

Dedicated time for deliberate practice: one emergency medicine program's approach to point-of-care ultrasound (PoCUS) training

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ABSTRACT

Point-of-care ultrasound (PoCUS) has become an essential skill in the practice of emergency medicine (EM). Various EM residency programs now require competency in basic PoCUS applications. The education literature suggests that deliberate practice is necessary for skill acquisition and mastery. We used an educational theory, Ericsson's model of deliberate practice, to create a PoCUS curriculum for our Royal College of Physicians and Surgeons of Canada EM residency.

Although international recommendations around curriculum requirements exist, this will be one of the first papers to describe the implementation of a specific PoCUS training program. This paper details the features of the program and lessons learned during its initial 3 years. Sharing this experience may serve as a nidus for scholarly discussion around how to best approach medical education in this area.

RÉSUMÉ

L'échographie au point de service (EPS) est devenue une habileté essentielle dans la pratique de la médecine d'urgence (MU). Divers programmes de résidence en MU exigent maintenant l'acquisition de compétences dans des applications de base de l'EPS. D'après la documentation en éducation, la pratique intentionnelle serait nécessaire à l'acquisition et à la maîtrise de compétences. Les auteurs ont donc appliqué une théorie de l'éducation, le modèle de pratique intentionnelle d'Ericsson, pour élaborer un programme d'EPS dans le cadre de la résidence en MU du Collège royal.

Bien qu'il existe des recommandations internationales sur les exigences du programme, le présent article est le premier d'une série portant sur la mise en œuvre d'un programme particulier de formation en EPS. Il y sera question surtout des éléments du programme et des leçons tirées au cours des trois premières années de mise en œuvre. Ainsi, l'exposé de l'expérience vécue peut servir de matière à des discussions théoriques sur la meilleure façon d'aborder la formation médicale dans le domaine.

Keywords: Point-of-care Ultrasound, Education, Deliberate Practice

BACKGROUND

Recent surveys of Canadian emergency medicine (EM) residency programs have demonstrated heterogeneity amongst point-of-care ultrasound (PoCUS) curricula.¹⁻² The Royal College of Physicians and Surgeons of Canada (RCPSC) EM objectives of training include competency in the following PoCUS applications:

- Facilitation of vascular access
- Presence of intraperitoneal free fluid
- Measurement of abdominal aorta diameter
- Presence of pericardial fluid
- Presence of cardiac motion
- Confirmation of intrauterine gestation³

The Canadian Association of Emergency Physicians (CAEP)⁴ and The College of Family Physicians of Canada (CFPC)⁵ also recognize PoCUS as a core EM skill. To date, few papers have reported implementation-level descriptions of PoCUS curricula.

RATIONALE

Deliberate practice is a dominant educational framework for procedural learning.⁶ K. Anders Ericsson proposed a model that explains the evolution of procedural learning and performance over time.⁶ Using Ericsson's model, we implemented a competency-based, residency-level, PoCUS curriculum grounded in

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his education theories. Our program facilitates the completion of the RCPSC PoCUS objectives³ as a minimum competency, with optional extension to include more advanced applications as per national and international guidelines.^{4,7-9}

DESCRIPTION OF THE INNOVATION

We developed a unique curriculum for PoCUS education in the RCPSC EM residency program at McMaster University, based on Ericsson's model. The stages of this model and how they map to our curriculum are summarized in Table 1.

In PGY-1 or early PGY-2, residents are introduced to PoCUS through a 1-day basic course with pre-readings, interactive lectures, and supervised hands-on practice. Within several weeks of the introductory

course, the residents are provided with more deliberate practice during a 9-hour scanning day. They scan more than 50 volunteers under the direct observation of PoCUS-credentialed faculty. We provide an instructor-to-participant ratio of 1:2, permitting frequent feedback with immediate integration through subsequent practice. A pelvic mannequin is provided to facilitate practice of transvaginal exams. The residents also participate in a 1-hour interactive case review to encourage their understanding of PoCUS within a clinical context.

Next, residents complete a mandatory PGY-2 core rotation lasting 4 weeks (see Figure 1). Residents are provided with CanMEDS-based rotation objectives, competency assessment tools (e.g., observed structured assessment of technical skills, or OSATs), recommended resources, including selected text and journal readings, and case-based presentations.

Table 1. Mapping Ericsson's model to our PoCUS curriculum

| Level of Expertise | Features of the Stage | Features of Ericsson's Model | Where it is in our Curriculum? |
|--------------------|---|--|--|
| Novice | <ul style="list-style-type: none"> • Instruction by teacher • Applies rules • Performs procedures step-by-step | <ul style="list-style-type: none"> • Well-defined task of mastering specific PoCUS techniques outside of clinical environment • Direct observation by experts with effective feedback • Opportunities for repetition and refinement of technique in low-stakes, simulated environment | <p><i>Introductory Course and Scanning Day</i></p> <ul style="list-style-type: none"> • 1 day duration • In either PGY1 or early PGY2 (pre-requisite for PGY2 Mandatory Core Rotation) |
| Intermediate | <ul style="list-style-type: none"> • Same outcomes but faster and more efficient | <ul style="list-style-type: none"> • More practice, with same well-defined task, now within clinical environment • Direct observation by experts with effective feedback from variety of PoCUS-capable mentors • Opportunities for repetition and refinement of technique in amply supervised real clinical environment | <p><i>PGY2 Mandatory Core Rotation</i></p> <ul style="list-style-type: none"> • 1 month duration • <i>Phase 1:</i> Residents acquire specific scans without direct patient care responsibilities • <i>Phase 2:</i> Residents integrate new PoCUS skills during clinical shifts for patient care |
| Expert | <ul style="list-style-type: none"> • Rapid and intuitive for basic scans | <ul style="list-style-type: none"> • Direct observation by PoCUS-capable mentors throughout rest of residency | <p><i>PGY2-5 Clinical Practice</i></p> <ul style="list-style-type: none"> • Clinical shifts during other junior and senior Emergency Department rotations |
| Advanced Expert* | <ul style="list-style-type: none"> • Rapid and intuitive for scans | <ul style="list-style-type: none"> • Dedicated time to master new, advanced PoCUS techniques • Again, observation/mentorship with feedback by PoCUS experts • Opportunities for repetition and refinement of advanced techniques | <p><i>PGY4 Subspecialty Focus*</i></p> <ul style="list-style-type: none"> • 6 month duration |

*This phase is available only to selected residents who apply and are accepted into the subspecialty experience.
Acronyms: PGY = postgraduate year; PoCUS = point-of-care ultrasound

Phase 1: Dedicated Scanning Time

- Competency-based: self-scheduled and self-directed by the resident
- One-on-one teaching sessions with rotation supervisor and subspecialty residents
- Real-time supervision for all scans via direct observation or remote review
- Focus on basic scanning modalities and facilitation of vascular access

Phase 2: Integrated Clinical Ultrasound Shifts

- Scheduled shifts with staff physicians who integrate POCUS into their practice

Figure 1. PGY-2 mandatory core rotation phases

During the first 2 weeks of the rotation (Phase 1), the resident performs PoCUS examinations on patients in the emergency department with the sole objective of gaining experience in image generation and interpretation, and one-on-one mentorship using direct observation or near-real-time remote scan review. We use an online archiving system (Q-Path Ultrasound Data and Process Management Tool, Telexy Networks Inc., Richmond, BC) to facilitate this process. Prompt review allows continuous feedback that helps flag potential areas of difficulty early on. Alternatively, we can also identify the exceptional resident for whom advanced learning objectives can be offered. In this way, we can create individualized learning plans for each resident.

In the latter 2 weeks of the rotation (Phase 2), the resident performs clinical shifts alongside PoCUS-credentialed staff physicians. During this phase, the resident gains experience integrating PoCUS applications into their patient-care workflow.

We emphasize a self-directed approach where the residents are given competency-based objectives to complete within the 4-week period. Residents are required to complete 200 or more PoCUS scans to ensure an adequate level of exposure. When the residents feel confident in a particular modality, they can trigger a competency assessment using our locally derived OSATs.

During an OSAT, a PoCUS-credentialed assessor observes the resident as they perform a clinically relevant exam. A modality-specific checklist is completed to ensure that all major competencies are met (see example at <http://teresachan.mededlife.org/wp-content/uploads/sites/6/2014/04/Aorta-OSAT-Creative-Commons.pdf>, available for usage under creative commons license). Immediate feedback is provided. OSATs are used along with observations and feedback from supervising clinicians to inform the end-of-rotation report. If concerns about competency arise, the rotation supervisor

mandates further practice of the relevant skills until competency is achieved.

Finally, selected residents who have demonstrated interest and skill are eligible for an intensive 6-month subspecialty period where they train in advanced ultrasound applications, as suggested by the literature.^{8,9}

OUTCOMES

Since implementing our new PoCUS curriculum in 2011, we have had 24 residents progress through the PGY-2 core rotation. Of these, 100% achieved competency in the basic PoCUS applications, as outlined in the RCPSC. All of these residents performed 200 or more reviewed scans during the 4 weeks and accumulated the requisite scans to qualify for the Canadian Emergency Ultrasound Society (CEUS) independent practitioner exam.

Our old curriculum offered the introductory scanning course only. There was no other formal structure in place to support subsequent progression to competency. In the 3 years prior to this program, the median year to qualify for the CEUS exam was PGY-5, with 33% of residents unable to accomplish this during their residency training. In contrast, after implementation, every resident (100%) who completed the dedicated ultrasound rotation was able to qualify for the CEUS exam in PGY-2.

DISCUSSION

PoCUS is a procedural skill that we are still learning how to incorporate into educational programming.¹⁰ The “front-end” loading of deliberate practice early in EM residency is particularly advantageous and provides residents with more efficient routes to achieve PoCUS competency. Our curriculum for PoCUS education is a

model that could be easily integrated into existing EM residency programs.

SUMMARY

Integration of modern educational frameworks (Ericsson's Deliberate Practice,⁶ Competency-Based Medical Education⁸) can facilitate skill acquisition. After redesigning our PoCUS curriculum around the precepts of deliberate practice, our residents were able to achieve competency in all basic PoCUS applications during their junior years of training.

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