity of learner outcomes. Global training programs, including HBB, ECEB and
48
49 the BAB need to be confident that OSCE scores truly reflect learner ability, to identify and support
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51 those needing further skill practice. Significant global investments have been made towards
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maternal newborn health provider training; participants need to leave workshop venues equipped with the skills to save mother and newborn lives.

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What is already known:

1. Few HBB, ECEB and BAB study results that report improvements post training in healthcare provider skill report rater agreement
2. There is a gap in our knowledge about the relationship between rater training, rater agreement and participant performance
3. There is a gap in our knowledge the appropriate rater training curriculum for in country raters in LMICs

What this study adds:

1. A conceptual framework for training in country health providers as raters in an LMIC
2. It is possible to achieve moderate rater agreement within country healthcare providers as Raters in an LMIC
3. OSCE checklist multi-step items add complexity and should be adapted to a local context

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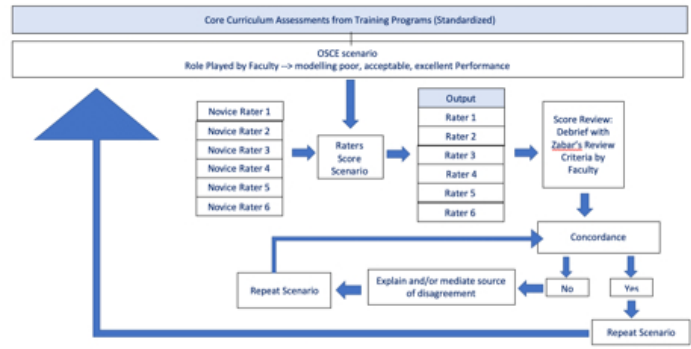


Figure 1. This figure provides a visual of the research design we used in this study. All six raters scored each of the 42 role played scenarios depicting poor, average and excellent levels of performance.

215x279mm (72 x 72 DPI)

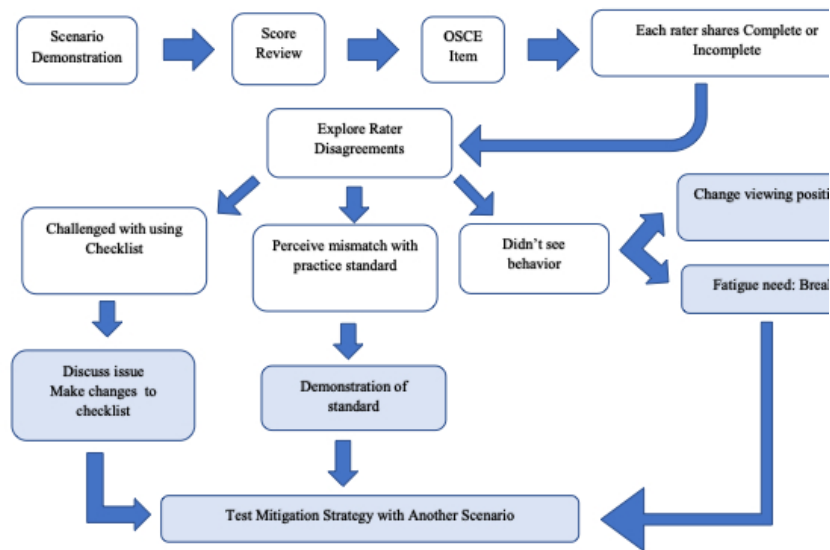


Figure 2. This figure summarizes the conceptual framework we used for score review and feedback. Zabar's review criteria provides guidance in score review with identification of source of rater agreement and mitigation strategy. This framework reflects the experiential learning cycle starting with experience, an opportunity to reflect (item review), abstract conceptualization (use feedback to rethink experience) and direct experimentation (another opportunity) to apply learning.

215x279mm (72 x 72 DPI)

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37 39 Girles Shabani contributed substantially to acquisition and analysis of data, revision of manuscript
38 drafts, approve submitted version and agree to be accountable for all aspects of the work ensuring
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42 42 Maendeleo Boniphace, Edgar Ndaboine, Lusako Mwaikasu, and Julieth Kabiligi contributed
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44 agree to be accountable for all aspects of the work ensuring questions related to accuracy or
45 integrity are examined and resolved.

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3 **56 Abstract:**
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5 **57 OBJECTIVES**
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8 58 To describe a simulation-based rater training curriculum for Objective Structured Clinical Exams
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10 59 (OSCEs) for clinician-based training for front line staff caring for mothers and babies in rural
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12 60 Tanzania.
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14 **61 BACKGROUND**
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17 62 Rater training for OSCE evaluation is widely embraced in high income countries (HIC) but not
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19 63 well described in low and middle-income countries (LMICs). Helping Babies Breathe (HBB),
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21 64 Essential Care for Every Baby (ECEB) and Bleeding after Birth (BAB) are standardized training
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23 65 programs that encourage OSCEs evaluations. Studies examining the reliability of assessments are
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25 66 rare.
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28 **67 METHODS**
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31 68 Training of raters occurred over three days. Raters scored selected OSCEs role played using
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33 69 standardized learners and low fidelity mannikins, assigning proficiency levels *a priori*.
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35 70 Researchers used Zabbar's criteria to critique rater agreement and mitigate measurement error
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37 71 during score review. Descriptive statistics, Fleiss' kappa and field notes were used to describe
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39 72 results.
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42 **73 RESULTS**
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45 74 Six healthcare providers scored 42 training scenarios. There was moderate rater agreement across
46
47 75 all OSCEs ($\kappa=0.508$). Kappa values increased with HBB ($\kappa=0.28$ to 0.48), and ECEB ($\kappa=0.42$ to
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49 76 0.77) by Day 3 of training but not with BAB ($\kappa=0.58$ to 0.33). Raters identified average
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51 77 proficiency 50% of the time.
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53 **78 CONCLUSION**
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3 79 Our study shows training of in-country raters resulted in the discernment of acceptable proficiency
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5 80 50% of the time, despite moderate rater agreement. Rater training is critical to ensure that the
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8 81 potential of training programs translates to improved outcomes for mothers and babies; more
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10 82 research into the concepts and training for discernment of competence in this setting is necessary.
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84 **BACKGROUND**

85 Helping Babies Breathe (HBB) and Essential Care for Every Baby (ECEB), from the Helping
86 Babies Survive Program[1,2] and the Bleeding after Birth (BAB) from the Helping Mothers
87 Survive (HMS) program[3,4] are examples of standardized health provider training programs
88 designed by expert clinicians and educators from high income countries (HIC) with input from
89 low and middle income countries (LMICs) for use in LMICs. The HBB training course reviews
90 skills related to newborn resuscitation; ECEB focuses on newborn routine care and danger sign
91 identification; BAB reviews management of maternal hemorrhage. All three courses and others
92 in the HMS, HBS series, use low-fidelity mannequins, hands-on simulation practice of common
93 case scenarios and emphasize compliance with algorithm-based ‘Action Plans’. Course content
94 addresses common gaps that lead to some of the highest sources of global maternal[5,6] and
95 newborn mortality.[1,2]

96 The competence of participants in these courses are frequently assessed using Objective
97 Structured Clinical Exams (OSCEs). A number of studies in a variety of LMIC settings have
98 demonstrated improvements in provider competency managing relevant obstetric and neonatal
99 cases post training.[6-16] However, few of these studies provide details of assessor training, or
100 the reliability of the OSCE assessments.[10,15,16] Furthermore, only one study used in-country
101 OSCE raters;[15] others have relied on external (from outside the country of study) development
102 and academic partners serving in rater roles.[9,16] Training of raters to serve as OSCEs assessors
103 is widely embraced in HIC,[17-25] but rater training has not been well described in LMICs.
104 Reisman and colleagues refer to standardized OSCE training but do not report details.[15] Formal
105 pre-OSCE training for assessors aims to minimise sources of measurement error,[17-25]
106 increasing confidence that a participant’s OSCE score truly reflects their competence. With OSCE

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3 107 administration, sources of error can arise from the OSCE structure and/or rater
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5 108 objectivity.[17,19,22,25] Facilitator materials for HBB, ECEB and BAB courses provide clear
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8 109 guidelines to minimise measurement error with the OSCE administration. For example, Jhpeigo
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10 110 provides information on quality assessment[3] for their HMS training series, but there are no
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12 111 guidelines for training OSCE raters or evaluating rater agreement. The purpose of our study was
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15 112 to describe a simulation based OSCE rater training curriculum and assessment of subsequent levels
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17 113 of rater agreement with administration of OSCEs in rural Tanzania using locally trained healthcare
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19 114 providers as raters.

21 115 **METHOD**

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24 116 This study was embedded within a Simulation Enhanced Maternal Newborn Health training
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26 117 workshop, conducted as part of an ongoing rural education program. The study was approved by
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28 118 Catholic University of Health and Allied Sciences Ethics Board (#CREC/070/2015), the Tanzania
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30 119 National Institute for Medical Research (NIMR) (#MR/53/100/525), and University of Calgary
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33 120 Science and Ethics Board (#REB15-1919).

35 121 **Patient and Public Involvement**

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38 122 Patients were not involved in this study.

40 123 **Setting**

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42 124 The study was conducted in Kwimba District located in Mwanza Region, Tanzania over three
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44 125 days; two days in April 2018 and one day in May 2018.

47 126 **Participants**

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49 127 Raters were recruited from clinical staff practising in the rural health facilities in the district where
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51 128 training was to occur. Selection was based on their demonstrated proficiency in previous Newborn
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54 129 Maternal training workshops conducted in the previous year. All trainees were clinically active in
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3 130 their health facility settings. All selected participants provided informed consent to be involved in
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5 131 the study. Rater characteristics and Rater OSCE scores for each OSCE scenario were collated
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7 132 under a master tracking number to ensure rater anonymity. Following three days of rater training,
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9 133 participants were involved as raters for OSCE evaluations to assess workshop learners pre and post
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11 134 training, at 6 and at 12 months. The rater training curriculum was led by a team comprised of
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13 135 clinician researchers from Catholic University of Health and Allied Sciences (CUHAS) and
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15 136 University of Calgary.

19 137 **Design**

21 138 This study used a descriptive study design (Figure 1). Raters attended rater training prior to any
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23 139 formal scoring of workshop participants. Categorical levels of proficiency (poor, acceptable and
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25 140 excellent) (decided a priori) were role modelled by clinician research team members for each
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27 141 OSCE each day to create a mock scoring context. All six raters observed and scored the exact
28
29 142 same scenario at the same time, making judgements about observed behaviors independent of
30
31 143 discussion with each other. Scores were collected and then reviewed with the raters; areas of
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33 144 disagreement were explored, using an inquiry approach and direct feedback in debriefing.
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35 145 Zabar's review criteria and mitigation strategies was used as the framework for both the reviews
36
37 146 and refining methodology. Categorical levels of proficiency that challenged rater agreement
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39 147 were repeated. Checklists were collected and collated on an MS Excel spreadsheet on a research
40
41 148 dedicated computer. Field notes were used to track challenges. SPSS version 26 was used to
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43 149 analyse rater data. Descriptive statistics were used to provide information about mock scoring
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45 150 and rater's abilities to identify the three categorical levels of proficiency. All raw scores
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47 151 indicating excellent levels of proficiency (Table 2) were also analyzed as acceptable (Table 3) to
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49 152 align with training program guidelines; two categories of proficiency. Fleiss' Kappa with
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3 153 standard error was calculated to provide information about the level of rater agreement.[26]
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5 154 Kappa values of <0.20, 0.21-0.40, 0.41-0.60 and 0.61-0.80 and 0.81 to 1.00 are considered poor,
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7 155 fair, moderate, good, and very good respectively.[26]
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10 156 **Evaluation Tools**

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12 157 The OSCEs used were drawn from training program materials.[1-4] There were 24 pass/fail items
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14 158 on the HBB OSCE, 15 items on the ECEB OSCE and 14 items on the BAB OSCE. All raters were
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16 159 familiar with the OSCE checklists and relevant training course content as they had recently
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18 160 participated in the same courses themselves as learners. Poor proficiency, often referred to as 'red'
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20 161 in reported studies was identified by a score of <71%; 0-17, 0-10, and 0-9 on the HBB, ECEB and
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22 162 BAB OSCE, respectively. Learner scores >70% identified an 'acceptable' level of proficiency or
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24 163 'green' in reported studies; >17, >10, & >9 on HBB, ECEB and BAB respectively.[1-4] The
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26 164 Research team added a third category, a candidate's score of >22, >13 and >12 identified excellent
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28 165 proficiency for HBB, ECEB and BAB OSCEs, respectively. To standardize the proficiency level in
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30 166 a scenario, a priori the researchers used the clinical consequences of an action to inform the
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32 167 scoring, which was then used to plan the actions role played in the scenario.
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35 168 **The Rater Curriculum**

36 169 The conceptual framework (Figure 2) and Zabar's review criteria[27] provides details about
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38 170 elements of the curriculum and the iterative nature of the training process. Three physical OSCE
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40 171 stations were set up to facilitate learner transition between each testing station. Checklists were
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42 172 reviewed prior to scoring practice Day 1 of training to ensure raters were familiar with OSCE
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44 173 items and how to use the checklist in scoring. Raters observed a scenario, with a predetermined
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46 174 level of proficiency. Training of raters occurred in the score review, with faculty leading
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48 175 discussions to discern the underlying ideas or concepts which may have led to the disagreement.
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176 Raters learned about potential sources of error in the discussion of rater disagreements in score
 177 review. Faculty discussed the importance of mitigating these sources of error to improve score
 178 reliability. Scenarios with disagreement on two or more items were repeated.

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180 RESULTS

181 Raters ($n=6$) included physicians ($n=1$), midwives ($n=4$) and nurses ($n=1$). All study participants
 182 completed the three full days of rater training which included participation in scoring and a focused
 183 debrief for 42 scenarios over the three days. Table one provides details about scenario scoring for
 184 HBB, ECEB and AMSTL over the three days.

185 **Table 1.** Kappa values

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Training Program	Proficiency Level	n	Average		Day 1 (n=16)		Day 2 (n=14)		Day 3 (n=12)	
			Fleiss' K	Standard error	Fleiss' K	Standard error	Fleiss' K	Standard error	Fleiss' K	Standard error
HBB		15	0.43	0.07	0.28	0.12	0.58	0.12	0.48	0.12
	Poor	2			0		1		1	
ECEB	Acceptable	13			5		4		4	
	Poor	2	0.61	0.07	1	0.42	0.10	0.70	0.13	0.77
BAB	Acceptable	10			4		3		3	
	Poor	6	0.46	0.07	2	0.58	0.12	0.19	0.12	0.33
All OSCEs	Acceptable	9			3		3		3	
			0.508	0.04						

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188 The time needed for each OSCE station with score review was longer for average proficiency
 189 levels (30-40 minutes) when compared to 'excellent' and 'poor' proficiency levels (15-20
 190 minutes). Fleiss' Kappa values (Table 1) showed that there was a moderate level of rater
 191 agreement in identifying 'poor' and 'acceptable' proficiency across all OSCEs ($\kappa=0.51$). Kappa
 192 values improved over the three days moving from 'fair' to 'moderate' for the HBB OSCE and

193 'moderate' to 'good' for the ECEB OSCE. The kappa value for BAB was 'moderate' Day 1 but
 194 decreased to 'fair' Day 2 and Day 3. Information about rater abilities to correctly identify
 195 proficiency levels is described in Table 2 and 3.

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Table 2. Proficiency level identification (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	18	8 (44%)	9 (50%)	9 (50%)	5 (28%)	8 (44%)	8 (44%)
	Excellent	14	10 (71%)	7 (50%)	10 (71%)	8 (57%)	11 (79%)	10 (71%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	3	2 (66%)	0 (0%)	0 (0%)	0 (0%)	2 (66%)	2 (66%)
	Excellent	6	3(50%)	1 (17%)	3 (50%)	2 (33%)	5 (83%)	3 (50%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	6	0 (0%)	3 (50%)	3 (50%)	1 (17%)	2 (33%)	3 (50%)
	Excellent	4	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	9	6 (67%)	6 (67%)	6 (67%)	4 (44%)	4 (44%)	3 (33%)
	Excellent	4	3 (75%)	2 (50%)	3 (75%)	2 (50%)	2 (50%)	3 (75%)

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Table 3. Proficiency level identification: (average and excellent categories combined) for training program categories (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	32	18 (56%)	16 (50%)	19 (59%)	14 (44%)	19 (59%)	18 (56%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	9	5 (55%)	1 (11%)	3 (33%)	2 (22%)	7 (78%)	5 (66%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	10	4 (40%)	7 (70%)	7 (70%)	5 (50%)	6 (60%)	3 (50%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	13	9 (69%)	8 (62%)	9 (69%)	6 (46%)	6 (46%)	6 (46%)

200

201 Raters were more accurate in identifying 'poor' and 'excellent' compared to average. Raters
 202 identified average proficiency approximately 50% of the time (Table 2 and 3). Information
 203 detailing challenges from field notes are presented in Table 4.

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Table 4. Rater Challenges from Field Notes

Challenge	HBB	ECEB	BAB
Differing perceptions of practice standard		Back rub stimulation Sequence for drying baby	Fundal Massage Bleeding Assessment Frequency of bleeding assessment
Tracking multi-step OSCE items	Item 1. Prepares area for delivery Item 2. Equipment preparation Item3. Hand washing Item 5. Removes wet clothes Item 24. Communication and teaching	Item 7: Improves thermal care Item 8: Identifying danger signs Advanced care classification Item 10. Medication calculation and administration	Item 7. Controlled cord traction counter pressure Item 12. Determining Postpartum hemorrhage
OSCE English Words		Hypothermia	Hypertension
Actions without verbalizing		Warming baby	

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207 DISCUSSION

208 This study describes an OSCE rater training curriculum and presents evaluation of the
 209 curriculum showing levels of rater agreement for HBB, ECEB and BAB training courses in an
 210 LMIC. Quality rater training and subsequent reliability analysis is especially important in LMIC
 211 context because of the limited quality assurance monitoring patient safety in the system and
 212 resources.[28-31] Our results suggest that the moderate levels of rater agreement, coupled by
 213 notable challenges in discriminating ‘acceptable’ performance, exposes a potential for either

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3 214 overestimating or underestimating competence. This has consequences for the individual, the
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5 215 training program, and the system. The challenge incurred in discriminating between borderline
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7 216 performance is not isolated to an LMIC context but reported universally.[32-34] With
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10 217 overestimation of competence, training programs may have passed clinicians who may need
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12 218 more training to provide safe care on the frontline. The problem of accurate discrimination of
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14 219 competency affects resource utilization: with underestimation of competence, training programs
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16 220 may be directing the limited resources to clinicians who do not need extra training. Furthermore,
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18 221 frontline staff frequently work short staffed when someone is away at training, so unnecessary
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20 222 remediation training may exacerbate staff overload.[28-31]
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24 223 In the majority of HBB, ECEB and BAB training program reports, validation of
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26 224 improved care-giver competency is determined by comparing pre and post training OSCE scores.
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28 225 Our results suggest that the existing reports describing a moderate IRR may be misleading
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30 226 without further validation of the accuracy of rater discernment of acceptable proficiency.
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33 227 [10,15,16] Our raters achieved moderate rater agreement yet discernment of acceptable
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35 228 proficiency, which is the pass criterion in these training programs, was approximately 50%.
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37 229 Based on our findings we would suggest including both measures of validation) Considering
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39 230 contexts with limited resources, it may be helpful to implement a further strategy such a global
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41 231 rating scale, which is common practice in the developed world[17-19,22-25] to provide another
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43 232 method of validation of participant competence.[35] A global rating scale allows the rater to
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45 233 evaluate how well a learner performs on a scale of 1 to 5, with 5 reflecting the highest level of
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47 234 competence.[35] More than one method of validation creates more certainty that results are an
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49 235 accurate reflection of participant competence and/or training program efficacy.[35] With the
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51 236 continued high reports of maternal and neonatal mortality, it is important to be confident that
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3 237 these training programs are accurate in identifying and supporting clinicians who may not be
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5 238 providing safe care on the frontline. Based on our findings we would suggest including both
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8 239 measures of validation.
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11 241 The guidelines for OSCE rater training used in this study were based on
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13 242 recommendations from HIC rater training experiences; these are challenging to implement in an
14
15 243 LMIC context. Globally, good practice is for OSCE raters to have relevant content expertise, be
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17 244 well orientated to the OSCE checklist and use a validated rating scale.[22-26] Although we
18
19 245 strived for this, we had a limited pool of potential raters; this may have affected the challenges
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21 246 we noted in rater perceptions of the expected practice standard. Raters were recruited by
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23 247 clinician researchers based on recollections of which previous participants from recent HBB,
24
25 248 ECEB, and BAB trainings had performed well; no objective strategy was employed in their
26
27 249 selection. This was the reason in country faculty inserted a third categorical level of proficiency;
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29 250 excellent. They wanted an objective strategy to identify content experts as the future raters for
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31 251 such training programs. A quality rater training curriculum includes standardized mock
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33 252 scenarios where raters practise and score a variety of expected learner proficiency levels. In our
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35 253 study, this was one of the greatest challenges. Research clinicians role playing scenarios Day 1
36
37 254 were challenged in demonstrating poor proficiency. In discussion, they shared they didn't want
38
39 255 participants to think they were not experts in the field. The inclusion of scripted and video
40
41 256 capture of proficiency levels may lessen this tension and inconsistency in role play. In a limited
42
43 257 resource setting this is challenging to develop and implement. Despite this, the level of rater
44
45 258 agreement improved over the three training days for both HBB and ECEB. The fall-off in rater
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47 259 agreement for BAB Day 2 and 3 was unexpected but may be in part related to the timing of these
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49 260 scenarios; they were the last role plays of the day and rater fatigue may have played a role.
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3 261 A solid rater curriculum incorporates a framework such as Zabar's (Figure 2) to guide rater
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5 262 feedback; this is especially important in a setting where the concept of rater training is novel.[27]
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8 263 In our study, Zabar's framework was simple and easy to use as evidenced by a decreased level of
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10 264 external coaching each day.

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12 265 A study strength was the achievement of a level of rater agreement similar to the few
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14 266 published training course reports for ECEB and HBB. In our participant group, the 'moderate to
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16
17 267 good' kappa for the ECEB OSCE was as reported by Kassick and colleagues in Ghana, the only
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19 268 other ECEB reported study to include in-country evaluators; a regional and national
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21 269 evaluator.[10] In the HBB OSCE, our findings demonstrated 'fair to moderate' kappa value
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24 270 which was similar to the 'fair to good' kappa value reported by Reisman and colleagues in
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26 271 Tanzania[15] whose raters included two external evaluators and one country based evaluator.
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28 272 Comparable studies for kappa value results for raters scoring the BAB OSCE module are not
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31 273 reported. The achievement of comparable IRR to the studies using in country and external
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33 274 partners provides support for the rater training curriculum, yet the inability to accurately discern
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35 275 acceptable proficiency (pass criteria) is concerning. To gain further insight into the relationship
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38 276 between faculty role play and the inability to discern acceptable proficiency, we plan to script the
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40 277 acceptable proficiency level for each OSCE, coach faculty in the role play, and repeat the
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42 278 curriculum and analysis.

43
44 279 Rater trainees were challenged by OSCE items where scores incorporated multi-steps for
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46 280 their achievement; this was consistent with experiences described by Seto and colleagues who also
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48
49 281 identified lower rater agreement for HBB OSCE multi-step items.[16] For example, in our study,
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51 282 one HBB OSCE 'item' requires the learner to 'prepare the area for delivery'. To achieve a point
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54 283 and 'pass' this item, the learner must complete all four of: (1) place towels at bedside; (2) place

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3 284 suction at bedside; (3) place a bag and mask at bedside; and (4) place oxytocin at bedside. This
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5 285 'item' created confusion amongst rater trainees; during mock session review, several participants
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8 286 had 'passed' the mock scenario learner on this item despite not having seen all steps yet having
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10 287 observed at least one step. To address this gap, we added sub-item tracking boxes when this
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12 288 challenge was identified Day 1; the use of this strategy warrants further study.

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15 289 Our study was limited by lack of formal training and experience in role-playing by
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17 290 simulated learners. Our 'actors' were not professionally trained (but rather research clinicians!)
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19 291 and scenarios and levels were de novo; ideally, with more resources and time, mock scenarios
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21 292 would be formally scripted and/or video-captured to optimize standardization. Additionally, time
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23 293 constraints necessitated working three long days; rater fatigue was likely. This was especially true
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26 294 for one pregnant rater-trainee who participated for the first two days then arrived with newborn in
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28 295 hand on Day 3. Our results may have limitations in generalisability but do provide context and
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30 296 learning for others interested in developing a rater training curriculum in a low resource setting.

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34 35 298 **CONCLUSION**

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37 299 Our results show that rater training in an LMIC setting is critical for administering OSCE based
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39 300 learner assessments. Clinician everywhere need ongoing training, but to optimize learning and
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41 301 then translate this to improved outcomes for mothers and babies, this training must be informed
42
43 302 by truly objective evaluations. Our study shows in rural, Tanzania, training of in-country raters is
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45 303 possible and can lead to an IRR which is similar to previous studies. Improved standardization
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47 304 and attention to the relationships between IRR and the accurate discernment of participant
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49 305 performance would provide insight into needed modifications, which in turn may lead to greater
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51 306 accuracy in rating competence. More research is warranted. Global training programs, including
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3 307 HBB, ECEB and the BAB need to be confident that OSCE scores truly reflect learner ability, to
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5 308 identify and support those needing further skill practice. Significant global investments have been
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7 309 made towards maternal newborn health provider training; participants need to leave workshop
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9 310 venues equipped with the skills to save mother and newborn lives. We hope this experience
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11 311 encourages program developers nationally and internationally to scale up in-country rater training.
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13 312 For LMIC simulation-based training programs to be sustainable, all countries and regions should
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15 313 have their own trained OSCE raters.
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4

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15

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21 331 What is already known:

- 22 332 1. Few HBB, ECEB and BAB study results that report improvements post training in
23 333 healthcare provider skill report rater agreement
24 334 2. There is a gap in our knowledge about the relationship between rater training, rater
25 335 agreement and participant performance
26 336 3. There is a gap in our knowledge the appropriate rater training curriculum for in country
27 337 raters in LMICs

28 338 What this study adds:

- 29 339 1. A conceptual framework for training in country health providers as raters in an LMIC
30 340 2. It is possible to achieve moderate rater agreement within country healthcare providers as
31 341 Raters in an LMIC
32 342 3. OSCE checklist multi-step items add complexity and should be adapted to a local context
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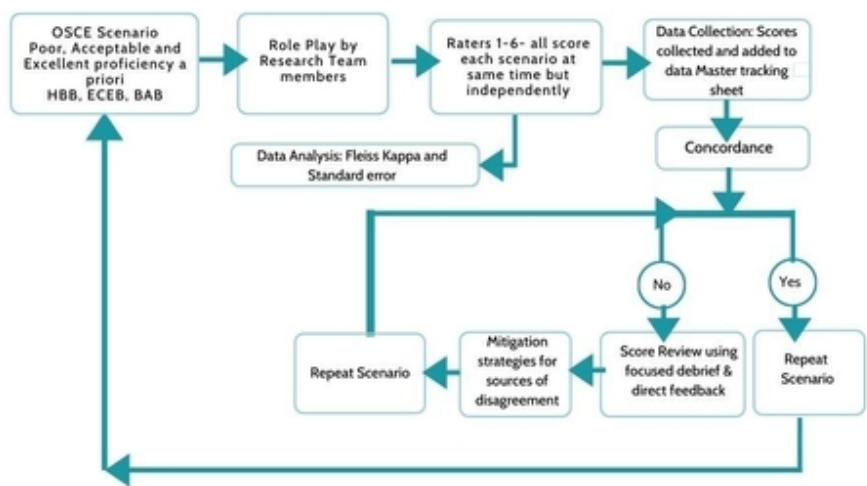


Figure 1. This figure provides a visual of the research design we used in the study each day. All six raters scored all 42 of the role played scenarios with proficiency determined a priori. Raters participated in 42 debrief sessions over the three days.

43x32mm (300 x 300 DPI)

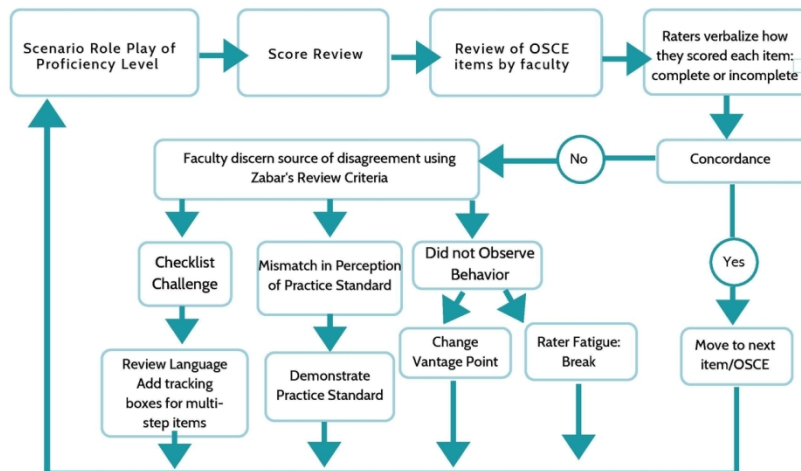


Figure 2. This figure provides a visual of the Conceptual framework used to improve the level of rater agreement.

135x101mm (300 x 300 DPI)

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Rater training for standardized assessment of Objective Structured Clinical Exams in rural Tanzania

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1 Rater training for standardized assessment of Objective Structured Clinical Exams in rural
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36 contributions to the conception and design of the work, drafting and revising the manuscript,
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39 Maendeleo Boniphace, Edgar Ndaboine, Lusako Mwaikasu, and Julieth Kabiligi contributed
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42 integrity are examined and resolved.

43 Girles Shabani contributed substantially to acquisition and analysis of data, revision of manuscript
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45 ensuring questions related to accuracy or integrity are examined and resolved.

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8 48 related to accuracy or integrity are examined and resolved.
9

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3 55 **Abstract:**
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5 56 **OBJECTIVES**
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7
8 57 To describe a simulation based rater training curriculum for Objective Structured Clinical Exams
9
10 58 (OSCEs) for clinician based training for front line staff caring for mothers and babies in rural
11
12 59 Tanzania.
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14 60 **BACKGROUND**
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16
17 61 Rater training for OSCE evaluation is widely embraced in high income countries but not well
18
19 62 described in low and middle-income countries. Helping Babies Breathe, Essential Care for Every
20
21 63 Baby and Bleeding after Birth are standardized training programs that encourage OSCEs
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23 64 evaluations. Studies examining the reliability of assessments are rare.
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25

26 65 **METHODS**
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28 66 Training of raters occurred over three days. Raters scored selected OSCEs role played using
29
30 67 standardized learners and low fidelity mannikins, assigning proficiency levels *a priori*.
31
32 68 Researchers used Zabar's criteria to critique rater agreement and mitigate measurement error
33
34 69 during score review. Descriptive statistics, Fleiss' kappa and field notes were used to describe
35
36 70 results.
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40 71 **RESULTS**
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42 72 Six healthcare providers scored 42 training scenarios. There was moderate rater agreement across
43
44 73 all OSCEs ($\kappa=0.508$). Kappa values increased with Helping Babies Breathe ($\kappa=0.28$ to 0.48), and
45
46 74 Essential Care for Every Baby ($\kappa=0.42$ to 0.77) by Day 3 of training but not with Bleeding after
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48 75 Birth ($\kappa=0.58$ to 0.33). Raters identified average proficiency 50% of the time.
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51 76 **CONCLUSION**
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3 77 Our study shows that the in-country raters in this study had a hard time identifying average
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5 78 performance despite moderate rater agreement. Rater training is critical to ensure that the
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7 79 potential of training programs translates to improved outcomes for mothers and babies; more
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9 80 research into the concepts and training for discernment of competence in this setting is
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11 81 necessary.
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83 BACKGROUND

84 Helping Babies Breathe (HBB) and Essential Care for Every Baby (ECEB), from the Helping
85 Babies Survive Program[1,2] and the Bleeding after Birth (BAB) from the Helping Mothers
86 Survive (HMS) program[3,4] are examples of standardized health provider training programs
87 designed by expert clinicians and educators from high income countries (HIC) with input from
88 low and middle income countries (LMICs) for use in LMICs. The HBB training course reviews
89 skills related to newborn resuscitation; ECEB focuses on newborn routine care and danger sign
90 identification; BAB reviews management of maternal hemorrhage. All three courses and others
91 in the HMS, HBS series, use low-fidelity mannequins, hands-on simulation practice of common
92 case scenarios and emphasize compliance with algorithm-based 'Action Plans'. Course content
93 addresses common gaps that lead to some of the highest sources of global maternal[5,6] and
94 newborn mortality. [1,2]

95 The competence of participants in these courses are frequently assessed using Objective
96 Structured Clinical Exams (OSCEs). A number of studies in a variety of LMIC settings have
97 demonstrated improvements in provider competency managing relevant obstetric and neonatal
98 cases post training.[6-16] However, few of these studies provide details of assessor training, or
99 the reliability of the OSCE assessments. [10,15,16] Furthermore, only one study used in-country
100 OSCE raters;[15] others have relied on external (from outside the country of study) development
101 and academic partners serving in rater roles.[9,16] Training of raters to serve as OSCEs assessors
102 is widely embraced in HIC,[17-25] but rater training has not been well described in LMICs.
103 Reisman and colleagues refer to standardized OSCE training but do not report details.[15] Formal
104 pre-OSCE training for assessors aims to minimise sources of measurement error, [17-25]
105 increasing confidence that a participant's OSCE score truly reflects their competence. With OSCE

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3 106 administration, sources of error can arise from the OSCE structure and/or rater
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5 107 objectivity.[17,19,22,25] Facilitator materials for HBB, ECEB and BAB courses provide clear
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7 108 guidelines to minimise measurement error with the OSCE administration. For example, Jhpeigo
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9 109 provides information on quality assessment[3] for their HMS training series, but there are no
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11 110 guidelines for training OSCE raters or evaluating rater agreement. The purpose of our study was
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13 111 to describe a simulation-based OSCE rater training curriculum and assessment of subsequent
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15 112 levels of rater agreement with administration of OSCEs in rural Tanzania using locally trained
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17 113 healthcare providers as raters.
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22 114 **METHOD**

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24 115 This study was embedded within a Simulation Enhanced Maternal Newborn Health training
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26 116 workshop, conducted as part of an ongoing rural education program. The study was approved by
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28 117 Catholic University of Health and Allied Sciences Ethics Board (#CREC/070/2015), the Tanzania
29
30 118 National Institute for Medical Research (NIMR) (#MR/53/100/525), and University of Calgary
31
32 119 Science and Ethics Board (#REB15-1919).
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35 120 **Patient and Public Involvement**

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37 121 Patients were not involved in this study.
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40 122 **Setting**

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42 123 The study was conducted in Kwimba District located in Mwanza Region, Tanzania over three
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44 124 days; two days in April 2018 and one day in May 2018.
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47 125 **Participants**

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49 126 Raters were recruited from clinical staff practising in the rural health facilities in the district where
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51 127 training was to occur. Selection was based on their demonstrated proficiency in previous Newborn
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53 128 Maternal training workshops conducted in the previous year. All trainees were clinically active in
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3 129 their health facility settings. All selected participants provided informed consent to be involved in
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5 130 the study. Rater characteristics and Rater OSCE scores for each OSCE scenario were collated
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7 131 under a master tracking number to ensure rater anonymity. Following three days of rater training,
8
9 132 participants were involved as raters for OSCE evaluations to assess workshop learners pre and post
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11 133 training, at 6 and at 12 months. The rater training curriculum was led by a team comprised of
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13 134 clinician researchers from Catholic University of Health and Allied Sciences (CUHAS) and
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15 135 University of Calgary.
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19 136 **Design**

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21 137 This study used a descriptive study design (Figure 1). Raters attended rater training prior to any
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23 138 formal scoring of workshop participants. Categorical levels of proficiency (poor, acceptable and
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25 139 excellent) (decided a priori) were role modelled by clinician research team members for each
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27 140 OSCE each day to create a mock scoring context. All six raters observed and scored the exact
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29 141 same scenario at the same time, making judgements about observed behaviors independent of
30
31 142 discussion with each other. Scores were collected and then reviewed with the raters; areas of
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33 143 disagreement were explored, using an inquiry approach for debriefing. Zabar's review criteria
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35 144 and mitigation strategies was used as the framework for both the reviews and refining
36
37 145 methodology. . The research team lead (content expert) gave direct feedback Categorical levels
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39 146 of proficiency that challenged rater agreement were repeated. Checklists were collected and
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41 147 collated on an MS Excel spreadsheet on a research dedicated computer. Field notes were used to
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43 148 track challenges. SPSS version 26 was used to analyse rater data. Descriptive statistics were
44
45 149 used to provide information about mock scoring and rater's abilities to identify the three
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47 150 categorical levels of proficiency. All raw scores indicating excellent levels of proficiency (Table
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49 151 2) were also analyzed as acceptable (Table 3) to align with training program guidelines; two
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3 152 categories of proficiency. Fleiss' Kappa with standard error was calculated to provide
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5 153 information about the level of rater agreement.²⁷ Kappa values of <0.20, 0.21-0.40, 0.41-0.60
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7 154 and 0.61-0.80 and 0.81 to 1.00 are considered poor, fair, moderate, good, and very good
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10 155 respectively.[27]

11 12 156 **Evaluation Tools**

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15 157 The OSCEs used were drawn from training program materials. [1-4] There were 24 pass/fail items
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17 158 on the HBB OSCE, 15 items on the ECEB OSCE and 14 items on the BAB OSCE. All raters were
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19 159 familiar with the OSCE checklists and relevant training course content as they had recently
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21 160 participated in the same courses themselves as learners. Poor proficiency, often referred to as 'red'
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23 161 in reported studies was identified by a score of <71%; 0-17, 0-10, and 0-9 on the HBB, ECEB and
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25 162 BAB OSCE, respectively. Learner scores >70% identified an 'acceptable' level of proficiency or
26
27 163 'green' in reported studies; >17, >10, & >9 on HBB, ECEB and BAB respectively.¹⁻⁴ The Research
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29 164 team added a third category, a candidate's score of >22, >13 and >12 identified excellent
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31 165 proficiency for HBB, ECEB and BAB OSCEs, respectively. To standardize the proficiency level
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33 166 deemed to be acceptable in a scenario, a priori the researchers used the clinical consequences of
34
35 167 an action to inform the scoring, which was then used to plan the actions role played in the scenario.

36 37 38 168 **The Rater Curriculum**

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42 169 The conceptual framework (Figure 2) and Zabar's review criteria[28] provides details about
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44 170 elements of the curriculum and the iterative nature of the training process. Three physical OSCE
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46 171 stations were set up to facilitate learner transition between each testing station. Checklists were
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48 172 reviewed prior to scoring practice Day 1 of training to ensure raters were familiar with OSCE
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50 173 items and how to use the checklist in scoring. Raters observed a scenario, with a predetermined
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52 174 level of proficiency. Training of raters occurred in the score review, with faculty leading
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175 discussions to discern the underlying ideas or concepts which may have led to the disagreement.
 176 Raters learned about potential sources of error in the discussion of rater disagreements in score
 177 review. Faculty discussed the importance of mitigating these sources of error to improve score
 178 reliability. Scenarios with disagreement on two or more items were repeated.

179 RESULTS

180 Raters ($n=6$) included physicians ($n=1$), midwives ($n=4$) and nurses ($n=1$). All study participants
 181 completed the three full days of rater training which included participation in scoring and a focused
 182 debrief for 42 scenarios over the three days. Table one provides details about scenario scoring for
 183 HBB, ECEB and AMSTL over the three days.

184 **Table 1.** Kappa values

Training Program	Proficiency Level	n	Average		n Day 1 (n=16)		n Day 2 (n=14)		n Day 3 (n=12)	
			Fleiss' K	Standard error	Fleiss' K	Standard error	Fleiss' K	Standard error	Fleiss' K	Standard error
HBB		15	0.43	0.07	0.28	0.12	0.58	0.12	0.48	0.12
	Poor	2			0		1		1	
ECEB	Acceptable	13			5		4		4	
	Poor	2	0.61	0.07	1	0.42	0.10	0.70	0.13	0.77
BAB	Acceptable	10			4		3		3	
	Poor	6	0.46	0.07	2	0.58	0.12	0.19	0.12	0.33
All OSCEs	Acceptable	9			3		3		3	
			0.508	0.04						

186
 187 The time needed for each OSCE station with score review was longer for average proficiency
 188 levels (30-40 minutes) when compared to 'excellent' and 'poor' proficiency levels (15-20
 189 minutes). Fleiss' Kappa values (Table 1) showed that there was a moderate level of rater
 190 agreement in identifying 'poor' and 'acceptable' proficiency across all OSCEs ($\kappa=0.51$). Kappa
 191 values improved over the three days moving from 'fair' to 'moderate' for the HBB OSCE and

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3 192 'moderate' to 'good' for the ECEB OSCE. The kappa value for BAB was 'moderate' Day 1 but
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5 193 decreased to 'fair' Day 2 and Day 3. Information about rater abilities to correctly identify
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7 194 proficiency levels is described in Table 2 and 3.
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Table 2. Proficiency level identification (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	18	8 (44%)	9 (50%)	9 (50%)	5 (28%)	8 (44%)	8 (44%)
	Excellent	14	10 (71%)	7 (50%)	10 (71%)	8 (57%)	11 (79%)	10 (71%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	3	2 (66%)	0 (0%)	0 (0%)	0 (0%)	2 (66%)	2 (66%)
	Excellent	6	3 (50%)	1 (17%)	3 (50%)	2 (33%)	5 (83%)	3 (50%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	6	0 (0%)	3 (50%)	3 (50%)	1 (17%)	2 (33%)	3 (50%)
	Excellent	4	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)	4 (100%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	9	6 (67%)	6 (67%)	6 (67%)	4 (44%)	4 (44%)	3 (33%)
	Excellent	4	3 (75%)	2 (50%)	3 (75%)	2 (50%)	2 (50%)	3 (75%)

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Table 3. Proficiency level identification: (average and excellent categories combined) for training program categories (Number of scenarios and resulting percentage correctly identified in proficiency category)

OSCE	Proficiency Level	n	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6
All		42						
	Poor	10	10 (100%)	10 (100%)	10 (100%)	10 (100%)	10 (100%)	9 (90%)
	Average	32	18 (56%)	16 (50%)	19 (59%)	14 (44%)	19 (59%)	18 (56%)
BAB		15						
	Poor	6	6 (100%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	5 (83%)
	Average	9	5 (55%)	1 (11%)	3 (33%)	2 (22%)	7 (78%)	5 (66%)
ECEB		12						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	10	4 (40%)	7 (70%)	7 (70%)	5 (50%)	6 (60%)	3 (50%)
HBB		15						
	Poor	2	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
	Average	13	9 (69%)	8 (62%)	9 (69%)	6 (46%)	6 (46%)	6 (46%)

198

199 Raters were more accurate in identifying ‘poor’ and ‘excellent’ compared to average, and often
 200 identified excellent proficiency level scenarios as average. Raters identified average proficiency
 201 approximately 50% of the time (Table 2 and 3). Information detailing challenges from field notes
 202 are presented in Table 4.

Table 4. Rater Challenges from Field Notes

Challenge	HBB	ECEB	BAB
Differing perceptions of practice standard		Back rub stimulation Sequence for drying baby	Fundal Massage Bleeding Assessment Frequency of bleeding assessment
Tracking multi-step OSCE items	Item 1. Prepares area for delivery Item 2. Equipment preparation Item 3. Hand washing Item 5. Removes wet clothes Item 24. Communication and teaching	Item 7: Improves thermal care Item 8: Identifying danger signs Advanced care classification Item 10. Medication calculation and administration	Item 7. Controlled cord traction counter pressure Item 12. Determining Postpartum hemorrhage
OSCE English Words		Hypothermia	Hypertension
Actions without verbalizing		Warming baby	

203

204 DISCUSSION

205 This study describes an OSCE rater training curriculum and presents evaluation of the
 206 curriculum showing levels of rater agreement for HBB, ECEB and BAB training courses in an
 207 LMIC. Quality rater training and subsequent reliability analysis is especially important in LMIC

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3 208 context because of the limited quality assurance monitoring patient safety in the system and
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5 209 resources.[29-31] Our results suggest that the moderate levels of rater agreement, coupled by
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8 210 notable challenges in discriminating ‘acceptable’ performance, exposes a potential for either
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10 211 overestimating or underestimating competence. This has consequences for the individual, the
11
12 212 training program, and the system. The challenge incurred in discriminating between borderline
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14 213 performance is not isolated to an LMIC context but reported universally.[32-34] With
15
16 214 overestimation of competence, training programs may have passed clinicians who may need
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18 215 more training to provide safe care on the frontline. The problems of accurate discrimination of
19
20 216 competency also affect resource utilization: with underestimation of competence, training
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22 217 programs may be directing the limited resources to clinicians who do not need extra training.
23
24 218 Further, frontline staff frequently work short staffed when someone is away at training, so that
25
26 219 unnecessary remediation training may exacerbate staff overload. [26,29-31]
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31 220 In the majority of HBB, ECEB and BAB training program reports, validation of
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33 221 improved care-giver competency is determined by comparing pre and post training OSCE scores.
34
35 222 Our results suggest that the existing reports describing a moderate IRR may be misleading
36
37 223 without further validation of the accuracy of rater discernment of acceptable proficiency.
38
39 224 [10.15.16] Our raters achieved moderate rater agreement yet discernment of acceptable
40
41 225 proficiency, which is the pass criterion in these training programs, was approximately 50%.
42
43 226 Based on our findings we would suggest including both measures of validation. Considering
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45 227 contexts with limited resources, it may be helpful to implement a further strategy such a global
46
47 228 rating scale, which is common practice in HICs [17-19,22-25] to provide another method of
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49 229 validation of participant competence. [27,28] A global rating scale allows the rater to evaluate
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51 230 how well a learner performs on a scale of 1 to 5, with 5 reflecting the highest level of
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3 231 competence.[28] More than one method of validation creates more certainty that results are an
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5 232 accurate reflection of participant competence and/or training program efficacy [27]. With the
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8 233 continued high reports of maternal and neonatal mortality, it is important to be confident that
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10 234 these training programs are accurate in identifying and supporting clinicians who may not be
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12 235 providing safe care on the frontline.
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16 237 The guidelines for OSCE rater training used in this study were based on
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18 238 recommendations from HIC rater training experiences; these are challenging to implement in an
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20 239 LMIC context. Globally, good practice is for OSCE raters to have relevant content expertise, be
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22 240 well orientated to the OSCE checklist and use a validated rating scale.[22-25] Although we
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25 241 strived for this, we had a limited pool of potential raters; this may have affected the challenges
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27 242 we noted in rater perceptions of the expected practice standard. Raters were recruited by
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29 243 clinician researchers based on recollections of which previous participants from recent HBB,
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31 244 ECEB, and BAB trainings had performed well; no objective strategy was employed in their
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33 245 selection. This was the reason in country faculty inserted a third categorical level of proficiency;
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35 246 excellent. They wanted an objective strategy to identify content experts as the future raters for
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37 247 such training programs. A quality rater training curriculum includes standardized mock
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39 248 scenarios where raters practise with a variety of expected learner proficiency levels demonstrated
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41 249 and practice scored. In our study, this was one of the greatest challenges. Research Clinicians
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43 250 role playing scenarios Day 1 were challenged in demonstrating poor proficiency. In discussion,
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45 251 they shared they didn't want participants to think they were not experts in the field. The
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47 252 inclusion of scripted and video capture of proficiency levels may lessen this tension and
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49 253 inconsistency in role play. Despite this, the level of rater agreement improved over the three
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51 254 training days for both HBB and ECEB. The fall-off in rater agreement for BAB Day 3 was
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3 255 unexpected but may be in part related to the timing of these scenarios Day 3; they were the last
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5 256 role plays of the day and rater fatigue may have played a role. Additionally, the greater number
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8 257 of differing perceptions of the practice standard (Table 4) may have impacted this finding.
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10 258 A solid rater curriculum incorporates a framework such as Zabar's (Figure 2) to guide
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12 259 rater feedback; this is especially important in a setting where the concept of rater training is
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14 260 novel. In our study, Zabar's framework was simple and easy to use as evidenced by a decreased
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16 261 level of external coaching each day.

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19 262 A study strength was the achievement of a level of rater agreement similar to the few
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21 263 published training course reports for ECEB and HBB. In our participant group, the 'moderate to
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23 264 good' kappa for the ECEB OSCE was as reported by Kassick and colleagues in Ghana, the only
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25 265 other ECEB reported study to include in-country evaluators; a regional and national
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27 266 evaluator.[10] In the HBB OSCE, our findings demonstrated 'fair to moderate' kappa value
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29 267 which was similar to the 'fair to good' kappa value reported by Reisman and colleagues in
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31 268 Tanzania[15] whose raters included two external evaluators and one country based evaluator.
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33 269 Comparable studies for kappa value results for raters scoring the BAB OSCE module are not
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35 270 reported. The achievement of comparable IRR to the studies using in country and external
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37 271 partners provides support for the rater training curriculum, yet the inability to accurately discern
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39 272 acceptable proficiency (pass criteria) is concerning. To gain further insight into the relationship
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41 273 between faculty role play and the inability to discern acceptable proficiency, we plan to script the
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43 274 acceptable proficiency level for each OSCE, coach faculty in the role play, and repeat the
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45 275 curriculum and analysis.

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47 276 Rater trainees were challenged by OSCE items where scores incorporated multi-steps for
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49 277 their achievement; this was consistent with experiences described by Seto and colleagues who also
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3 278 identified lower rater agreement for HBB OSCE multi-step items.[16] For example, in our study,
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5 279 one HBB OSCE ‘item’ requires the learner to ‘prepare the area for delivery’. To achieve a point
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8 280 and ‘pass’ this item, the learner must complete all four of: (1) place towels at bedside; (2) place
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10 281 suction at bedside; (3) place a bag and mask at bedside; and (4) place oxytocin at bedside. This
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12 282 ‘item’ created confusion amongst rater trainees; during mock session review, several participants
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14 283 had ‘passed’ the mock scenario learner on this item despite not having seen all steps yet having
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16 284 observed at least one step. To address this gap, we added sub-item tracking boxes when this
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19 285 challenge was identified Day 1; the use of this strategy warrants further study.
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22 286 Our study was limited by lack of formal training and experience in role-playing by
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24 287 simulated learners. Our ‘actors’ were not professionally trained (but rather research clinicians!)
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26 288 and scenarios and levels were de novo; ideally, with more resources and time, mock scenarios
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28 289 would be formally scripted and/or video-captured to optimize standardization. Additionally, time
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30 290 constraints necessitated working three long days; rater fatigue was likely. This was especially true
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33 291 for one pregnant rater-trainee who participated for the first two days then arrived with newborn in
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35 292 hand on Day 3. Our results may have limitations in generalisability but do provide some context
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38 293 and learning for others interested in developing a rater training curriculum in a low resource
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40 294 setting.
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43 44 296 **CONCLUSION**

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47 297 Our results show that rater training in an LMIC setting is critical for administering OSCE based
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49 298 learner assessments especially since the raters in this study had a hard time identifying average
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51 299 performance. Clinician everywhere need ongoing training, but to optimize learning and then
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54 300 translate this to improved outcomes for mothers and babies, this training must be informed by truly
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3 301 objective evaluations. Our study shows in rural, Tanzania, training of in-country raters is possible
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5 302 and can lead to an IRR which is similar to previous studies. Improved standardization and attention
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7 303 to the relationships between IRR and the accurate discernment of participant performance would
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9 304 provide insight into needed modifications, which in turn may lead to greater accuracy in rating
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11 305 competence. More research is warranted. Global training programs, including HBB, ECEB and
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13 306 the BAB need to be confident that OSCE scores truly reflect learner ability, to identify and support
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15 307 those needing further skill practice. Significant global investments have been made towards
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17 308 maternal newborn health provider training; participants need to leave workshop venues equipped
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19 309 with the skills to save mother and newborn lives. We hope this experience encourages program
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21 310 developers nationally and internationally to scale up in-country rater training. For LMIC
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23 311 simulation-based training programs to be sustainable, all countries and regions should have their
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25 312 own trained OSCE raters.
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4

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21 330 What is already known:

- 22 331
- 23 332 1. Studies examining the effectiveness of Helping Babies Breathe, Essential Care for Every
24 333 Baby and Bleeding after Birth report improvements in clinician skill post training.
 - 25 334 2. Global partners support course evaluations in most published studies.
 - 26 335 3. Experts in the field recommend that all examiners undergo rater training prior to
27 336 becoming an OSCE assessor.

28 337 What this study adds:

- 29 338
- 30 339 1. A conceptual framework for training in country health providers as raters in an LMIC
 - 31 340 2. ***Raters had a hard time identifying average performance, despite the achievement of***
32 341 ***moderate rater agreement.***
 - 33 342 3. Raters often identified excellent proficiency as average.
 - 34 343 4. OSCE checklist multi-step items add complexity and should be adapted to a local context
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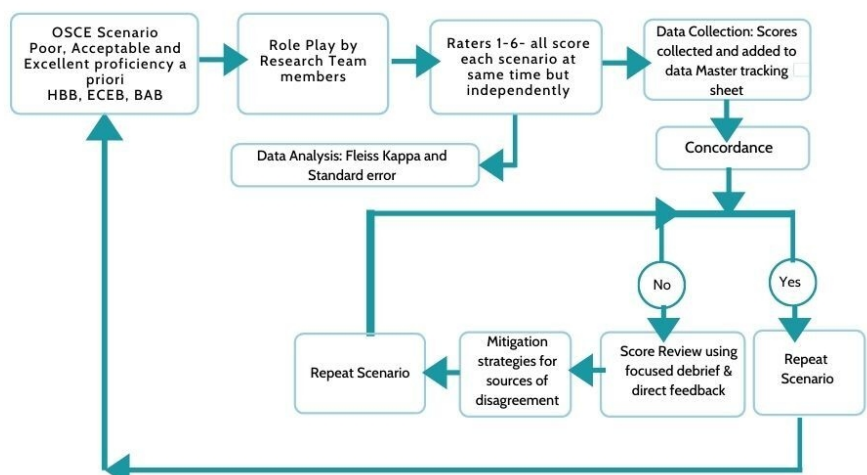


Figure 1. This figure provides a visual of the research design we used in the study each day. All six raters scored all 42 of the role played scenarios with proficiency determined a priori. Raters participated in 42 debrief sessions over the three days.

43x32mm (600 x 600 DPI)

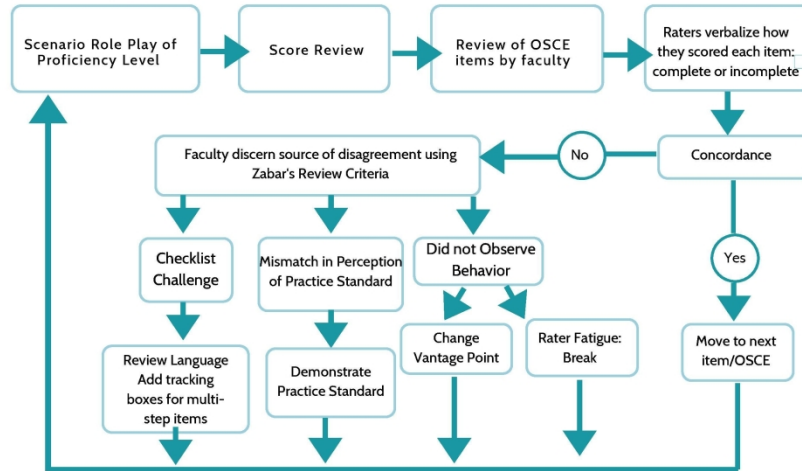


Figure 2. This figure provides a visual of the Conceptual framework used to improve the level of rater agreement.

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