

A bidirectional virtual teaching platform for postgraduate Point-of-Care Ultrasound training: a proof-of-concept study

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Implication Statement

Point-of-Care Ultrasound (POCUS) has become an important modality for procedural guidance and patient diagnostics. However, rural postgraduate trainees in Canada who need to acquire these knowledge and skills face barriers to accessing POCUS training, in part because of a lack of qualified onsite teaching faculty. To help address this issue, our study describes a novel, relatively easy to implement, approach to teach POCUS to postgraduate trainees who do not access to the resources at larger, more well-funded sites. This allows experienced POCUS instructors to teach remotely, which would improve access to POCUS training for both medical learners in remote sites and continuing professional development for rural physicians. Additionally, it offers a cost-effective solution that reduces travel-related expenses for both trainees and faculty. It also provides a unique approach to remote medical education and ongoing skill development.

Énoncé des implications de la recherche

Résumé français à venir.

Introduction

Rural hospitals often lack access to diagnostic equipment, which negatively impacts patient care and outcomes. Integrating point-of-care ultrasound (POCUS) in these settings can empower healthcare providers by improving their diagnostic confidence, improving quality of care provided, and reducing reliance on external imaging services.¹ As interest grows in POCUS curricula for rural settings, in-person hands-on training remains impractical. Rural clinicians often face barriers such as insufficient

training and a lack of local mentors, which can hinder POCUS adoption.²

Current remote training setups are typically expensive, with handheld POCUS devices costing \$1,000-\$4,000, posing a barrier for resource-limited settings.³ Unequal access to training opportunities and mentors, who are predominantly based in urban centers, exacerbates disparities in POCUS expertise between urban and rural medical residents. Additionally, various POCUS training methods use proprietary mobile platforms such as

Butterfly iQ[®] and Lumify,[®] but these platforms are limited by technological issues and high costs.^{1,4-6} Our study tested a simplified bidirectional tele-POCUS instruction model for postgraduate medical residents, offering an interactive virtual POCUS education method tailored to rural settings.

Innovation

In this proof-of-concept study, participants rotated through nine hands-on stations and one virtual station using our bi-directional camera setup. In the virtual setup, the instructor and learner were in separate rooms and connected via standard video conferencing software (e.g., WebEx[®]). Each room had one computer connected to a USB webcam, which captured an overhead view of the standardized patient so that both rooms could demonstrate and view probe placement. A second computer was connected to a standard cart-based POCUS (Sonosite[®] Edge 2) via a low-cost image capture adapter (UltraStream 4K HDMI to USB 3.0 Capture Card; \$19.99) so each room could see the images displayed on the other's POCUS screen (Appendix A). The virtual station modeled and taught all core acute care ultrasound topics from the Canadian Point-of-Care Ultrasound Society (CPOCUS)

curriculum, which is designed specifically for physicians with no prior ultrasound experience but has been widely used as well in introductory POCUS courses for medical students and residents.

The study was approved by the Human Research Ethics Board (HREB) standards at Memorial University of Newfoundland (Reference # 2022.154). All participants signed an informed consent form prior to participation.

Outcomes

We tested the bi-directional setup with 18 first-year family medicine residents attending the Discipline of Emergency Medicine introductory POCUS course at Memorial University of Newfoundland. All participants engaged in the in-person and virtual stations and anonymously completed a post-course evaluation survey. Nearly all participants (94%) had limited prior experience with POCUS. All learners (100%) noted it was easy to interact with the instructor using the virtual set-up and 88% agreed the virtual POCUS set-up was just as interactive as the in-person teaching. Only 11% felt the virtual set-up was less effective than the in-person instruction (Table 1).

Table 1. In-Person and Virtual POCUS station participant survey results

Questions	Easy	Neither Easy nor difficult <i>n</i> (%)	Not easy
At the <i>virtual station</i> , how difficult or easy was it to follow the directions of the instructor?	17 (94.4)	1 (5.6)	-
At the <i>virtual station</i> , how difficult or easy was it to interact with the instructor?	18 (100)	-	-
At the <i>virtual station</i> , how difficult or easy was it to ask the instructor questions?	18 (100)	-	-
	Agree	Neither agree nor disagree <i>n</i> (%)	Disagree
At the <i>in-person station</i> , I was able to learn hand positioning effectively	18 (100)	-	-
At the <i>in-person station</i> , I was able to learn external and internal landmarking effectively	18 (100)	-	-
At the <i>in-person station</i> , I was able to learn image generation effectively	18 (100)	-	-
At the <i>virtual station</i> , I was able to learn hand positioning effectively	9 (50)	2 (11.1)	7 (38.9)
At the <i>virtual station</i> , I was able to learn external and internal landmarking effectively	18 (100)	-	-
At the <i>virtual station</i> , I was able to learn image generation as effectively as at the in-person station	14 (77.8)	1 (5.6)	3 (16.7)
At the <i>virtual station</i> , I was able to receive specific corrections/feedback from the instructor while I was scanning	12 (83.3)	3 (16.7)	-
I felt that the virtual teaching was just as interactive as in-person teaching	16 (88.8)	-	2 (11.1)
At the <i>virtual station</i> , I was able to receive specific corrections/feedback from the instructor while I was scanning	9 (50)	3 (16.7)	6 (33.3)
	Likely	Neither likely nor unlikely <i>n</i> (%)	Unlikely
How likely would you participate in a POCUS course taught only via virtual instruction?	14 (77.8)	2 (11.1)	2 (11.1)
How likely would you pursue your C-POCUS IP* certification if you could have a practice scan signed off virtually?	16 (88.8)	-	2 (11.1)
How likely would you be to pursue your C-POCUS IP certification if you could do the exam virtually?	17 (84.4)	-	1 (5.6)

*Note: Canadian POCUS Society Independent Practitioner (C-POCUS IP). Responses were originally on a 5-point Likert scale. However, due to a heavily skewed distribution, categories were combined for ease of interpretation and presentation.

Next steps

Our bidirectional virtual teaching platform is a relatively easier-to-implement option for rural and remote POCUS instruction using laptops, webcams, and a streaming adapter. The high degree of resident satisfaction with the bidirectional set-up indicates the virtual set-up may offer an effective alternative for delivering and learning POCUS skills.

A limitation of our study is having residents complete both the in-person and virtual training, which may have introduced bias, such as carryover. Residents' prior experiences with the in-person training could have influenced their performance and satisfaction with the virtual training, making it difficult to ensure a valid evaluation of the remote instruction. The next steps are a pilot study that compares learners taught only with the bidirectional setup, remote setup and those taught in person, then measuring the performance of the resident through an objective structured clinical exam (OSCE)-style assessment.

Conflicts of Interest: All authors declare that they have no conflicts of interest.

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Appendix A: POCUS set-up figure

Standardized Patient, Webex Screen, and POCUS Machine Set-Up for each room.



Note: The learner's and instructor's video outputs are displayed simultaneously on each other's screens. A computer is connected to a standard cart-based POCUS machine, the Sonosite Edge II, a highly portable, compact ultrasound device equipped with advanced image clarity and optimized for high-contrast imaging in point-of-care settings. Known for its rugged durability, the Edge II has fast boot-up times, which make it ideal for challenging environments often encountered in rural and emergency settings. Through a low-cost image capture adapter [UltraStream 4K HDMI to USB 3.0 Capture Card; \$19.99], this setup enables each room to view the other's POCUS screen, supporting hands-on training