BRIEF
REPORTS

Expanding Point-of-Care Ultrasound Training in a Low- and Middle-Income Country: Experiences From a Collaborative Short-Training Workshop in Kenya

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BACKGROUND AND OBJECTIVES: In Kenya, little data exists on point-of-care ultrasound (POCUS) training and use for family medicine physicians. In 2017, a 3-day POCUS workshop assembled most of the family medicine physicians in Kenya. Through surveys, we assessed how this workshop could affect the level of POCUS use, skill, and confidence in family medicine practitioners in the long term.

METHODS: Structured surveys, distributed before, after, and 10 months post-workshop assessed demographics, POCUS use, barriers, comfort, and skills based on attendee self-assessment. We compared data from the pre-workshop surveys to postsurveys and post-postsurveys to assess immediate and long-term differences. Wilcoxon signed-rank test was used to evaluate continuous data, and significance was based on a *P* value of <.05.

RESULTS: The proportion of participants who self-reported using POCUS increased significantly between presurvey and post-postsurvey (29.7% to 63.2%, *P*=.0161). Mean confidence scores increased significantly from presurvey to postsurvey and post-postsurvey. For all body systems, self-reported mean skill scores increased significantly from presurvey to postsurvey and post-postsurvey. Lack of access to machines and mentorship are substantial barriers to increasing POCUS use.

CONCLUSIONS: This study highlights the utility of one-time POCUS training in increasing long-term POCUS uptake by participants. While encouraging, our findings also show barriers to increasing POCUS use. These barriers must be addressed, potentially through intradepartmental and interorganizational exchanges of resources to ensure that future POCUS workshops are successful in supporting POCUS use in Kenya.

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Access to diagnostic imaging is a challenge in health facilities of low- and middle-income countries (LMICs). A 2011 World Health Organization (WHO) survey reported that the density of computerized tomography (CT) scans was 2.06 per million people in LMICs compared to 44.31 in high-income countries.[1] As an alternative, point-of-care ultrasound (POCUS) use has recently increased in LMICs.[2]

POCUS is attractive for multiple reasons. Units are compact and operate with rechargeable batteries, minimal infrastructure and training are required, and diagnosis can be done solo at the bedside. The WHO stated that capital costs for the most advanced ultrasound machine were

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10% of those for a CT machine.[3] Although quality evidence is lacking, a systematic review demonstrated that portable ultrasound may have a clinical impact in up to 70% of cases.[2]

In Kenya (an LMIC), family physicians are well situated to utilize POCUS in multiple settings yet lack formal training. In 2017, the Kenya Association of Family Physicians (KAFP) organized a 3-day training in collaboration with Moi, Aga Khan, Kenyatta, and Kabarak Universities, as well as the Contra Costa, University of Massachusetts, and Brown University family medicine (FM) residency programs. Contra Costa FM has been conducting POCUS workshops for over 5 years[4] with a course based on American College of Emergency Physician Guidelines. Our study aimed to assess the immediate and long-term (10-month) impact of an adapted version of this course on POCUS use, confidence, and skills for FM trainees and faculty in Kenya.

Methods

In May 2017, we conducted a 3-day POCUS course for all FM physicians and trainees in Kenya, with residents (registrars) and faculty (consultants) from four out of five FM residency programs attending. The course comprised lectures, large-group demonstrations, and hands-on scanning. See Figure 1 for course agenda.

We distributed pre- and post-structured surveys before and immediately after the workshop, and 10 months postworkshop (Appendix 1). Question types included multiple choice, open-ended, and Likert scale.

Surveys were anonymous but linked by a unique identifier. A single investigator (L.J.) entered all data into a Microsoft Excel (version 1901) spreadsheet and used Wilcoxon signed-rank test to evaluate continuous data. Significance was based on a P value of <.05. Statistical analysis was performed using Stata/IC 15.

The University of Massachusetts Institutional Review Board reviewed the project and determined that it was not human subjects research given that this was a program evaluation and survey data was anonymous.

Results

Of 41 participants, 39 completed the surveys and were included in pre/post analysis. Of these participants, 28 (72%) were male and 11 (28%) were female; 26 (67%) were registrars; 34 (87%) reported never having POCUS training previously. Twenty (51%) participants completed the 10-month post-postsurvey, 19 (49%) of whom were matched to the original pre- and posttraining analysis and were included in post-post analysis (Table 1).

The three most cited barriers on presurvey were cost of machine, insufficient training, and lack of formal POCUS curriculum (Figure 2). The proportion of respondents who cited lack of training as a barrier to POCUS use decreased significantly from presurvey to postsurvey (47.37% to 5.13%, P=.00000) and from presurvey to post-postsurvey (47.37% to 15.79%; P=.0198). The proportion of participants who self-reported using POCUS increased significantly between presurvey and post-postsurvey (29.7% to 63.2%; P=.0161).

Participants rated their confidence in using POCUS in practice, teaching POCUS, and sharing POCUS findings with patients. For all three questions, mean confidence score increased significantly from presurvey to postsurvey, and from presurvey to

Figure 1: POCUS Workshop Agenda

Friday, May 12th	*Saturday, May 13th*	*Sunday, May 14th*
1230-1300: Registration and Check-In	0730-0830: Breakfast	0730-0830: Breakfast
1300-1315: Introduction	0800-0830: Check-In	0800-0830: Check-In
1315-1330: Ultrasound Basics	0830-0850: Cardiac Echo	0830-0900: FASH exam
1330-1400: FAST Exam	0850-1000: Cardiac Echo lab	0900-1000: FASH lab
1400-1500: FAST and E-FAST lab	1000-1030: Chai	1000-1030: Chai
1500-1530: Chai	1030-1050: Pulmonary	1030-1050: RUSH exam
1530-1600: Pulse Health Care	1050-1110: DVT	1050-1150: RUSH lab
1600-1625: Liver/Spleen/Gallbladder	1110-1210: Pulmonary and DVT lab	1150- 1250: OSCE
1625-1650: Renal/Aorta	1210-1300: Pass the Pointer	1250-1350: Advanced applications/Closing remarks
1650- 1800: Liver/Spleen/Gallbladder and Renal/Aorta lab	1300-1400: Lunch	1330-1430: Survey completion and lunch
1800-1900: Dinner	1400-1430: Soft tissue/Procedural	
	1430-1530: Soft tissue/Procedural lab	
	1530-1600: Chai	
	1600-1620: OB	
	1620-1640: Gynecology	
	1640-1730: OB/GYN lab	
	1730-2200: Dinner	

Abbreviations: POCUS, point-of-care ultrasound; FAST, focused assessment with sonography in trauma; E-FAST, extended FAST; DVT, deep venous thrombosis; OB, obstetric; GYN, gynecologic; FASH, focused assessment with sonography for HIV-associated tuberculosis; RUSH, rapid ultrasound for shock and hypotension; OSCE, objective structured clinical examination.

Table 1: Key Demographics of Survey Respondents

Characteristics	Pre/Post	Post-Post	*P*
Total Respondents	39	19	-
Age (mean, years)	35.35	35.45	.9633
Gender			
Male	28 (72%)	12 (63%)	.5046
Female	11 (28%)	7 (37%)	.5046
Clinical Practice			
Registrar	26 (67%)	15 (79%)	.3449
Consultant	11 (28%)	4 (21%)	.5670
Other	2 (5%)	0 (0%)	-
Training Program			
Aga Khan	9 (23%)	3 (16%)	.5369
Kabarak	6 (15%)	2 (11%)	.6775
Kenyatta	8 (21%)	6 (32%)	.3613
Moi	11 (28%)	8 (42%)	.2857
Past POCUS Training			
Yes	5 (13%)	-	-
No	34 (87%)	-	-
Level of Access to POCUS			
Have machine, can access	13 (33%)	7 (37%)	.7653
Have machine, not easily available	4 (10%)	4 (21%)	.2556
Machine available at other training sites	0 (0%)	1 (5%)	-
No access	17 (44%)	6 (32%)	.3856
Other	3 (8%)	1 (5%)	.6773
Frequency of POCUS Use in Practice			
Never	19 (49%)	6 (32%)	.2243
Daily	1 (3%)	0 (0%)	-
Few times a week	3 (8%)	9 (47%)	.0007
Few times a month	8 (21%)	3 (16%)	.6539
Few times a year	6 (15%)	1 (5%)	.2707

Abbreviations: Pre/Post, participants who completed presurvey and postsurvey; Post-Post, participants who completed presurvey, postsurvey, and post-postsurvey; *P*, *P* value; Registrar, Kenyan resident-equivalent; Consultant, Kenyan attending equivalent, POCUS, point-of-care ultrasound.

post-postsurvey, but decreased significantly from postsurvey to post-postsurvey (Table 2).

For all body systems, self-reported mean skill scores increased significantly from presurvey to postsurvey, and from presurvey to post-postsurvey. Self-reported mean skill scores decreased significantly across all body systems from postsurvey to post-postsurvey, except for obstetric and liver/spleen/gallbladder (Table 3).

Discussion

Considering the potential of POCUS use by FM physicians in Kenya, it is necessary to determine whether training modalities such as short workshops are effective. Our findings show that self-reported use, skills, and confidence with POCUS increased significantly after a short workshop and that this increase, while declining slightly after 10 months, remained significantly elevated from preworkshop levels. This highlights the utility of one-time, basic POCUS training in increasing long-term POCUS uptake by participants and confirms findings of previous studies.[5,6] The workshop played a key role in addressing the lack of training that was noted by most trainees as a barrier in the presurvey and in other studies.[7]

Our study was one of the first to assess perceived barriers to POCUS use in an LMIC 10 months after a POCUS workshop, allowing insight

Figure 2: Perceived Barriers to POCUS Use by Survey Type

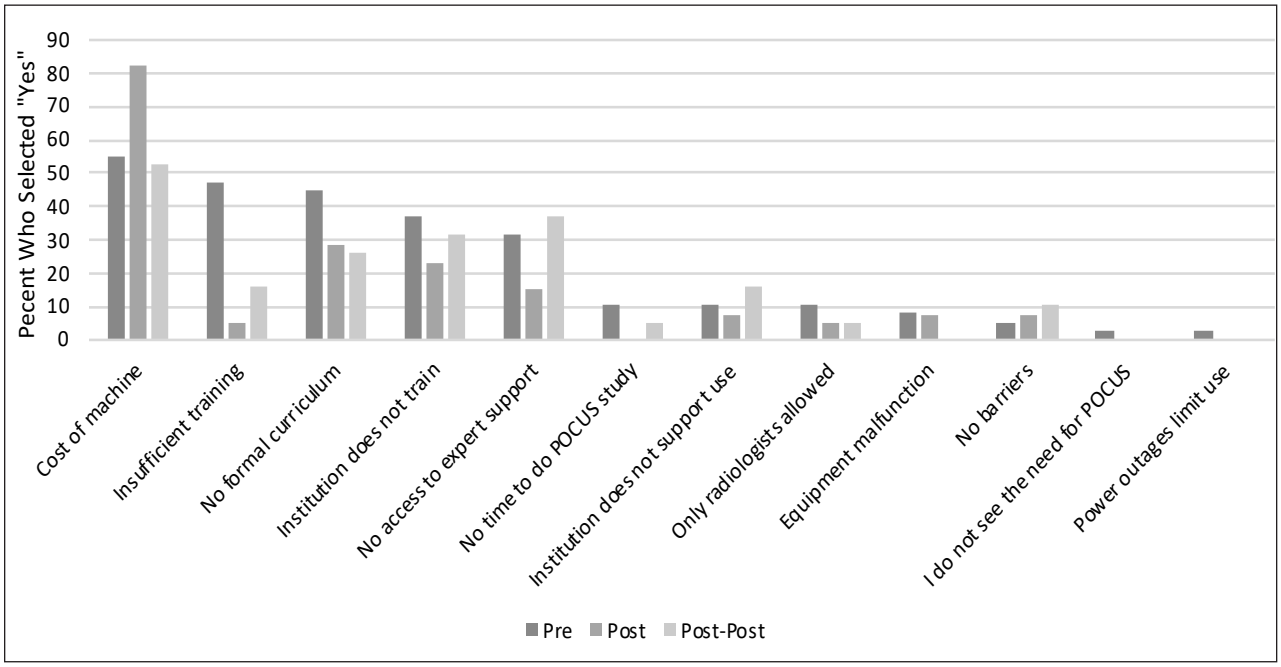

Table 2: Comparing Mean Confidence Scores

	Comparing Pre and Post					Comparing Pre and Post-Post					Comparing Post and Post-Post				
	N	M Pre	M Post	M Diff	*P*	N	M Pre	M PP	M Diff	*P*	N	M Post	M PP	M Diff	*P*
Using POCUS in practice	23	1.78	3.65	1.87	.00	12	1.67	3.00	1.33	.00	19	3.53	3.00	-0.53	.01
Teaching POCUS	23	1.35	3.30	1.96	.00	12	1.17	2.83	1.67	.00	19	3.11	2.63	-0.47	.04
Sharing results with patients	23	1.78	3.57	1.78	.00	12	1.75	3.08	1.33	.00	19	3.42	3.00	-0.42	.03

Note: Mean confidence scores reflect the average response on a 5-point Likert scale with 1=extremely confident and 5=not at all confident. The scale was reversed in analysis, and here reflects 1=not at all confident and 5=extremely confident.

Abbreviations: POCUS, point-of-care ultrasound; Pre, presurvey; Post, postsurvey; Post-Post, 10-month postsurvey; N, number analyzed; M Pre, mean confidence score from presurvey; M Post, mean confidence score from postsurvey, M PP, mean confidence score from 10-month postsurvey, M Diff, mean difference between scores; *P*, *P* value.

into the reasons for the decline in skills and confidence over that period. Lack of ready access to a machine was the most commonly cited barrier to POCUS use. Ultrasound devices, while relatively inexpensive, remain cost prohibitive in LMICs.[8,9] Nongovernmental organizations are distributing POCUS machines to rural health care facilities across the country, but full coverage to all facilities is yet to be realized.

The other commonly cited barrier related to lack of continuous, onsite POCUS training. Although faculty attended the workshop, they were also in the learning stages. Collaborations among departments and other institutions both nationally and internationally could provide opportunities for such mentorship.

This study has several strengths. Our workshop marked the first time that most Kenyan FM physicians and trainees were gathered together, and our survey results provide new insight into the state of the field of family medicine in Kenya. Additionally, our 10-month post-postsurvey assessed the impacts of the workshop over time, suggesting that although uptake remains increased compared to preworkshop levels, future workshops must facilitate machine donations and foster accessible teaching relationships to promote sustainability.

Table 3: Comparing Self-Reported Mean Skill Scores

	Comparing Pre to Post					Comparing Pre to Post-Post					Comparing Post to Post-Post				
System	**N**	**M Pre**	**M Post**	**M Diff**	***P***	**N**	**M Pre**	**M PP**	**M Diff**	***P***	**N**	**M Post**	**M PP**	**M Diff**	***P***
Cardiac	36	1.36	3.28	1.92	.00	19	1.37	2.68	1.32	.00	19	3.16	2.68	-0.47	.00
Ob	36	1.69	3.22	1.53	.00	19	1.63	2.89	1.26	.00	18	2.89	2.89	.00	1.00
Pulm	36	1.33	3.42	2.08	.00	19	1.32	2.37	1.05	.00	18	3.22	2.39	-0.83	.00
FAST	36	1.56	3.58	2.03	.00	18	1.44	2.89	1.44	.00	19	3.37	2.89	-0.47	.01
FASH	36	1.14	3.42	2.28	.00	18	1.17	2.39	1.22	.00	18	3.28	2.39	-0.89	.00
RUSH	34	1.24	3.47	2.24	.00	18	1.22	2.50	1.28	.00	18	3.39	2.50	-0.89	.00
DVT	37	1.54	3.65	2.11	.00	19	1.63	3.21	1.58	.00	19	3.58	3.21	-0.37	.03
L/S/G	37	1.51	3.51	2.00	.00	19	1.47	3.05	1.58	.00	19	3.37	3.05	-0.32	.22
Gyn	37	1.46	3.27	1.81	.00	19	1.47	2.79	1.32	.00	19	3.26	2.79	-0.47	.04
Renal	37	1.43	3.46	2.03	.00	19	1.42	2.84	1.42	.00	19	3.42	2.84	-0.58	.03
Soft tissue	36	1.39	3.42	2.03	.00	19	1.58	2.84	1.26	.00	18	3.28	2.61	-0.67	.00

Note: Self-reported mean skill scores reflect the average response on a 5-point Likert scale with 1=highly skilled and 5=not at all skilled. The scale was reversed in analysis, and here reflects 1=not at all skilled and 5=highly skilled.

Abbreviations: POCUS, point-of-care ultrasound; Pre, presurvey; Post, postsurvey; Post-Post, 10-month postsurvey; N, number analyzed; M Pre, mean skill score from presurvey; M Post, mean skill score from postsurvey; M PP, mean skill score from 10-month postsurvey; M Diff, mean difference between scores; *P*, *P* value; Ob, obstetric, FAST, focused assessment with sonography in trauma; FASH, focused assessment with sonography in HIV-related tuberculosis; RUSH, rapid ultrasound for shock and hypotension; DVT, deep venous thrombosis; L/S/G, liver/spleen/gallbladder; Gyn, gynecologic

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