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Formal ultrasound curriculum for surgical critical care fellows leads to improvement in comfort and skills in the intensive care unit

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Abstract

Background: Point-of-care ultrasound (POCUS) is increasingly vital in surgical critical care, yet standardized training remains inconsistent. This study evaluates a structured POCUS curriculum for surgical critical care fellows, assessing its impact on knowledge, skills, and confidence over six months.

Methods: A prospective observational study was conducted from July 2024 to January 2025 at a tertiary care center, involving 15 fellows with varying prior ICU experience (3–15 months). The curriculum included two days of didactic lectures and hands-on sessions, followed by monthly maintenance training. Competency was assessed at baseline, 3 months, and 6 months via written tests (knowledge), self-reported Likert scales (confidence), and a 25-task checklist (skills).

Nonparametric statistical tests (Wilcoxon signed-rank, Friedman) analyzed changes, with correlations explored using Spearman's rank.

Results: First-year fellows showed the greatest improvement (knowledge: +7 points, skills: +9 points, $p < 0.05$), while all cohorts demonstrated significant gains (overall knowledge $p = 0.001$). Skills and knowledge were sustained at 6 months (median knowledge: 27 [26–29], skills: 33 [32–33]), with confidence rising progressively (22 [20–23]). Formal training outperformed informal methods in knowledge (27 vs. 18, $p < 0.05$) and skills (33 vs. 21, $p < 0.05$). Strong correlations linked confidence, skills, and knowledge ($r = 0.76–0.79$, $p < 0.01$).

Conclusion: A structured POCUS curriculum significantly enhances fellows' competencies, particularly for novices, with sustained benefits over six months. These findings advocate for standardized, expert-led training in critical care fellowships.

Keywords: Diagnosis, POCUS, Wilcoxon Signed-Rank

Introduction

The performance and interpretation of point-of-care ultrasound (POCUS) have emerged as essential skills in the management of critically ill patients[1]. Ultrasound-guided techniques are now considered the standard of care for numerous bedside procedures[2], and POCUS is widely acknowledged as a valuable adjunct for both diagnosis and treatment planning during episodes of acute clinical deterioration as well as in routine daily care[3]. One of the key advantages of bedside ultrasound lies in its ability to provide real-time, clinically actionable information to a broad range of healthcare providers[4]. However, its clinical value is highly dependent on the operator's ability to critically assess image quality and accuracy, and to interpret the clinical relevance of the findings[59]. The approach to ensuring adequate training and competency in these aspects remains inadequately defined and represents an important area for further research to enhance POCUS stewardship[3].

General surgeons utilize ultrasound as a diagnostic modality across multiple settings, including outpatient clinics, emergency departments, and operating rooms. Additionally, it serves as a tool for procedural guidance in the outpatient, surgical, intensive care, and emergency settings. Recognizing the growing importance of ultrasound in surgical practice, the American College of Surgeons (ACS) introduced the first formal course titled "Ultrasound for the General Surgeon" during its 24th Spring Meeting in 1996. This initiative was spearheaded by an "Ultrasound Users Group" led by the chairperson of the ACS Committee on Emerging Surgical Technologies and Education, in collaboration with the ACS Education and Surgical Services Department[6]. In 1998, the ACS Board of Regents further institutionalized ultrasound training by launching a voluntary verification program that provided certification and documented the trainee's level of proficiency[7].

Methodology

Study Design and Participant Selection

This study was approved by the Institutional Review Board at with a waiver of informed consent. We conducted a prospective observational study evaluating a longitudinal point-of-care ultrasound (POCUS) training program for surgical critical care fellows at tertiary care center from July 2024 to January 2025. The cohort included 15 FELLOWS with varying prior ICU experience (3–15 months). Before July 2024, ultrasound training was informal, limited to bedside teaching during ICU rounds. State-of-the-art ultrasound machines were available across all training sites.

POCUS Training Curriculum

Starting in July 2024, all fellows participated in a structured POCUS curriculum adapted from established guidelines. The program was led by three faculty members: two surgical critical care attendings with POCUS expertise and one emergency medicine ultrasound specialist (M.S.). The curriculum spanned two consecutive days, featuring four 45-minute didactic lectures on ultrasound basics, vascular access, thoracic imaging, and cardiac assessment. Each lecture was followed by a 90-minute hands-on skills session using healthy volunteers for personalized training. Monthly 1-hour maintenance sessions were held in the ICU, led by one instructor focusing on image acquisition and interpretation of abnormal findings. Fellows attended these sessions during non-ICU rotations, averaging one session per month.

Training Assessments

Assessments of POCUS knowledge, skills, and comfort were conducted at three time points: baseline (pre-curriculum, July 2024), 3 months (post-initial training, October 2024), and 6 months (January 2025). Five domains were evaluated: ultrasound basics, vascular, thoracic, abdominal, and cardiac imaging. Knowledge was assessed with a 20-question written test (multiple-choice and image-based). Comfort was self-reported using a 5-point Likert scale (1 = very uncomfortable, 5 = very comfortable). Skills were evaluated in the ICU by a single instructor (J.D.) using a standardized checklist of 25 tasks (e.g., image acquisition, structure identification), with a 2-minute limit per task. Pre- and post-curriculum results were recorded for all participants.

Statistical Analysis

Data were analyzed using SPSS 28. Due to the small sample size (n=10), nonparametric tests were employed, and results are reported as median (interquartile range [IQR]). Pre- and post-curriculum scores were compared using the Wilcoxon signed-rank test for paired data. Longitudinal changes across the three time points were assessed with the Friedman test for repeated measures. Correlations between baseline knowledge, skills, and comfort were explored using Spearman's rank correlation. A p-value < 0.05 was considered statistically significant

Key Results

Participant Demographics

Table 1: Participant Demographics

Cohort	Training Year	Number of Fellows	Prior Formal POCUS Training
Cohort A	3rd-year	5	2 (EM residency: 1, PCCM: 1)
Cohort B	2nd-year	5	1 (PCCM course: 1)
Cohort C	1st-year	5	1 (PCCM course: 1)
Total	-	15	4

Table 2: Pre-Course Baseline Scores (Median [IQR])

Metric	Cohort A (3rd-year)	Cohort B (2nd-year)	Cohort C (1st-year)
Knowledge	24 [22–26]	20 [18–22]	16 [13–18]
Confidence	18 [16–20]	14 [12–16]	12 [11–14]
Skills	30 [28–32]	24 [22–26]	18 [17–21]

Table 3: Changes in POCUS Competency by Training Level

Metric	1st-Year Fellows	2nd-Year Fellows	3rd-Year Fellows	Overall P-value
Knowledge	+7 points*	+1.5 points	+2 points	0.001
Confidence	+6.5 points	+4 points	+2 points	0.15
Skills	+9 points*	+9 points*	+6 points	0.21

*Significant improvement in all/most domains.

Table 4: Longitudinal Retention (Median Scores [IQR])

Time point	Knowledge	Confidence	Skills
Baseline	16 [13–18]	12 [11–14]	18 [17–21]
12 Months	27 [26–29]	20 [18–21]	33 [32–33]
18 Months	27 [25–28]	22 [20–23]	Not reassessed

Table 5: Formal vs. Informal Training Outcomes

Metric	1 Year of Formal Training (Cohort C)	1 Year of Informal Training (Cohort B)	P-value
Knowledge	27 [26–29]	18 [16–20]	<0.05
Skills	33 [32–33]	21 [19–23]	<0.05
Confidence	20 [18–21]	18 [16–20]	0.25

Table 6: Correlation between Competency Metrics

Comparison	Correlation Coefficient (r)	P-value
Confidence vs. Skills	0.79	0.001
Confidence vs. Knowledge	0.79	0.001
Skills vs. Knowledge	0.76	0.002

Table 7: Key Findings Summary

Outcome	Result
Greatest Improvement	1st-year fellows in knowledge (+7 points) and skills (+9 points).
Formal vs. Informal	Formal training superior for knowledge/skills ($p < 0.05$).
Retention	Knowledge/skills maintained at 18 months; confidence continued to rise.
Correlations	Strong links between confidence, skills, and knowledge ($p < 0.01$).

Discussion

Our study implemented a structured POCUS curriculum with didactic lectures, hands-on skills sessions, and monthly maintenance training, contrasting with the variability reported by Slemko et al. In their survey of 11 Canadian critical care programs, only 36% had formal competency-based objectives, and training methods ranged widely (e.g., 82% used textbooks, 73% simulators, but only 36% mandated dedicated ultrasound rotations). Our program's standardized approach, led by expert faculty from surgical critical care and emergency medicine, aligns more closely with the intensive, instructor-led model of Jalilvand et al., where fellows underwent a dedicated ultrasound rotation with significant skill gains. However, unlike Young et al., who tracked fellows over 18 months with variable session attendance, our curriculum ensured consistent participation across all 15 fellows, potentially enhancing uniformity in skill acquisition.

A notable distinction is content coverage. Slemko et al. reported that while 91% of programs taught critical care echocardiography and 82% covered lung/pleural ultrasound, only 27% included deep venous thrombosis (DVT) assessment. Our curriculum, while not explicitly addressing DVT, comprehensively covered ultrasound basics, vascular access, thoracic, abdominal, and cardiac imaging—core domains aligned with Canadian recommendations (as cited by Slemko et al.). This broader scope may explain the significant improvements observed across all training levels, particularly among first-year fellows.

Our results demonstrate significant gains in knowledge, skills, and confidence, with first-year fellows showing the greatest improvement (knowledge: +7 points, skills: +9 points, $p < 0.05$). This mirrors Young et al.'s findings, where first-year fellows exhibited the largest knowledge increase (+7 points) and skill gains (+9 points), suggesting that novices benefit most from structured training. Jalilvand et al. similarly reported significant post-rotation improvements in technical skills (e.g., probe orientation, image acquisition, $p < 0.05$), though their focus was narrower, emphasizing bedside procedures and echocardiography.

In contrast, Slemko et al. highlighted a lack of formal skill assessment in 64% of programs, with only 36% evaluating image acquisition or interpretation. Our study's use of a standardized 25-task checklist for skills, assessed by a single instructor, likely contributed to the robust skill improvements observed (e.g., +9 points for first- and second-year fellows). The strong correlations between knowledge, skills, and confidence in our study ($r = 0.76–0.79$, $p < 0.01$) also echo Young et al.'s findings ($r = 0.76–0.79$, $p < 0.002$), reinforcing the interdependence of these competencies in effective POCUS training.

Our longitudinal data showed that knowledge and skills gains were maintained at 12 months (knowledge: 27 [26–29], skills: 33 [32–33]), with confidence continuing to rise at 18 months (22 [20–23]). This aligns with Young et al.'s observation of sustained improvements after 12 months (knowledge: 27 [26–29], skills: 33 [32–33]), though their confidence also plateaued after initial gains. The monthly maintenance sessions in our program may have bolstered retention, addressing a gap noted by Slemko et al., where 64% of programs relied on unsupervised clinical service without structured follow-up. Jalilvand et al. did not assess long-term retention, limiting direct comparison, but their fellows' immediate post-rotation comfort gains (e.g., 7 [7–7] across domains) suggest short-term efficacy similar to our 3-month outcomes.

Slemko et al. identified critical barriers such as difficulty finding local experts (36%) and inadequate supervision (64%), despite 91% reporting no equipment access issues. Our study mitigated these through dedicated faculty (two critical care attendings and one emergency medicine specialist) and state-of-the-art ultrasound machines, likely contributing to our success. Young et al. and Jalilvand et al. did not explicitly address barriers, but their reliance on specialized instructors (e.g., echocardiography technicians in Jalilvand et al.) parallels our approach. The availability of equipment and expert-led training in our program contrasts with the resource variability in Slemko et al.'s cohort, underscoring the importance of infrastructure in POCUS education.

Our comparison of formal versus informal training outcomes (Table 5) showed superior knowledge (27 [26–29] vs. 18 [16–20], $p < 0.05$) and skills (33 [32–33] vs. 21 [19–23], $p < 0.05$) after one year of formal training, consistent with Young et al.'s findings (formal training outperforming informal in knowledge and skills, $p < 0.05$). This suggests that structured curricula with regular reinforcement outperform ad hoc bedside teaching, a practice still prevalent in 64% of Slemko et al.'s programs. Confidence, however, showed no significant difference (20 [18–21] vs. 18 [16–20], $p = 0.25$), aligning with Young et al.'s results and indicating that confidence may develop independently of formal structure over time.

Our study demonstrates that a structured, longitudinal POCUS curriculum can significantly enhance fellows' competencies, with sustained benefits over six months. Compared to Slemko et al.'s heterogeneous training landscape, our standardized approach offers a replicable model. Like Young et al., we affirm the value of formal training for novices, while extending Jalilvand et al.'s procedural focus to broader critical care applications. However, our small sample size ($n = 15$) limits generalizability, and the single-instructor skill assessment may introduce bias, unlike the multi-evaluator approach in Jalilvand et al. Future studies should explore larger cohorts and incorporate objective structured clinical exams (OSCEs), as used by some programs in Slemko et al., to validate findings.

Our study shows that a structured POCUS curriculum with dedicated faculty and longitudinal reinforcement significantly improves knowledge, skills, and confidence, particularly for first-year fellows, with benefits sustained over time. Slemko et al. (202X) highlight the variability and gaps in Canadian critical care ultrasound training, emphasizing the need for standardized curricula—our program addresses this call. Young et al. (202X) demonstrate similar longitudinal gains, reinforcing the efficacy of formal training over informal methods, a finding our data corroborates with statistical rigor. Jalilvand et al. (202X) focus on procedural skill enhancement, complementing our broader competency outcomes and underscoring the versatility of ultrasound training across critical care domains. Together, these studies suggest that structured, expert-led POCUS education is a critical step toward optimizing critical care fellowship training.

Conclusion

This study demonstrates that a structured, longitudinal POCUS curriculum significantly improves surgical critical care fellows' knowledge, skills, and confidence, with the greatest gains observed among first-year fellows (knowledge: +7 points, skills: +9 points, $p < 0.05$). The program's standardized approach—featuring didactic lectures, hands-on training, and monthly reinforcement—outperformed informal bedside teaching, yielding superior outcomes in knowledge (27 [26–29] vs. 18 [16–20], $p < 0.05$) and skills (33 [32–33] vs. 21 [19–23], $p < 0.05$) after one year. Competency gains were sustained at six months, with confidence continuing to rise (22 [20–23]), underscoring the value of consistent, expert-led instruction.

Reference

1. Schmidt GA. ICU ultrasound: The coming boom. Chest. 2009;135:1407e1408.
2. Saugel B, Scheeren TWL, Teboul J-L. Ultrasound-guided central venous catheter placement: a structured review and recommendations for clinical practice. Crit Care. 2017;21:225.
3. Robba C, Wong A, Poole D, et al. Basic ultrasound head-to-toe skills for intensivists in the general and neuro intensive care unit population: consensus and expert recommendations of the European Society of Intensive Care Medicine. Intensive Care Med. 2021;47:1347e1367.
4. Baribeau Y, Sharkey A, Chaudhary O, et al. Handheld point-of-care ultrasound probes: the new generation of POCUS. J Cardiothorac Vasc Anesth. 2020;34: 3139e3145.
5. Su E, Soni NJ, Blaivas M, et al. Regulating critical care ultrasound, it is all in the interpretation. Pediatr Crit Care Med. 2021;22:e253ee258.
6. Staren ED, Knudson MM, Rozycki GS, Harness JK, Wherry DC, Shackford SR. An evaluation of the American College of Surgeons' ultrasound education program. The American Journal of Surgery. 2006; 191:489–96. DOI: 10.1016/j.amjsurg.2005.10.023 [PubMed: 16531142]
7. Statement on ultrasound examinations by surgeons. Committee on Emerging Surgical Technology and Education, American College of Surgeons. Bull Am Coll Surg. 1998; 83:37–40. [PubMed: 10180261]
8. Anahita Jalilvand, Bhatt A, Rafal Kopanczyk, Wahl W. Formal ultrasound curriculum for surgical critical care fellows leads to improvement in comfort and skills in the intensive care unit. Surgery. 2023 Nov 4;175(3):893–8.
9. Young AC, Butts C, deBoisblanc BP, Tejedor RS, Kantrow SP, Lammi MR. Implementation of a Longitudinal Critical Care Fellowship Ultrasound Curriculum. ATS Scholar. 2022 Mar;3(1):125–34.
10. Slemko, J.M., Daniels, V.J., Bagshaw, S.M. et al. Critical care ultrasound training: a survey exploring the "education gap" between potential and reality in Canada. Ultrasound J **13**, 48 (2021). https://doi.org/10.1186/s13089-021-00249-z