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Training Community Paramedics to Remotely Acquire Lung & Inferior Vena Cava Point-of-Care Ultrasound to Support Physicians' Clinical Decision-Making on Hospital at Home

Michelle N. Grinman MD, FRCPC, MPH[1,2], Steve Reid B.Eng[3] ,Dennis Moon ACP[2], Suean Pascoe, B.App.Sc-MRT, AMS, FAIUM[4], Oladoyin Olaosebikan, MBBS[1], Negar Dehghan Noudeh MBT [5], Salome Saunders, MBT[1], Amanda Ip MSc[1], Amanda Raven, M.S.I.E.[2], Eryn Libert-Scott, BEng[1], Katelyn Wiley PhD[2], Ryan Kozicky B.Sc., MPH, EMT-P[2], Michele Smith BSc & ACP[2], Andrew Kirkpatrick CD MD MHSc, FRCSC, FACS[1,2], John Conly MD DSc CCFP FRCPC FCAHS FAMMI FIDSA FSHEA FACP [1,2], Jeff Round, PhD[6,7], Irene Ma, MD, PhD, FRCPC, FACP, RDMS, RDCS[1,2], Tin-Shan Chung MSc(c) ACP[2], Ghazwan Altabbaa, MD FRCPC MSc[1,2]

1) University of Calgary; 2) Alberta Health Services; 3) Presuna; 4) Zedu Ultrasound Training Solutions; 5) University of Toronto 6)Institute of Health Economics 7) University of Alberta

Background

Point of care ultrasound (POCUS) is portable, without risk of radiation exposure, and able to diagnose congestive heart failure (CHF).[i,ii] Advances in handheld ultrasound devices and trials of image acquisition by non-expert personnel and patients have paved the way for innovative uses of POCUS on Hospital at Home (HAH).[iii,iv]

Project Objectives:

1) To design, deploy, and evaluate a blended curriculum model for Community Paramedics (CPs) to acquire lung & inferior vena cava (IVC) POCUS and for physicians to interpret acquired images. This curriculum consisted of multiple components offered in the following order:
   a) On-line module - Canadian Point-of-Care Ultrasound Society[v]
   b) Classroom instruction on lung and IVC POCUS basics
   c) Presuna training session (60-minute videoconference).
   d) In-person training with Internal Medicine POCUS expert MDs (~90-min) & intermittent mentorship.
   e) Asynchronous feedback on quality of image acquisition and interpretation to both CP and MD participants.
2) To evaluate the feasibility and usability of CP-acquired images for clinical decision-making for patients on HAH with congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD) and pneumonia.

Note: *Pandemic and new electronic health record created challenges in delivering the originally planned training with POCUS experts. There project team pivoted to train-the-trainer approach with intermittent expert teaching.*

Methods

Cross-sectional, mixed methods evaluation of curriculum, usability (human factors) and a RCT to evaluate the ability to incorporate lung and IVC on clinical decision-making in the management of heart failure, COPD and pneumonia (Note: RCT is in progress and not reported here).

Setting: Hybrid in-person/remote HAH at 2 tertiary hospitals in Calgary, Canada.

Educational Assessment:

1. Survey and focus group to assess CP experience and confidence in POCUS image acquisition.
2. A standardized check-list was used by Zedu Ultrasound Solutions to assess the quality of image acquisition (technical ability, scanning skill, and interpretability) and physician competency of interpretation of normal and abnormal findings.

Usability and Feasibility Testing:

1. Simulation-based mock clinical scenarios used for testing workflow and process of acquiring, uploading, and receiving images prior to deployment in clinical setting.
2. Human Factors assessment of usability of CP-acquired POCUS images on Presuna by POCUS expert and non-EXPERT physicians on a variety of device platforms.

Demographics/Community Paramedics Characteristics

Convenience Sample (n =6)	
Sex (Female, %)	3, 50.0%
Age (Mean Years, Range)	49.3, [41 – 59]
Community Paramedic Experience (Mean Years, Range)	6.5, [2 – 12]
General Paramedic Experience (Mean Years, Range)	26, [20 – 40]
Previous Ultrasound Training (Yes, %)	1, 16.7%
Ultrasound Favorability (Mean Likert, Range)	4.5 [3 – 5]

Likert scale: 1-Not at all, 2-very little, 3-neutral, 4- quite a bit, 5-completely

Focus Group Feedback

Successes

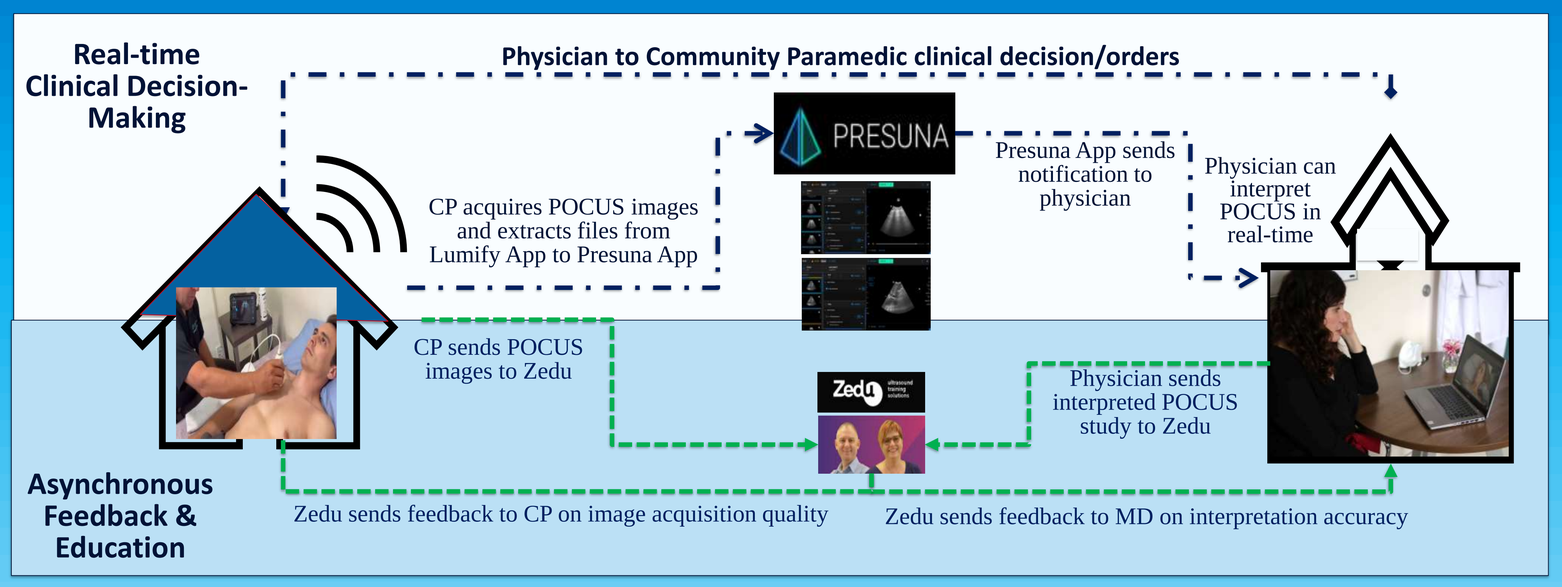
- Real-time training with POCUS expert MDs in-person / HAH MD virtual consultation was effective for learning & confidence building.
- CPs created own communication and support group to share tips and tricks, as well as learning from a broader range of cases.
- CPs felt patient assessment / care significantly benefits of incorporating POCUS into clinical decision-making.
- Blended model empowered CPs to learn this new skill and made them feel capable.

Challenges

- Training felt "scattered" with reliance on virtual modalities while arranging for MD in-person training in hospital. This made the CPs question when their training was completed and/or sufficient.
- CP training time varied (due to CP recruitment, and access to MDs/HAH patients) → at times hindering ability to build on prior learning.
- Asynchronous feedback was appreciated but required more explicit instructions from Zedu on how to meet the standardized rubric.
- Feedback focused on the quality and completeness of image acquisition, but CPs preferred receiving feedback about how practically the image was directly pertinent in making clinical decisions.
- Technological challenges including exporting data from Lumify to Presuna App, which initially required CPs to go in pairs to deal with the delays and troubleshooting.
- Ergonomics, condition of the home and patient comfort (e.g.: gender dynamics) added to CP cognitive load.

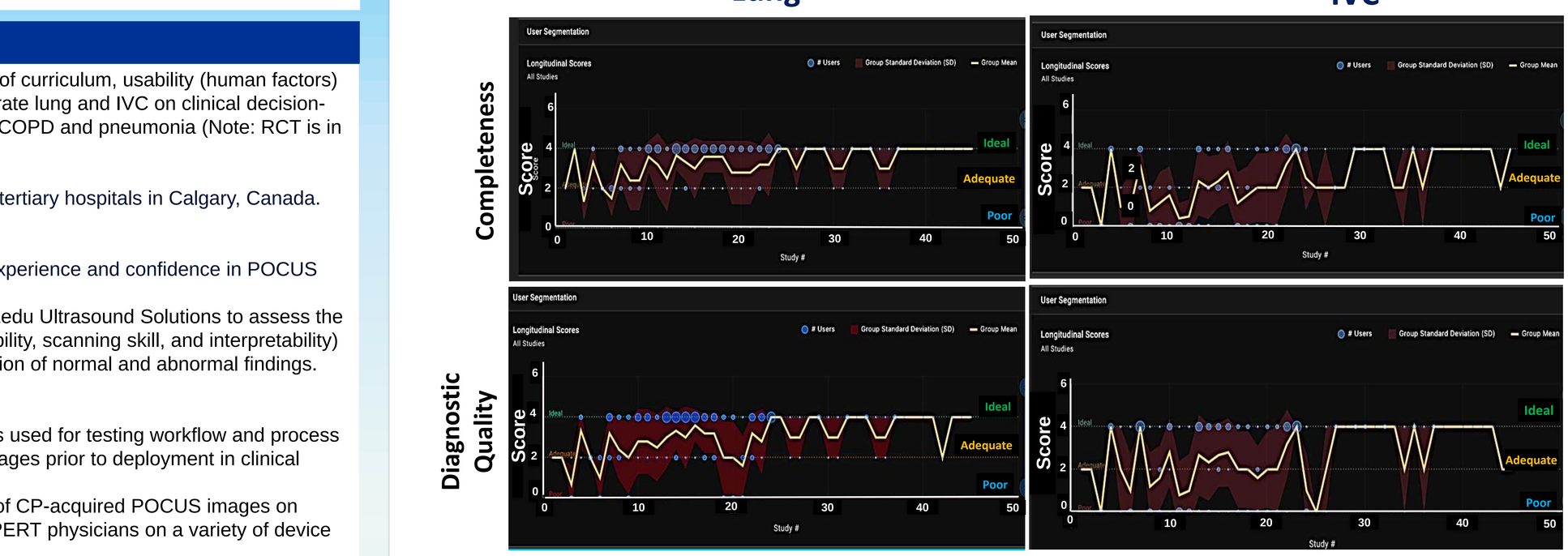
Recommendations

- Continue to refine blended model with more structure
- More real-time feedback (whether in person or virtual with MDs)
- More formal structure for training including graded patient pathology to meet increasing skills of learner and for learners that may not be as adaptable as CPs;
- Ensure clear communication during asynchronous feedback;
- Limitations of technology were addressed through cheat sheets, ongoing improvements to Presuna software, instructional videos.

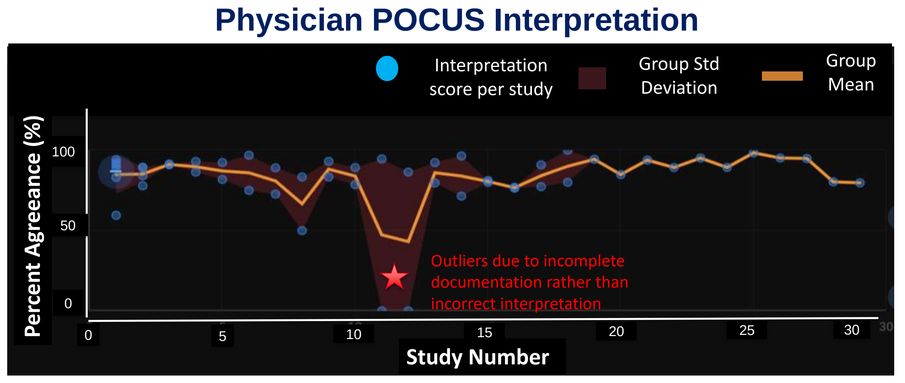


Competency Assessment

Community Paramedic POCUS Acquisition Skill Assessment



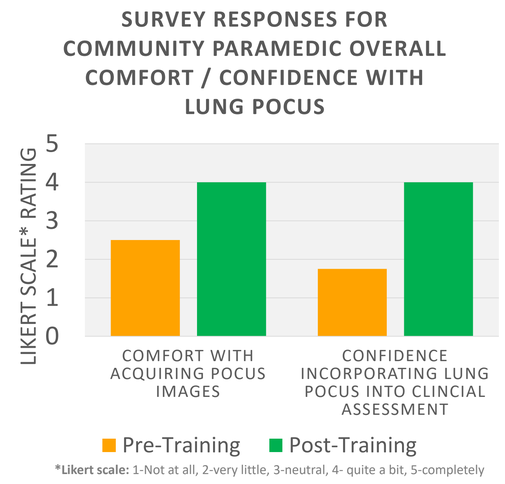
Physician POCUS Interpretation



% Agreeance = proportion of correct responses compared to Zedu assessment on standardized rubric
Study Number = # of studies each physician interpreted.

- Interpretation score varied more widely with the 1st few scans (from 60%-95%) and improved over time (80-100%)
- 2 MDs (trained trainers) that improved over time
- POCUS expert MDs showing good agreeance with rubric with only training on Presuna
- Reasons for variance:
  - Physician/Zedu entered "?" Vs "no"
  - Unexpected pathology/low image quality due to patient factors.

# Studies needed to be rated as:	Lung	IVC
"Adequate"	11	22
"Ideal"	25	27



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Discussion/Conclusion

- Necessary pivot to "train-the-trainer" hybrid training model caused disruptions in progress initially, but CPs were still able to become competent in lung/IVC POCUS acquisition with significant independent and shared learning.
- Competence for lung and IVC POCUS image acquisition was achieved earlier than expected.
- CP-acquired images able to be incorporated into clinical care in the RCT currently in progress. (Preliminary successes are diagnosis and monitoring of CHF/pleural effusions, acute pneumonia without escalation to hospital).

Next Steps

Human factors accuracy and usability study (final stages)

- Compares expert/non expert interpretation accuracy across devices
- Usability of CP-acquired images for clinical decision-making with mock cases

Real-world RCT (expected completion Dec 2024)

Real world trial for utility of lung and IVC POCUS enhanced HAH (intervention) vs usual HAH care (control).

Potential future research

- Other populations
- Artificial intelligence incorporation into Presuna
- Rural/remote HAH care applications

References:
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[iii] Swarmy, V., et. al. Eur J Cardiovasc Nurs, (Aug 2019). 18(6): 474-483.
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Contact: michelle.grinman@ucalgary.ca
Cumming School of Medicine, University of Calgary
Calgary Alberta, Canada