Title: Training non-expert users in cardiopulmonary point-of-care ultrasound using a longitudinal virtual curriculum and tele-consultation model: A multicentre study across Canada

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Background: Disparities in access to post-graduate point-of-care cardiopulmonary ultrasound (POCUS) training have limited uptake by non-specialists in remote care centres. This multicentre pre-test post-test study evaluated the skill improvement of learners after participating in a longitudinal and virtual POCUS training program.

Methods: Non-expert POCUS users were recruited at urban teaching hospitals and geographically remote hospitals/nursing stations across four Canadian provinces (Ontario, Manitoba, Saskatchewan, Alberta). As part of a 'hub-and-spoke' model, each geographically isolated hospital or nursing station (spoke) partnered with a Canadian university in the same province (hub) to provide consultation services from experts within their affiliated hospitals during the training period (Figure 1A). The three-week educational program consisted of e-learning, independent imaging practice, and point-of-care tele-ultrasound (tele-POCUS) consultations with experts during clinical encounters (Figure 1B). Standardized assessments were used to evaluate image acquisition, quality, and interpretation for cardiac and lung/pleura POCUS (as measured on a 5-point Likert scale). To evaluate POCUS skill improvement after program completion and remotely delivered guidance via tele-POCUS, pre- and post-test scores were compared using the Wilcoxon signed-rank test.

Results: Among 29 learners, 17 (41% female) completed the training program, of which 7 practiced in remote hospitals/nursing stations. For cardiac POCUS, pre- and post-training assessments noted improvements in image acquisition (mean scores: 3.02 to 4.48, p<0.01), quality (2.49 to 4.06, p<0.01), and interpretation (3.03 to 4.44, p<0.02). Improvements in image acquisition (3.27 to 4.63, p<0.01), quality (3.25 to 4.53, p<0.01), and interpretation (2.65 to 4.18, p<0.01) were also noted for lung/pleura POCUS. A total of 153 tele-POCUS consultations (77 cardiac and 76 lung/pleura) were performed. Image acquisition improved after remote guidance was provided to learners using tele-POCUS (all p<0.01). Results were similar in analyses stratified by geographical setting. Most learners agreed or strongly agreed that tele-POCUS was easy to use (82%), clinically relevant (92%), and useful (88%).

Conclusion: Cardiopulmonary POCUS can be successfully taught to learners in diverse geographical settings using a virtual training format and tele-POCUS. This novel program addresses Canada's geographic barriers to imaging by leveraging virtual POCUS training to reduce transport costs and enhance timely diagnosis and management.



Figure 1. ARCTICA program hub-and-spoke model (A) and timeline (B). ARCTICA: Accelerated Remote Cardiopulmonary Tele-POCUS; Tele-POCUS: point-of-care tele-ultrasound.