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EDUCATION AND TRAINING

Emergency obstetrics knowledge and practical skills retention among medical students in Rwanda following a short training course

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ABSTRACT

Objective: To describe rates of improved knowledge following a structured 2-day emergency obstetrics training course. **Methods:** Quantitative assessments to evaluate emergency obstetrics knowledge and practical skills were administered before, immediately after, and 3–9 months following the training course for 65 final-year medical students at the National University of Rwanda. A survey was administered during the final assessment. **Results:** In total, 52 (80.0%) students demonstrated knowledge improvement after training. Fifty-seven (87.7%) students improved or maintained their scores from the post-training written test to the final assessment, and 32 (49.2%) retained practical skills. Twenty-one (32.3%) of the class demonstrated competency in both written and practical skills. According to multivariable logistic regression analysis, female gender was associated with overall competency ($P=0.01$), and use of the internet for academic purposes more than 3–5 times per week tended toward competency ($P=0.11$). **Conclusion:** A 2-day emergency obstetrics training course increased knowledge among medical students. Because educational policies are tailored to address high rates of maternal mortality in resource-poor settings, workshops dedicated to emergency obstetrics should be promoted.

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1. Introduction

Maternal mortality and morbidity are among the leading causes of death and illness among women aged 15–49 years in low-income countries [1]. Despite a significant decrease between 2005 and 2008, the maternal mortality ratio in Rwanda remains high, at an estimated 249–584 maternal deaths per 100 000 live births [2,3].

Rwanda—a country of 10.7 million people—has 1 physician for every 18 000 inhabitants. Each year, approximately 80 students graduate from a 6-year Bachelor of Medicine and Surgery program at the National University of Rwanda (NUR) Faculty of Medicine, Butare, Rwanda [4,5]. In their final year, students complete internships in 4 fields: internal medicine; surgery; pediatrics; and obstetrics/gynecology (OB/GYN).

Upon graduating, students complete a 1-year internship in a district hospital (the second point of care after community health centers), where they are often required to handle complicated obstetric emergencies and cases. Appropriate and rapid competency-driven medical education is critical to preparing healthcare providers for administering effective emergency obstetrics interventions and saving lives.

In January 2011, the NUR and the University Teaching Hospital in Kigali (UTH-K) piloted a yearlong educational initiative wherein all sixth-year medical (MD6) students received a targeted orientation prior to beginning each clerkship. The OB/GYN faculty modeled this orientation after the Advanced Life Support in Obstetrics (ALSO) course, which was developed by the American Academy of Family Physicians as a structured, evidence-based approach to maintaining the knowledge and skills necessary to manage obstetric emergencies [6,7].

The study had 3 main aims: to determine improvement in knowledge among MD6 students after completion of ALSO training; to determine retention of knowledge from completion of the ALSO course to the final assessment; and to determine individual, structural, and

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environmental factors that might predict competence among students with regard to provision of quality obstetric care.

2. Materials and methods

Quantitative assessments to evaluate emergency obstetrics knowledge and practical skills were administered before, immediately after, and 3–9 months following intensive training of MD6 students attending the ALSO course at the NUR. Study activities were conducted in collaboration with the NUR, UTH-K, and the Duke Global Health Institute, Durham, USA. Data were collected from January 17 to October 19, 2011. The investigation was performed in accordance with the guidelines of the Duke University Health System Institutional Review Board (IRB) and the UTH-K Ethics Committee; the Duke IRB declared the protocol exempt from review. Students provided verbal consent, and participants were assigned identification numbers to ensure confidentiality.

Throughout 2011, each MD6 student ($n = 67$) participated in 1 of 4 ALSO trainings at UTH-K prior to their OB/GYN clerkship. Trainings—using ALSO-adopted material—were conducted in English by ALSO-certified trainers in January, March, June, and July 2011. Before beginning the training, students completed a 20-question standardized written exam testing their knowledge of major causes of maternal mortality and appropriate preventative and treatment measures. Following the training, students repeated the 20-question exam. Both pre- and post-training tests were graded on a 100-point scale. Trainers then administered a practical skills exam to each participant. The exam assessed critical tasks, including the following: ability to recognize the need for assisted vaginal delivery; demonstration and knowledge of manual skills with vacuum extraction; ability to recognize and manage shoulder dystocia; and ability to recognize and manage postpartum hemorrhage. A standardized ALSO checklist, adapted to low-resource settings, facilitated consistent scoring of each student's performance on the practical skills assessment. Points were awarded for each of the critical tasks, and a total score out of 100 was calculated for each student [8].

All MD6 students were invited to UTH-K for a final assessment on October 10–11, 2011, the timing of which was determined based on their graduation in December. Students were asked to complete a practical skills exam and a 50-question written exam, which included the 20 original questions from the pre- and post-training written exam. At this point, students had completed the ALSO course between 3 and 9 months earlier. Fig. 1 shows the assessment schedule.

A quantitative survey instrument evaluating the students' demographics, career aspirations, academic standing, and feedback on ALSO training was also developed and administered with the final assessment at UTH-K. All assessment and survey materials were written in English.

Three outcomes were measured: improvement in knowledge between pre- and post-training tests; retention of knowledge from post-training test to final assessment; and competency after final assessment. Improvement in knowledge was defined as either an increase in assessment score to at least 70% or maintenance of the

70% or higher score from pre- to post-training tests. Retention of knowledge was defined as maintenance or improvement of baseline knowledge and practical skills demonstrated from post-training test to final assessment. Competency was defined as aptitude to address emergency obstetrics issues, as demonstrated by performance on the final, comprehensive written and practical ALSO exam. Participants with scores of at least 85% on the written exam and at least 80% on the practical skills assessment were defined as competent.

To maintain consistency in analysis for the written exam testing improvement in knowledge and retention of knowledge, scores for the 20-question exam were compared pre-training, post-training, and in the final assessment. Median scores for the 50-question final written assessment were used to define competency.

Collected data were entered into Excel (Microsoft, Redmond, WA, USA) and coded. Data analysis was performed using Stata version 11.0 (StataCorp, College Station, TX, USA). Descriptive and summary statistics (means for continuous variables and proportions for categorical variables) were calculated. Bivariable analyses used χ^2 and Fisher exact statistics for common and rare outcomes to estimate the association between potential predictors and the various outcomes of interest. The α level was set to 0.2 as the level of significance for both the χ^2 and the Fisher exact tests. All potential predictors independently associated with a given outcome (at an α level of 0.2) during bivariable analysis were retained for multivariable regression. For each outcome, multivariable analyses were begun by running logistic regression models that included all independent predictors for that outcome that were retained during bivariable analysis. Backward elimination was then used to remove any variables that had Wald test P values at or above 0.2. The most parsimonious model for each outcome (the model in which all the predictors had Wald P values less than 0.2) was retained as the final predictive model.

3. Results

At the time of data collection, there were 67 MD6 students attending the Faculty of Medicine at NUR. In total, 65 students voluntarily participated in the study; linked data from ALSO training and final assessment results were obtained for all 65. With the final sample, there was a power of 0.96 to detect a difference in score of 5 percentage points (or a 1-point difference on the 20-point scale) between pre-training and post-training tests at an α level of 0.05 for the primary outcome of improvement in knowledge. Table 1 outlines the basic demographic details of the participants. Of the 65 students, 55 (84.6%) were male and 10 (15.4%) were female. Students completed their OB/GYN clerkships at 3 referral hospitals: University Teaching Hospital of Butare ($n = 26$); UTH-K ($n = 30$); or King Faisal Hospital ($n = 9$). Forty-one (63.1%) students reported that physicians spent 1–2 sessions per week or less on instruction during their clerkship. Fifty-one (78.5%) students assisted with 25 or fewer deliveries during this time.

In total, 52 (80.0%) students met the criteria for knowledge improvement, demonstrating a sufficient increase in test score after

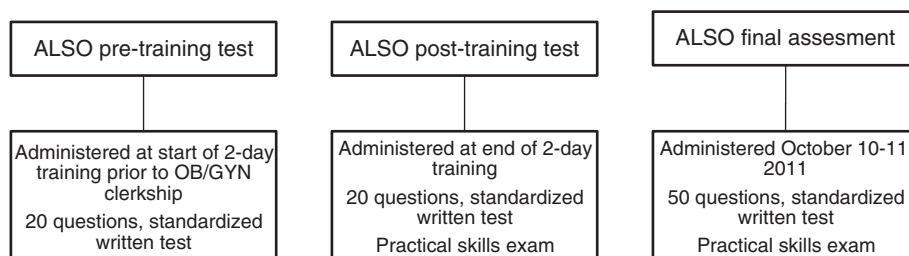


Fig. 1. Schedule of emergency obstetrics training assessment.

Table 1
Characteristics of MD6 students at NUR (n = 65).

Characteristic	No. (%)
Gender	
Male	55 (84.6)
Female	10 (15.4)
English fluency	
Non-fluent	19 (29.2)
Fluent ^a	46 (70.8)
Owned laptop computer	
Yes	54 (83.1)
No	11 (16.9)
Frequency of internet access	
≤1–2 times per week	32 (49.2)
≥3–5 times per week	33 (50.8)
Internet use for academics ^b	
≤1–2 times per week	34 (52.3)
≥3–5 times per week	31 (47.7)
Owned textbooks	
No	6 (9.2)
Yes	59 (90.8)
1–3	27/58 (46.6)
4–7	10/58 (17.2)
≥8	21/58 (36.2)
Frequency of textbook use	
<1–3 times per week	37 (56.9)
Daily	28 (43.1)
History of externships	
Yes	11 (16.9)
No	54 (83.1)
Site of OB/GYN clerkship	
CHUB	26 (40.0)
UTH-K	30 (46.2)
KFH ^c	9 (13.8)
Assisted student deliveries during clerkship	
≤25	51 (78.5)
>25	14 (21.5)
Frequency of physician instruction during OB/GYN rotation	
≤1–2 sessions per week	41 (63.1)
≥3–5 sessions per week	24 (36.9)
Interest in OB/GYN before ALSO training	
High interest ^d	36 (55.4)
Low interest	29 (44.6)
Career aspirations	
OB/GYN	23 (35.4)
Pediatrics	19 (29.2)
Internal medicine	11 (16.9)
Surgery	5 (7.7)
Emergency medicine	3 (4.6)
None of the above	4 (6.2)
Primary care or psychiatry	0 (0.0)
Date of ALSO training	
January 2011	13 (20.0)
March 2011	16 (24.6)
June 2011	18 (27.7)
July 2011	18 (27.7)

Abbreviations: ALSO, Advanced Life Support in Obstetrics; CHUB, University Teaching Hospital of Butare; KFH, King Faisal Teaching Hospital; MD6, sixth-year medical students; NUR, National University of Rwanda; OB/GYN, obstetrics/gynecology; UTH-K, University Teaching Hospital of Kigali.

^a Defined on a 5-point Likert scale as a score of either 4 or 5.

^b Use of laptop for academics was defined as the use of laptops to read medical journals or research medical topics.

^c One student at KFH completed a portion of their OB/GYN training at KFH and Kanombe Military Hospital.

^d Interest in OB/GYN was defined on a 5-point Likert scale as a score of either 4 or 5.

ALSO training. Written exam scores improved by 21.6 percentage points (a 38% increase) within the 2-day training period (Table 2).

Students demonstrated high retention rates for written knowledge (Table 3, Fig. 2). There were no significant differences in mean score among the 4 groups receiving training at different times. Overall, 57 (87.7%) students met the criteria for knowledge retention. Retention of practical skills was lower, however, with 32 (49.2%) students successfully retaining knowledge from the post-training test to

Table 2
Overall performance of students (n = 65).

Assessment	Mean score ± SD, %
ALSO training	
Pre-training written test (20 questions)	54.0 ± 11.0
Post-training written test (20 questions)	74.6 ± 9.1
Practical	79.1 ± 6.4
Final assessment	
Final written test (20 questions)	83.3 ± 7.9
Final written test (50 questions)	84.2 ± 7.3
Practical	79.0 ± 8.9

Abbreviation: ALSO, Advanced Life Support in Obstetrics.

Table 3
Outcome measurements (n = 65).

Outcome	Number (%) of students
Outcome 1: improvement of knowledge over 2-day training	
Improved or maintained pass	52 (80.0)
Outcome 2: knowledge retention from post-training test to final assessment	
Written assessment:	
Met successful retention criteria	57 (87.7)
Practical assessment:	
Met successful retention criteria	32 (49.2)
Outcome 3: competence demonstrated in final assessment	
Demonstrated competence criteria	21 (32.3)

the final practical examination. Multivariable regression analysis showed that female gender (odds ratio [OR] 0.367; 95% confidence interval [CI], 0.084–1.609; $P=0.18$) and daily textbook use (OR 2.22; 95% CI, 0.805–6.160; $P=0.12$) tended to predict practical skills retention but the results were not statistically significant (Table 4).

Twenty-one (32.3%) students met the criteria for competency. Bivariable logistic regression analysis showed that, within this group, trends toward association with competence were noted for female gender ($P=0.10$), use of the internet for academic purposes ($P=0.20$), interest in OB/GYN before ALSO training ($P=0.20$), and clerkship site ($P=0.20$). Multivariable regression analysis showed that female gender was a strong predictor of student competence (OR 0.136; 95% CI, 0.029–0.628; $P=0.01$) and that student use of the internet for academic purposes more than 3–5 times per week trended toward statistical significance (OR 2.562; 95% CI, 0.812–8.082; $P=0.11$) (Table 4).

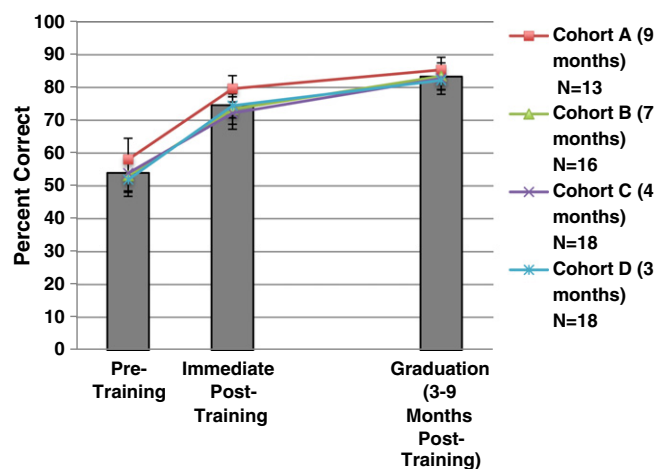


Fig. 2. Scores for written assessment of emergency obstetrics knowledge before, immediately after, and 3–9 months after a 2-day course among final-year medical students (n = 65) at the National University of Rwanda.

Table 4

Multivariable logistic regression analysis correlates for retention of practical skills and competency in written and practical skills (n = 65).

	Odds ratio (95% confidence interval)	P value
Retention of practical skills		
Female gender ^a	0.367 (0.084–1.609)	0.184
Daily textbook use ^b	2.227 (0.805–6.160)	0.123
Competency in written and practical skills		
Female gender ^a	0.136 (0.029–0.628)	0.011
Internet use for academic purposes > 3–5 times per week ^c	2.562 (0.812–8.082)	0.109

^a Male = 1 (reference); female = 0.

^b Daily = 1 (reference); <3 times per week = 0.

^c Internet use for academic purposes > 3–5 times per week = 1 (reference); <1–2 times per week = 0.

Questions from the final written assessment were divided into 6 broad subjects to determine areas of strength and weakness in student knowledge: monitoring of labor; monitoring of delivery; infections and sepsis; prepartum hemorrhage; postpartum hemorrhage; and hypertensive disorders of pregnancy (Fig. 3). Students answered more than three-quarters of questions correctly in all areas. Students performed worst on questions (76% correct) about monitoring and management of labor, and best on questions (91% correct) about hypertensive disorders of pregnancy.

4. Discussion

Rates of knowledge and practical skills improvement and retention, in addition to associated predictors, were determined among final-year Rwandan medical students following a structured emergency obstetrics training course. Knowledge scores improved by 38% following the ALSO training course. Furthermore, 87.7% of students retained written knowledge and maintained or improved their score from the post-training test to the final assessment; 49.2% of students retained practical skills.

Each of the measured outcomes highlights important findings. First, there was expected improvement in knowledge as a result of a 2-day ALSO training course. The findings are consistent with those

from other studies demonstrating that similar short courses—such as Managing Obstetrics Emergencies and Trauma, and the Essential Obstetric Care Manual for Health Care Providers—lead to knowledge improvement in emergency obstetrics training in low-resource environments [9].

Second, across a period of 3–9 months, rates of retention of written knowledge in emergency obstetrics were high. Clerkship site, contact hours with physicians, and number of student-assisted deliveries did not predict written knowledge retention, and no differences were observed in the written or practical scores among the students based on time elapsed between training date and final assessment. Female gender and daily use of textbooks trended toward predicting practical skills retention in multivariable regression analysis. It is likely that students who read textbooks on a daily basis continually reinforce their practical skills knowledge. Further investigation in a larger, more varied sample of medical students over a longer period of time is merited to understand better the predictive factors for retention.

More than one-third of the class met the definition of written and practical competence. Female gender was a strong predictor of achieving competence, and use of the internet for academic purposes was weakly predictive. Consequently, the overall trend of the analysis was that female MD6 students had a higher likelihood of demonstrating retention and competency compared with their male counterparts—highlighting the fact that women (15% of the sixth-year student body) were high performers. More efforts should be made to recruit and encourage female participation in the field of medicine, where women's abilities to achieve have been established.

There were several limitations to the study. The small sample size restricted the opportunity to perform extensive predictive modeling. Although the study involved a representative population of students, it was underpowered to identify the many varied factors that affect knowledge retention. It is also possible that social desirability bias exaggerated reported rates of predictive variables, including textbook and academic internet use, interest in OB/GYN, and career aspirations. To minimize this bias, participants were anonymized and confidentiality of responses was assured. Lastly, during the final assessment period, students had been in the process of preparing for their final exams, which may have confounded the relationship between ALSO training and knowledge improvement/retention.

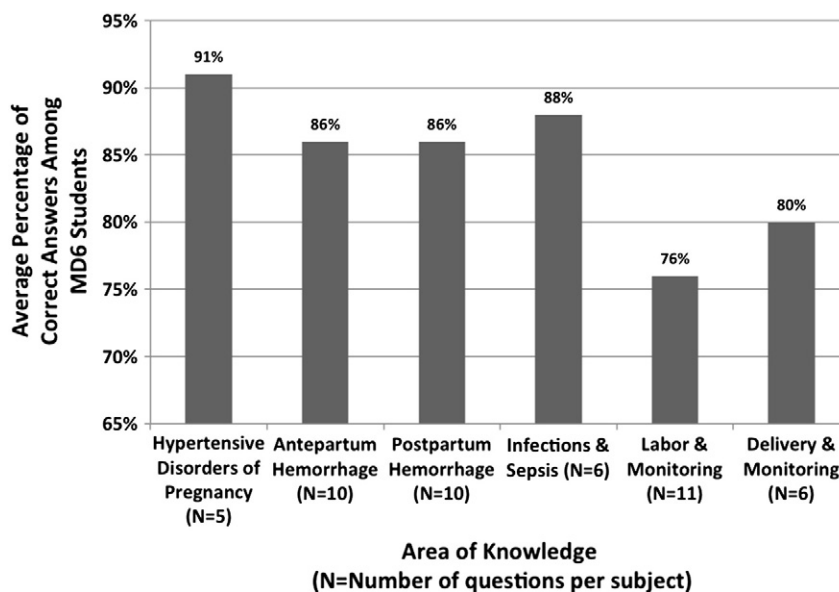


Fig. 3. Breakdown of performance on final assessment among final-year medical students (n = 65) at the National University of Rwanda. Breakdown based on 6 areas of emergency obstetrics knowledge. The results shown are for 48 of 50 questions. Two questions from the assessment did not map to any of these categories and were not included in the figure breakdown.

The findings indicate several possible modifications to emergency obstetrics training for medical students in Rwanda. Greater access to academic internet resources and daily textbook use may help to reinforce emergency obstetrics training and promote retention of knowledge and practical skills. The practical skills of students eroded over time and, although the present results do not highlight optimal timing of such courses, the data emphasize the need for refresher skills sessions to enhance retention. Future curriculum changes should consider competency-based learning models, focused on outcomes rather than processes, to reinforce and promote retention of medical knowledge and technical skills. The present data also highlight potential for improvements in future ALSO trainings, especially for the monitoring and management of labor.

In conclusion, the present research demonstrates that 2-day emergency obstetrics courses increase knowledge among medical students. The knowledge gained from these courses was retained for up to 9 months but practical skills deteriorated. Further exploration is merited to determine how female gender and use of textbooks or internet for academic purposes predict competency and retention. Optimal timing and configuration of practical skills refresher trainings also need to be defined.

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Conflict of interest

The authors have no conflicts of interest.

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