



# Point-of-care ultrasonography in Canadian anesthesiology residency programs: a national survey of program directors

## L'échographie au point d'intervention dans les programmes de résidence en anesthésiologie au Canada : sondage national des directeurs de programme

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### Abstract

**Purpose** Point-of-care ultrasonography (POCUS) is a useful tool with multiple perioperative applications relevant to the anesthesiologist. Nevertheless, the full scope of POCUS applications has yet to be formally incorporated into Canadian anesthesiology training. The purpose of this study was to determine the current state of POCUS training in Canadian anesthesiology residency programs.

**Methods** We conducted a web-based survey of program directors from Royal College-accredited anesthesiology residency programs across Canada. Respondents were asked about POCUS training and assessment strategies at their institution as well as perceived barriers to POCUS education. We also elicited program directors' views on the importance of various POCUS applications as well as future direction of POCUS education within Canadian anesthesiology residency programs.

**Results** Thirteen of 17 (76%) program directors responded to our survey. All respondents' residency programs provide some training in POCUS-facilitated vascular access, peripheral nerve blocks, neuraxial techniques, and transthoracic echocardiography. Nevertheless, training varies significantly for the other

POCUS applications in our survey. The most frequently quoted teaching method employed is informal bedside teaching, followed by structured expert demonstration, hands-on scanning, and didactic lectures. The most frequently quoted barrier to teaching POCUS is the lack of trained staff. The majority of respondents agreed that competence in POCUS is important for graduating anesthesiology residents, and that POCUS should be incorporated into the National Curriculum for Canadian Anesthesiology Residency.

**Conclusion** Point-of-care ultrasonography training within Canadian anesthesiology residency programs is highly variable. Given the importance of POCUS abilities and their relevance to modern anesthesia practice, POCUS training and assessment within Canadian anesthesiology residency programs should be formalized.

### Résumé

**Objectif** L'échographie au point d'intervention (POCUS) est un outil utile offrant de multiples applications périopératoires pertinentes pour l'anesthésiologiste. Toutefois, l'étendue des applications de l'échographie au point d'intervention n'est pas encore formellement intégrée dans la formation en anesthésiologie canadienne. L'objectif de cette étude était de déterminer l'état actuel de la formation en échographie au point d'intervention dans les programmes de résidence en anesthésiologie canadiens.

**Méthode** Nous avons réalisé un sondage en ligne destiné aux directeurs de programme des programmes de résidence en anesthésiologie certifiés par le Collège royal au Canada. Nous avons questionné les répondants concernant la formation en échographie au point d'intervention et les stratégies d'évaluation dans leur

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*établissement ainsi que les obstacles perçus à la formation en échographie au point d'intervention. Nous avons également demandé aux directeurs de programme leur opinion quant à l'importance de diverses applications de l'échographie au point d'intervention ainsi qu'à l'orientation future de la formation en échographie au point d'intervention dans les programmes de résidence en anesthésiologie canadiens.*

**Résultats** Treize des 17 (76 %) directeurs de programme ont répondu à notre sondage. Tous les programmes de résidence des répondants offrent de la formation fondée sur l'échographie au point d'intervention pour guider la réalisation d'accès vasculaires, de blocs nerveux périphériques, de techniques neuraxiales et de l'échocardiographie transthoracique. Notre sondage a toutefois révélé que la formation était très variable concernant les autres applications de l'échographie au point d'intervention. L'enseignement informel au chevet était la méthode d'enseignement la plus fréquemment citée, suivie des démonstrations d'experts, de l'échographie sur modèles et des cours pédagogiques. L'obstacle le plus fréquemment cité à l'enseignement de l'échographie au chevet était le manque de personnel formé. La majorité des répondants étaient d'accord sur le fait que des compétences en échographie au point d'intervention sont importantes pour les résidents en anesthésiologie terminant leur formation, et que l'échographie au point d'intervention devrait être intégrée dans le Programme national de résidence en anesthésiologie canadien.

**Conclusion** Au Canada, la formation en échographie au point d'intervention varie beaucoup d'un programme de résidence en anesthésiologie à un autre. Étant donné l'importance des compétences en échographie au point d'intervention et leur pertinence à la pratique de l'anesthésie moderne, la formation en échographie au point d'intervention et son évaluation devraient être formalisées dans les programmes de résidence en anesthésiologie canadiens.

The last several decades have seen the growing use of bedside ultrasound (US) within medical practice. In its infancy, the clinical use of US was limited largely to the domains of cardiology and obstetrics.<sup>1</sup> With refinements in US technology, however, the number of clinical US applications has expanded to include almost every medical specialty. Moreover, its noninvasive nature, portability, and safety profile have made US an indispensable tool for the modern-day physician.

Today, point-of-care ultrasonography (POCUS) is defined as real-time use of US by the physician at the patient's bedside for the purpose of answering a focused

clinical question or facilitating an invasive procedure.<sup>2</sup> POCUS is well established in emergency medicine with the Focused Assessment with Sonography for Trauma (FAST) examination. Relevant POCUS applications within anesthesiology and perioperative medicine include, but are not limited to, vascular access, facilitation of regional and neuraxial anesthesia techniques, transthoracic echocardiography (TTE), transesophageal echocardiography (TEE), lung ultrasonography (lung US), confirmation of endotracheal tube positioning (airway US), evaluation of gastric contents for aspiration risk (gastric US), assessment of intraperitoneal free fluid (abdominal US), and estimation of intracranial pressure via measurement of the optic nerve sheath diameter (ONSD).<sup>1-8</sup> These applications make POCUS a useful tool in the perioperative care of complex patients with the potential to alter patient management.<sup>9-12</sup>

Despite the utility of US technology in anesthesiology, training in POCUS at the postgraduate level has not kept pace with the rapidly growing number of POCUS applications. In contrast to Canadian emergency medicine and critical care medicine postgraduate training programs which have included POCUS as a learning objective,<sup>13,14</sup> POCUS training amongst the 17 Canadian anesthesiology residency programs accredited by the Royal College of Physicians and Surgeons of Canada (Royal College) has not yet been standardized. While there are elements of bedside US within the National Curriculum for Canadian Anesthesiology Residency (National Curriculum),<sup>15</sup> the scope is limited to "mainstream" uses, such as US-facilitated nerve blocks and vascular access, and is not representative of the full spectrum of perioperative POCUS applications. On this basis, we hypothesized that the current training of anesthesiology residents in POCUS across Canada is variable and informal.

While a recent correspondence has reported the results of a survey of focused cardiac ultrasonography (FoCUS) training in Canadian anesthesiology residency programs,<sup>16</sup> little is known about the broader perioperative applications of POCUS within anesthesiology training in Canada. Our study aimed to survey program directors of Canadian Royal College anesthesiology residency programs to evaluate the state of POCUS training across Canada, elicit barriers to learning POCUS, and identify potential core competencies in POCUS specific to anesthesiology.

## Methods

### Study procedures

Ethics approval for our study was obtained through the University of British Columbia Behavioural Research

Ethics Board (H16-01442, approved June 2016). The e-mail addresses of the 17 Canadian Royal College anesthesiology residency program directors were obtained online from the Royal College of Physicians and Surgeons website (<http://www.royalcollege.ca/rcsite/documents/arps/anesthesia-e>) and cross-referenced for accuracy with the e-mail list obtained from the program director at the authors' institution. Program directors were invited to participate in the study via an initial recruitment e-mail with a link to a 15-question survey (Appendix) hosted on the online survey instrument, FluidSurveys™ (<https://fluidsurveys.com>). This was distributed via e-mail in October 2016, with a subsequent reminder e-mail sent every two weeks thereafter for a total of four reminders. Because a turnover of program directors at several residency programs occurred during this time period, additional invitations were sent to the newly appointed program directors if a response had not already been received from their residency program. To optimize the response rate, all respondents were entered into a random draw for one \$50 gift certificate, which was delivered via e-mail to the winner of the draw. All responses were collected using FluidSurveys and kept confidential.

### Survey development

The survey questions were designed to address five areas with the following specific goals: 1) to describe existing POCUS training at the residency program; 2) to describe existing POCUS assessment methods at the residency program; 3) to elicit barriers to training residents in POCUS; 4) to obtain program directors' views on core POCUS applications relevant to anesthesiology; and 5) to obtain program directors' views regarding future training and assessment of anesthesiology residents in POCUS.

Survey content was generated following a literature review of relevant publications on POCUS education amongst postgraduate training programs of various specialties.<sup>1-6,14,17-33</sup> We additionally looked at published<sup>34-36</sup> and unpublished<sup>A</sup> curricula of several anesthesiology-oriented POCUS courses to identify other possible perioperative POCUS applications relevant to our study. Survey content was further refined and simplified following review of the questions with six faculty anesthesiologists at the authors' institution. A preliminary online version of the survey was created on FluidSurveys and pilot-tested for clarity and flow by three faculty anesthesiologists, including a former program director,

prior to finalization of the survey. Our survey employed multiple-choice questions, a five-point Likert scale, and free-form text commentary in order to assess the state of POCUS use and education at each residency program (Appendix).

### Statistical analysis

Survey data were stored on the FluidSurveys host server and downloaded for analysis following completion of data collection. Data were analyzed using Microsoft Excel (Microsoft, Redmond, WA, USA). Graphs were created using GraphPad Prism version 7.02 (GraphPad Software, San Diego, CA, USA). Descriptive statistics, including mean, standard deviation (SD), frequencies, and percentages, were reported as appropriate.

### Results

Thirteen of 17 (76%) program directors responded to the survey. These 13 programs represent 493 anesthesiology residents in postgraduate years 1 through 5.

### Point-of-care ultrasonography training across residency programs

The Table lists the POCUS applications selected for our survey of programs directors. All responding program directors (13/13, 100%) stated that POCUS training is provided for arterial and venous access, peripheral nerve blocks, neuraxial blocks, and TTE. Training in lung US, inferior vena cava (IVC) assessment, and TEE is provided at 12/13 (92%) programs. The other POCUS applications in our survey are much less commonly taught.

Informal bedside instruction is by far the most commonly used training method for teaching POCUS. Formal instruction, when provided, most commonly occurs in the form of didactic lectures, structured hands-on scanning, and structured expert demonstration. Image/video review and simulation are most routinely used for teaching TTE compared with any other POCUS modality, with 62% (8/13) and 69% (9/13) of programs reporting use of these training modalities, respectively. Additionally, 77% (10/13) of residency programs reported providing TTE training by means of either mandatory ( $n = 5$ ) or elective ( $n = 5$ ) rotations in TTE. Similarly for TEE, 62% (8/13) of residency programs offer either mandatory ( $n = 2$ ) or elective ( $n = 6$ ) rotations to their residents. Notably, a clinical rotation in US-guided regional anesthesia is provided at only 10 (77%) programs, although this is mandatory in all of these programs.

<sup>A</sup> Proposal for one-day perioperative ultrasound workshop for Canadian Anesthesiologists' 2016 Annual Meeting. Obtained via e-mail in September 2016 from the Canadian Anesthesiologists' Society, with permission from Dr. M. Meineri.

**Table** POCUS applications taught in the Canadian anesthesiology residency programs in our survey

POCUS application	No. of residency programs providing training*
Arterial access	13/13 (100%)
Venous access	13/13 (100%)
Peripheral nerve blocks	13/13 (100%)
Neuraxial blocks	13/13 (100%)
TTE	13/13 (100%)
IVC assessment	12/13 (92%)
Lung ultrasonography	12/13 (92%)
TEE	12/13 (92%)
Abdominal ultrasound <sup>†</sup>	8/13 (62%)
Airway ultrasound <sup>‡</sup>	3/13 (23%)
Gastric ultrasound <sup>§</sup>	4/13 (31%)
ONSD <sup>  </sup>	1/13 (8%)

IVC = inferior vena cava; ONSD = optic nerve sheath diameter; POCUS = point-of-care ultrasonography; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography

\*Training methods listed in our survey: informal bedside teaching, online modules, lectures, simulation, structured expert demonstration, structured hands-on scanning, video/image review, mandatory ultrasound-based rotation, elective ultrasound-based rotation, extracurricular POCUS course

<sup>†</sup> for intraperitoneal free fluid

<sup>‡</sup> for confirmation of endotracheal tube position

<sup>§</sup> for assessment of gastric contents

<sup>||</sup> for assessment of intracranial pressure

Six of 13 (46%) programs have specific requirements for hours of formal POCUS training and/or an expected number of POCUS scans by completion of residency. In particular, TTE training requirements stood out as the most well-defined. Two programs require at least 15 hr of formal TTE training with at least 25-50 scans. Another program specifies > 15 hr of formal training but no requisite specific number of scans. A third requires  $\geq 50$  scans but no requisite hours of formal training. A fourth specifies one to five hours of formal TTE training only. Notably, only one

program provides broad perioperative POCUS training with requirements for hours of formal training *and* an expected number of POCUS studies by completion of residency. At this program, specific training requirements are outlined for TTE (>15 hr; 25-50 scans), TEE (1-5 hr; 30-40 scans), IVC assessment (1-5 hr; 20-25 scans), lung US (6-10 hr; 6-10 scans), abdominal US (< 1 hr; 1-5 scans), and ONSD assessment (< 1 hr; 1-5 scans).

Program directors were asked about availability of funding for extracurricular POCUS training (e.g., POCUS workshops offered during conferences or by other academic institutions). Only one program has funding dedicated specifically for extracurricular POCUS training, while six of 13 (46%) programs have non-specific funding available which could be purposed towards extracurricular POCUS training. Five other programs have no funding available. One respondent was unsure of funding availability.

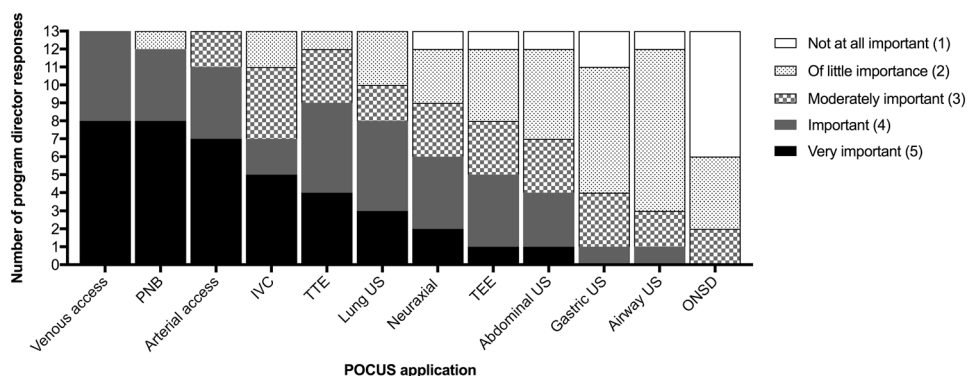
#### Assessment of POCUS skills across residency programs

Only two of 13 (15%) programs have strategies in place for a formal assessment of residents' abilities in POCUS. One program assesses residents' skills in arterial and venous access, peripheral nerve blocks, neuraxial blocks, TEE, lung US, and IVC assessment. This is accomplished through direct observation and supervision, a required number of procedures, US image and video review, a formal written exam, and a formal practical exam. The other program has a mandatory TTE rotation with formal assessment of residents' abilities achieved via direct observation, a required number of scans, US image and video review, and a formal written exam.

#### Program directors' views of POCUS

Program directors were asked to rate the importance of trainees achieving competence in each of the POCUS applications in the survey by the time they complete residency (Fig. 1). Competence was defined for respondents

**Fig. 1** Program directors' views on the importance of competence in various point-of-care ultrasonography (POCUS) applications by end of residency. IVC = inferior vena cava; ONSD = optic nerve sheath diameter; PNB = peripheral nerve block; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; US = ultrasound



as “the ability to independently obtain and interpret US imaging to answer a focused clinical question or to facilitate a procedure.” At least 85% (11/13) of program directors considered competence in arterial access, venous access, and peripheral nerve blocks to be “important” or “very important”. Nearly 70% (9/13) of program directors considered competence in TTE to be “important” or “very important”, and 62% (8/13) considered competence in lung US to be “important” or “very important” for the graduating anesthesiology resident. Over half of the surveyed group of program directors deemed competence in TEE, US-facilitated neuraxial blocks, and abdominal US to be *at least* “moderately important”. The majority of respondents rated competence in airway US, gastric US, and ONSD assessment as largely unimportant for the graduating anesthesiology resident. None of the program directors deemed competence in any additional POCUS applications, beyond those appearing in the survey, to be “important” or “very important” for the graduating anesthesiology resident.

When asked which POCUS applications should be included in the National Curriculum,<sup>15</sup> the majority of program directors responded that TTE (10/13, 77%), IVC assessment (10/13, 77%), and lung US (9/13, 69%) should be adopted, in addition to US-guided vascular access, peripheral nerve blocks, and neuraxial blocks which are currently part of the National Curriculum.

Regarding assessment of POCUS competency amongst future graduating anesthesiology residents, most program directors (10/13, 77%) thought that POCUS should be an entrustable professional activity (EPA) within Competence by Design, the competency-based curriculum championed by the Royal College of Physicians and Surgeons of Canada. Three program directors (3/13, 23%) thought that POCUS should be assessed in some format at the Royal College examinations, while two program directors (2/13, 15%) opined that residents should not be assessed.

Respondents were allowed to select more than one response.

### Barriers to training anesthesiology residents in POCUS

All program directors who responded to the survey (13/13, 100%) deemed lack of POCUS-trained staff to be at least a “moderate barrier” (i.e., 3 on our five-point Likert scale) to residents gaining bedside US skills (Fig. 2). Seven of 13 (54%) respondents thought that this is a “significant barrier” (i.e., 5 on our five-point Likert scale). Over two-thirds of program directors considered the following factors to be at least “moderate barriers” to training residents in POCUS: lack of available US machines, lack of funding for residents to pursue extracurricular POCUS training, and lack of time during patient care for staff to train residents as well as for residents to perform POCUS scans. Lack of resident interest in learning POCUS was universally deemed *not* to be a barrier.

Our survey asked program directors to provide their best estimate of the percentage of faculty anesthesiologists in their training program who are competent in the POCUS applications listed in our survey—competence was defined as previously described. Estimates of competence were highly heterogeneous and varied across POCUS applications and residency programs (Fig. 3). Most program directors estimated the competence of faculty anesthesiologists in vascular access and US-guided regional nerve blocks to be high (at least “50-75%” or “76-100%”). At least 70% (9/13) of respondents estimated competence in TTE and lung US amongst faculty to be 25% or less. All program directors considered competence to be lowest in gastric US and ONSD assessment.

Respondents were asked if there is a faculty anesthesiologist at their respective training programs whose role is to be the “local POCUS expert” and to coordinate

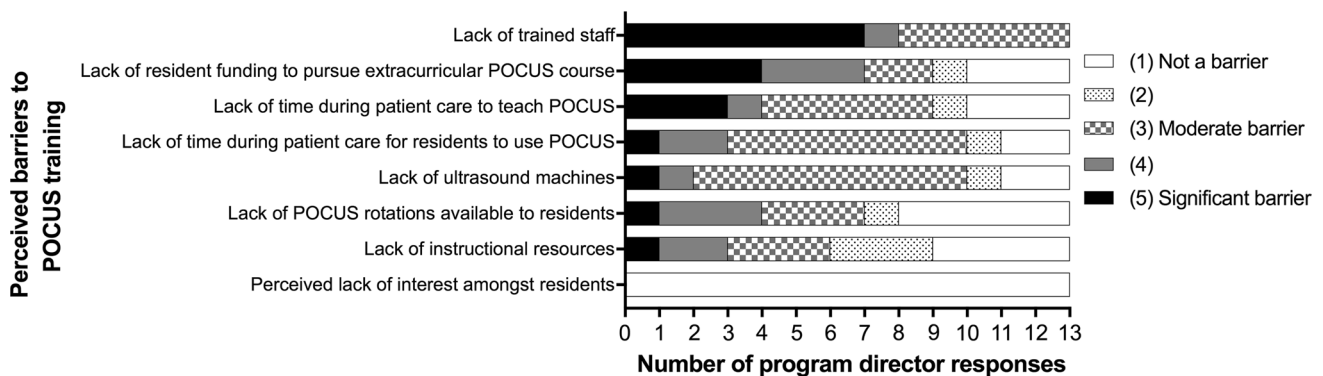
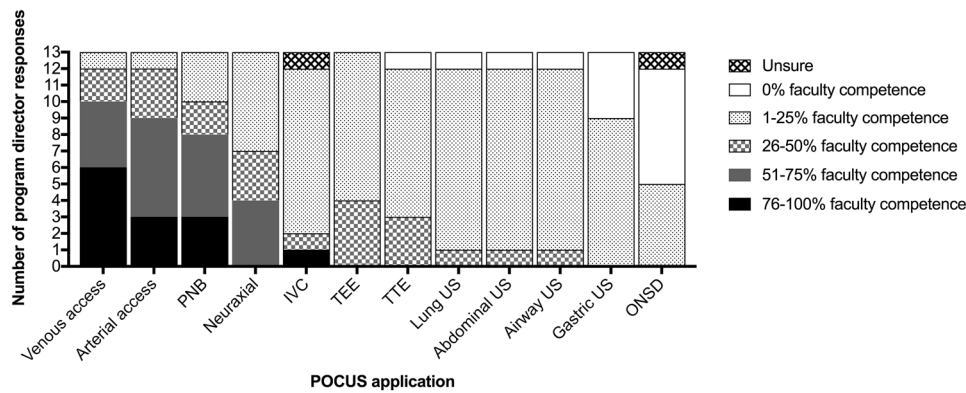


Fig. 2 Perceived barriers to point-of-care ultrasonography (POCUS) training and relative impact on resident learning



**Fig. 3** Program directors' estimates of competence in various point-of-care ultrasonography (POCUS) applications amongst faculty anesthesiologists at their respective training programs. IVC =

inferior vena cava; ONSD = optic nerve sheath diameter; PNB = peripheral nerve block; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; US = ultrasound

POCUS education. Ten of 13 (77%) program directors indicated that there is such a local POCUS expert at their institution. Two of the three programs that do not have a local POCUS expert are in the process of developing such a position, and the director of the remaining program is unsure.

## Discussion

All survey respondents indicated that point-of-care ultrasonography is taught in some format in their training program. As we hypothesized, there are considerable differences between programs with respect to which POCUS applications are taught. Ultrasound-facilitated vascular access, peripheral nerve blocks, and neuraxial blocks—skills that have long been the domain of anesthesiology—are taught universally among all responding residency programs. This is not surprising, as these are core skills outlined in the National Curriculum.<sup>15</sup> Nevertheless, the remainder of the POCUS applications in our survey are not currently part of the National Curriculum. Furthermore, their uptake into residency training has been variable amongst the responding residency programs, even though the value of POCUS beyond vascular access and regional anesthesia has been recognized in our specialty.<sup>1-3,10</sup> By comparison, training programs in emergency medicine,<sup>13</sup> critical care,<sup>14</sup> and even undergraduate medical programs<sup>37</sup> have readily integrated broad yet relevant POCUS applications into their curricula. Encouragingly, our study indicates that TTE training in some format, including mandatory or elective TTE-based rotations, is provided by a majority of residency programs, despite this not being part of the National Curriculum.<sup>38</sup> These findings corroborate those of a recent correspondence by Mizubuti *et al.* on focused

cardiac US training within Canadian anesthesiology residency programs.<sup>16</sup> Hence, the present findings reaffirm the need to formalize not only bedside TTE training but also perioperative POCUS training as a whole within the National Curriculum.

The most common method of teaching POCUS skills in the surveyed residency programs is informal bedside teaching during patient care, regardless of the POCUS application. Formal teaching by way of structured expert demonstration and guided hands-on scanning sessions is provided to a lesser extent. The fact that informal bedside teaching is the prevalent method of teaching POCUS highlights the importance of staff proficiency in enabling residents to develop bedside US skills. As with other technical aspects of anesthesiology training, it is of paramount importance to have frequent opportunities to perform procedures with expert constructive criticism. Nevertheless, our survey results suggest that staff proficiency in POCUS is low beyond its use for vascular access, peripheral nerve blocks, and neuraxial techniques. These findings corroborate the conclusions of other studies across a multitude of medical specialties regarding bedside US training—i.e., a lack of POCUS-trained staff is a common and recurring motif and a barrier for trainees seeking to learn bedside US.<sup>16,22,23,29,30,34,35</sup> Clearly, the growth of POCUS has outpaced the number of physicians trained in its various clinical applications, and there is a need for continuing medical education in POCUS. To that end, our survey asked program directors whether there is a faculty anesthesiologist at their institution with the role of “local POCUS expert”. Nearly all residency programs have such a figure or are in the process of developing this position. Beyond being a subject matter expert, in our view, the role of the local expert should also be to champion POCUS use and education at their respective

institutions. This will help create an environment conducive to learning and employing bedside US by staff and trainees alike.

The importance of POCUS in current anesthesia practice cannot be overstated, and it is incumbent upon anesthesiology residency programs to provide the appropriate training.<sup>39</sup> As anesthesiology training in Canada transitions towards a competency-based model (i.e., Competence by Design), now is the opportune time to formalize POCUS training and assessment within our specialty. Incorporating relevant perioperative POCUS applications into the National Curriculum is a practical first step towards standardizing bedside ultrasonography training amongst anesthesiology residency programs. In our study, the majority of surveyed program directors think that POCUS-facilitated vascular access, peripheral nerve and neuraxial blocks, TTE, IVC assessment, and lung US should be incorporated into the National Curriculum. We also consider the other surveyed POCUS applications to have special relevance to our role as anesthesiologists and perioperative physicians and to deserve consideration for inclusion in residency training. With respect to the assessment of residents' abilities in POCUS, the majority of respondents (10/13, 77%) support the incorporation of POCUS as an EPA—that is, a specific clinical task in which a resident must demonstrate competence—within the new competency-based curriculum. Future direction should focus on delineating the specific milestones that make up the POCUS EPA and how best to teach the requisite skills and abilities to achieve these milestones.

### Limitations

Our study has several limitations inherent in online survey studies, including responder bias and possible misinterpretation of the questions by respondents. Despite attempts to optimize response rate, we were unable to obtain responses from all 17 program directors, thus preventing us from obtaining a more complete picture of the state of POCUS training amongst Canadian anesthesiology residency programs. This may be due in part to the changeover of program directors that occurred at several residency programs during the distribution phase of our survey. Additionally, our study surveyed program directors but not residents or local POCUS experts; therefore, it may not fully reflect the resident experience of POCUS training at their institution.

### Conclusions

This online survey study describes the state of POCUS training and education in Canadian Royal College-

accredited anesthesiology residency programs. Our findings suggest that, while program directors strongly considered resident competency in several POCUS applications to be important, there is a delivery gap in role-modelling, formal instruction, and assessment of these skills. The result is a highly variable POCUS landscape across training programs. Moving forward, the next logical step may be to incorporate perioperative anesthesia-specific POCUS applications into the National Curriculum and competency-based medical education. Questions remain for future consideration, including which specific POCUS applications, how best to incorporate POCUS into residency training, and how to conduct assessments of competence.

**Conflicts of interest** None of the authors have any competing financial interests relating to this study.

**Author contributions** *Daniel Mok, Stephan Schwarz, and Kevin Rondi* were involved in study design and manuscript preparation. *Daniel Mok and Kevin Rondi* were involved in data extraction and analysis. *Daniel Mok* wrote the first draft of the manuscript. All authors provided intellectual contributions to this work.

**Editorial responsibility** This submission was handled by Dr. Hilary P. Grocott, Editor-in-Chief, *Canadian Journal of Anesthesia*.

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### Appendix

1. Please select your anesthesiology residency training program:
  - a. University of British Columbia
  - b. University of Calgary
  - c. University of Alberta
  - d. University of Saskatchewan
  - e. University of Manitoba
  - f. Northern Ontario School of Medicine
  - g. Western University
  - h. McMaster University
  - i. University of Toronto
  - j. Queen's University
  - k. University of Ottawa
  - l. McGill University
  - m. Université de Montréal
  - n. Université de Sherbrooke
  - o. Université Laval
  - p. Dalhousie University
  - q. Memorial University

2. Please indicate the total number of anesthesia residents (Royal College only) currently in your training program: \_\_\_\_\_
3. For the following POCUS applications, please indicate the training modalities used to teach anesthesiology residents at your training program (select all that apply):
  - a. Yes – there is funding specifically for extracurricular POCUS training
  - b. Yes – nonspecific funding available, which may be used for extracurricular POCUS training
  - c. No funding available
  - d. Unsure
6. Which of the following statements best represents POCUS training at your residency program? (select all that apply)

	Informal Bedside instruction	Online Modules	Lectures	Simulation Sessions	Structured Expert Demonstration	Structured hands-on scanning	Video or image review	Mandatory U/S-based rotation	Elective U/S-based rotation	Extra-curricular course	None
Arterial access											
Venous access											
Peripheral nerve blocks											
Neuraxial blocks											
Transthoracic ECHO											
IVC assessment											
Lung U/S											

4. For the following POCUS applications, please indicate the training modalities used to teach anesthesiology residents at your training program (select all that apply):
  - a. As part of the curriculum, residents are expected to receive a specified NUMBER OF HOURS of formal POCUS training (i.e., structured and dedicated teaching with specific learning objectives, occurring outside of patient care)

	Informal Bedside instruction	Online Modules	Lectures	Simulation Sessions	Structured Expert Demonstration	Structured hands-on scanning	Video or image review	Mandatory U/S-based rotation	Elective U/S-based rotation	Extra-curricular course	None
Trans-esophageal ECHO											
Abdominal U/S for free fluid											
Airway U/S for ETT placement											
Gastric U/S											
Optic nerve sheath diameter											

5. Is there funding available for anesthesia residents at your program to take a formal extracurricular POCUS course?
  - b. As part of the curriculum, residents are expected to perform a specified NUMBER OF POCUS SCANS and/or POCUS-FACILITATED PROCEDURES



c. None of the above

**IF RESIDENTS ARE EXPECTED TO RECEIVE A SPECIFIED NUMBER OF HOURS OF FORMAL POCUS TRAINING...**

*occurring outside of patient care. This includes – but is not limited to – didactic lectures, simulation sessions, hands-on scanning sessions, and extracurricular POCUS courses.*

	<b>Hours of formal training</b>	<b>Comments on POCUS training (optional)</b>
<b>Arterial access</b>	<ul style="list-style-type: none"> <li>○ 0 hr</li> <li>○ &lt; 1 hr</li> <li>○ 1-5 hr</li> <li>○ 6-10 hr</li> <li>○ 11-15 hr</li> <li>○ &gt;15 hr</li> </ul>	
<b>Venous access</b>	<ul style="list-style-type: none"> <li>○ 0 hr</li> <li>○ &lt; 1 hr</li> <li>○ 1-5 hr</li> <li>○ 6-10 hr</li> <li>○ 11-15 hr</li> <li>○ &gt;15 hr</li> </ul>	
<b>Peripheral nerve blocks</b>	“”	
<b>Neuraxial blocks</b>	“”	
<b>Transthoracic ECHO</b>	“”	
<b>Transesophageal ECHO</b>	“”	
<b>IVC assessment</b>	“”	
<b>Lung U/S</b>	“”	
<b>Abdominal U/S for free fluid</b>	“”	
<b>Airway U/S for ETT placement</b>	“”	
<b>Gastric U/S</b>	“”	
<b>Optic nerve sheath diameter</b>	“”	

For the POCUS applications listed below, please indicate the amount of formal training (in hours) that residents may receive by the end of residency. A space is provided beside each item should you wish to provide extra details regarding formal POCUS training at your program.

*Formal training refers to structured and dedicated teaching by a designated instructor with specific learning objectives and outcomes,*

**IF RESIDENTS ARE EXPECTED TO PERFORM A SPECIFIED NUMBER OF POCUS SCANS AND/OR POCUS-FACILITATED PROCEDURES...**

For the POCUS applications listed below, please indicate the number of POCUS scans or POCUS-facilitated procedures expected of residents by the end of residency. A space is provided beside each item should you wish to provide extra details regarding formal POCUS training at your program.

	Number of scans/procedures expected of residents	Comments on POCUS experience required of residents (optional)
<b>Arterial access</b>	<ul style="list-style-type: none"> <li><input type="radio"/> 0</li> <li><input type="radio"/> 1-5</li> <li><input type="radio"/> 6-10</li> <li><input type="radio"/> 11-15</li> <li><input type="radio"/> 16-20</li> <li><input type="radio"/> 20-25</li> <li><input type="radio"/> 26-30</li> <li><input type="radio"/> 30-40</li> <li><input type="radio"/> 40-50</li> <li><input type="radio"/> &gt;50</li> </ul>	
<b>Venous access</b>	<ul style="list-style-type: none"> <li><input type="radio"/> 0</li> <li><input type="radio"/> 1-5</li> <li><input type="radio"/> 6-10</li> <li><input type="radio"/> 11-15</li> <li><input type="radio"/> 16-20</li> <li><input type="radio"/> 20-25</li> <li><input type="radio"/> 26-30</li> <li><input type="radio"/> 30-40</li> <li><input type="radio"/> 40-50</li> <li><input type="radio"/> &gt;50</li> </ul>	
<b>Peripheral nerve blocks</b>	“”	
<b>Neuraxial blocks</b>	“”	
<b>Transthoracic ECHO</b>	“”	
<b>Transesophageal ECHO</b>	“”	
<b>IVC assessment</b>	“”	
<b>Lung U/S</b>	“”	
<b>Abdominal U/S for free fluid</b>	“”	
<b>Airway U/S for ETT placement</b>	“”	
<b>Gastric U/S</b>	“”	
<b>Optic nerve sheath diameter</b>	“”	

7. To the best of your ability, please estimate the percentage of faculty anesthesiologists at the core training sites in your program who are competent at using POCUS for the following applications:

*Competence is defined as the ability to independently obtain and interpret U/S imaging to answer a focused clinical question or facilitate a procedure*

	0%	1-25%	26-50%	51-75%	76-100%	Unsure
<b>Arterial access</b>						
<b>Venous access</b>						
<b>Peripheral nerve blocks</b>						
<b>Neuraxial blocks</b>						
<b>Transthoracic ECHO</b>						
<b>Transesophageal ECHO</b>						
<b>IVC assessment</b>						
<b>Lung U/S</b>						
<b>Abdominal U/S for free fluid</b>						
<b>Airway U/S for ETT placement</b>						
<b>Gastric U/S</b>						
<b>Optic nerve sheath diameter</b>						

8. Is there currently a faculty anesthesiologist in your program whose role includes acting as the local POCUS expert for the residency program? (i.e., subject matter expert, uses POCUS perioperatively, coordinates POCUS education)
- a. Yes
  - b. No
  - c. Unsure

**IF “NO” OR “UNSURE”...**

Are there plans to develop this position in the future?

9. In your program, are residents formally assessed on their ability to use POCUS and perform POCUS-facilitated procedures?
- a. Yes
  - b. No

**IF “YES”...**

Assessment of anesthesiology residents using POCUS for the following applications takes place in the form of (select all that apply):

	Direct observation and supervision	Required number of scans / procedures	U/S image or video review	Formal written examination	Formal practical examination
Arterial access					
Venous access					
Peripheral nerve blocks					
Neuraxial blocks					
Transthoracic ECHO					
Transesophageal ECHO					
IVC assessment					
Lung U/S					
Abdominal U/S for free fluid					
Airway U/S for ETT placement					
Gastric U/S					
Optic nerve sheath diameter					

- a. Yes, within one year
- b. Yes, over one year from now
- c. No, there are currently no plans to develop such a position
- d. Unsure

10. Please indicate how important you think it is for anesthesiology residents to be competent in the following POCUS applications by completion of residency:

Competency is defined as the ability to independently obtain and interpret U/S imaging to answer a focused clinical question or to facilitate a procedure.

- i. Abdominal U/S for free fluid
- j. Airway U/S for ETT placement
- k. Gastric U/S
- l. Optic nerve sheath diameter

	Not at all important (1)	Of little importance (2)	Moderately important (3)	Important (4)	Very important (5)
Arterial access					
Venous access					
Peripheral nerve blocks					
Neuraxial blocks					
Transthoracic ECHO					
Transesophageal ECHO					
IVC assessment					
Lung U/S					
Abdominal U/S for free fluid					
Airway U/S for ETT placement					
Gastric U/S					
Optic nerve sheath diameter					

11. Please list any other applications of POCUS not mentioned above for which you think competency is “important (4)” or “very important (5)” for the graduating anesthesiology resident.

- m. None of the above
- n. Other, please specify: \_\_\_\_\_

13. In the future, a graduating anesthesiology resident’s competency in POCUS should be assessed by the

12. Which of the following POCUS applications should be included in the National Curriculum for Canadian anesthesiology training in the future (select all that apply):

- a. Arterial access
- b. Venous access
- c. Peripheral nerve blocks
- d. Neuraxial blocks
- e. Transthoracic ECHO
- f. Transesophageal ECHO
- g. IVC assessment
- h. Lung U/S

following (select all that apply):

- a. POCUS skills should be examined in some format during the Royal College examinations
- b. POCUS should be an entrustable professional activity (EPA) in competence by design (CBD)
- c. Competency in POCUS should not be assessed
- d. Other, please specify: \_\_\_\_\_

14. Please identify possible barriers to training residents in POCUS at your program. For each of the potential barriers listed below, rate the extent to which it impacts POCUS training for residents (1 – not a barrier; 5 – significant barrier).

Barriers to POCUS training:	Please rate the impact of this issue on POCUS training for residents:
Limited availability of U/S machines	<input type="radio"/> 1 – not a barrier <input type="radio"/> 2 <input type="radio"/> 3 – moderate barrier <input type="radio"/> 4 <input type="radio"/> 5 – significant barrier
Lack of instructional resources available (e.g., textbooks, online modules, scanning mannequins, etc.)	“”
Lack of funding for residents to pursue formal extracurricular POCUS training	“”
Lack of trained staff who are able to teach and supervise residents	“”
Lack of time during patient care for staff to teach and supervise residents	“”
Lack of time during patient care for residents to perform POCUS scans	“”
Lack of formalized POCUS rotation available to residents	“”
Perceived lack of interest amongst residents	“”

15. Please list any other issues you feel are perceived barriers to training residents in POCUS at your program. Please rank all listed issues on a scale of 1-5 as above (i.e., 1 – not a barrier; 5 – significant barrier)

ECHO = echocardiography; ETT = endotracheal tube; IVC = inferior vena cava; POCUS = point-of-care ultrasonography; U/S = ultrasound.

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