Point of care ultrasound training needs for primary care physicians: Practice setting matters

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Abstract: Background: Point of care ultrasound (POCUS) is increasingly used in primary care. This study seeks to determine the educational needs of primary care physicians. Methods: All primary care practitioners in Calgary, Alberta, on the electronic departmental newsletter distribution list were invited to participate in an online survey. Interests in learning 25 POCUS applications and 9 procedures were assessed using a 5-point Likert scale. Results: Of the 1394 members on the distribution list, 96 responded. Of these, 88 completed the survey. The majority of the participants (n = 69, 78%) were office-based while 19 (21%) were hospital-based. The top applications for office-based participants included: (1) confirming fetal heart rate, (2) assessing fetal lie, and (3) confirming intrauterine pregnancy. For hospital-based participants, these were: (1) assessing soft tissue/superficial abscesses, (2) looking for ascites, and (3) confirming volume status of the patient. Of the 75 participants who perform procedures, both office- and hospital-based participants were most interested in learning incision and drainage for superficial abscesses and joint aspirations/injections; other procedural interests significantly differed between the two groups. Conclusions: Interests of office-based primary care practitioners in learning POCUS differed significantly from hospital-based...
practitioners. We recommend that separate office vs. hospital practice streams be offered to address their educational needs.

**Subjects:** General Medicine; Medical Education; Primary Health Care & Family Practice

**Keywords:** family practice; continuing medical education; ultrasonography; needs assessment; curriculum development; clinical skills

1. Introduction

It is increasingly recognized that point-of-care ultrasound (POCUS) may have an important role in the primary care setting (Bornemann & Bornemann, 2014; Flick, 2016; Steinmetz & Oleskevich, 2016). For example, a limited/focused cardiac ultrasound performed by family practitioners can accurately and reliably answer important basic point-of-care questions and provide prognostic and diagnostic information (Bornemann, Johnson, & Tiglao et al., 2015; Esquerrà et al., 2012; Lindgaard & Risgaard, 2017; Mjølstad et al., 2012). Others have shown that trained family physicians can competently perform important office-based screening tests such as abdominal aortic aneurysms (Blois, 2012; Steinmetz & Oleskevich, 2016). While point-of-care imaging does not replace formal diagnostic imaging, bedside screening tests can help family physicians triage certain presentations. To be able to do so may be particularly important in settings where formal imaging studies are not readily available. Indeed, cost analyses suggest that the use of POCUS in the primary care setting may result in significant cost savings (Wordsworth & Scott, 2002).

To incorporate the use of POCUS in family medicine requires appropriate training. From a trainee perspective, while there is data to support training residents (Bornemann, 2017; Wong, Franco, Phelan, Lam, & David, 2013), and guidelines are now in place on a recommended curriculum for family medicine residencies (American Academy of Family Physicians, 2018), one of the greatest barriers to POCUS education is the lack of trained faculty (Hall et al., 2015; Micks et al., 2018). Although weekend courses are common for faculty development (Szwamel, Polański, & Kurpas, 2017), the vast number of POCUS applications in the family medicine curriculum makes it difficult for individuals to master these skills in such a short timeframe. A more targeted approach to learning is necessary.

To help prioritize curriculum content, we conducted a needs assessment study to evaluate the needs of primary care practitioners.

2. Methods

All primary care practitioners in Calgary, Alberta, Canada on the distribution list of an electronic Department of Family Medicine newsletter (N = 1394) were invited to participate. Calgary, a city with a population of 1.2 million (Bornemann, 2017) has 1864 general practice/family medicine practitioners (Bornemann & Bornemann, 2014). The survey invitation was included in the newsletter on two occasions (July 13 and 27 July 2017). There was no incentive included for participating. This study was approved by the University of Calgary Conjoint Health Research Ethics Board (REB 17-0730).

2.1. Survey development

Survey content development was supported by a search of key POCUS texts and articles (American Academy of Family Physicians, 2018; American College of Emergency Physicians, 2016; Levitov, Dallas, & Sionim, 2011; Soni, Arntfield, & Kory, 2015; Wordsworth & Scott, 2002) and developed by two investigators (RJ, IM), whereby participants were asked how applicable each of the 24 POCUS applications was to the practice of family medicine and how interested they were in learning it. This survey was then piloted on five clinicians regarding clarity and flow, areas of deficiencies and redundancies. Based on pilot feedback, a question about optic nerve diameter and 9 questions about procedures were added to the final survey. Only participants who indicated that they
perform procedures in their practice setting(s) were asked about their interest in learning procedures. In addition, for each of the 9 procedures and 25 applications, the participants were only asked about their interest in learning as high redundancy was identified between perceived applicability and interests.

Self-reported interest was assessed using a 5-point Likert scale, where 1 = not at all interested and 5 = very interested. The final survey was distributed using an online survey tool (SurveyMonkey Inc., San Mateo, California, USA; www.surveymonkey.com).

2.2. Statistical analysis
Between-group comparisons of continuous and categorical variables were made using Student’s t-tests and Fisher’s exact tests, respectively. For Likert scale data, we used parametric analyses which have previously been shown to be statistically robust (Murray, 2013; Norman, 2010). All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results
Ninety-six participants responded to the survey. Of these, 7 declined to consent and 88 participants agreed to participate. The majority of the participants (n = 69, 78%) indicated that their primary practice setting as office-based (defined as practice in an office, clinic, community clinic, or clinic at a health center), while 19 (21%) were hospital-based (ward or emergency department, Table 1). A higher percentage of office-based participants was female (n = 58, 84% vs. n = 9, 47%; \( p < 0.002 \)). Approximately half of the participants (n = 44, 49%) reported no prior training in POCUS.

3.1. Interest in learning POCUS applications
Office-based participants’ reported interests in POCUS applications differed significantly from hospital-based participants. The top three applications for office-based participants included: (1) confirming fetal heart rate, (2) assessing for fetal lie, and (3) confirming the presence of intrauterine pregnancy (Table 2). The top three applications for hospital-based participants were: (1) determining if there is a superficial abscess collection in soft tissues, (2) looking for ascites, and (3) confirming volume status of the patient (Table 2).

3.2. Interest in learning ultrasound-guided procedures
Of the 88 participants, 75 (85%) reported performing procedures in their practice settings. For these participants, the top two procedures that both office-based and hospital-based participants were most interested in learning were the same: incision and drainage for superficial abscesses and joint aspirations/injections (Table 3). Interests differed for other procedures such as intravenous access, paracentesis, and thoracentesis, arterial blood gas sampling, and lumbar punctures, where hospital-based clinicians were more interested than the office-based clinicians (\( P < 0.05 \) for all).

4. Discussion
In this needs assessment survey of primary care practitioners, office-based participants’ interests in learning POCUS applications significantly differed from hospital-based participants. Specifically, office-based practitioners were most interested in obstetric-based applications while their hospital-based colleagues were most interested in more traditional POCUS applications such as identifying abscesses, ascites, and volume status. Further, while both groups were most interested in learning incision and drainage procedures and joint aspirations/injections, hospital-based participants were more interested in learning procedures such as venous access, paracentesis, thoracentesis, arterial blood gas sampling, and lumbar puncture than their office-based colleagues.

Learning needs differences identified between office- and hospital-based practitioners likely reflect variations in the scope of individual practices. More importantly, these differences point to the need for developing separate office-based versus hospital-based streams in POCUS faculty development training for POCUS. Currently, the recommended POCUS family medicine residency curriculum, endorsed by the American Academy of Family Physicians, is rather extensive...
American Academy of Family Physicians, 2018) and difficult to master in a short time frame. While this curriculum is advisable in a residency training setting, its feasibility may be limited for family practitioners already in practice. For faculty development purposes, separating office vs. hospital practice streams may offer training that is more tailored to the clinicians’ needs.

Our study has some limitations. First, our response rate is low and likely only those with higher interests in POCUS responded. Therefore, their interests may not be representative of family practitioners at large. Indeed, based on demographics listed by the College of Physicians and Surgeons of Alberta (College of Physicians and Surgeons of Alberta) as of April 2019, 47% of family physicians practicing in Calgary are male, while only 16% of our office-based participants (p < 0.0001) and 53% of our hospital-based participants were male (p = 0.65). These results further suggest the presence of a response bias in our office-based group. Nonetheless, to our knowledge, our needs assessment study sample size is one of the largest reported to date, and further, those most interested in POCUS will be more likely to enroll in training. Therefore, the results of our survey may potentially still be reflective of those most likely to undergo POCUS training, especially for the hospital-based group. Second, our participants were

Table 1. Baseline demographics of 88 participants

|                      | Office-based; N (%) (n = 69) | Hospital-based; N (%) (n = 19) | P-value |
|----------------------|------------------------------|-------------------------------|---------|
| Sex                  |                              |                               |         |
| Male                 | 11 (16)                      | 10 (53)                       | 0.002   |
| Female               | 58 (84)                      | 9 (47)                        |         |
| Years in practice    |                              |                               | 0.31    |
| <1 year              | 0                            | 0                             |         |
| 1-2 years            | 6 (9)                        | 4 (21)                        |         |
| 3-5 years            | 12 (17)                      | 2 (11)                        |         |
| 6-10 years           | 16 (23)                      | 6 (32)                        |         |
| 11-15 years          | 10 (14)                      | 1 (5)                         |         |
| 16-20 years          | 8 (12)                       | 0                             |         |
| >20 years            | 17 (25)                      | 6 (32)                        |         |
| Presence of trainees in primary practice setting*          |                              |                               |         |
| Residents            | 59 (86)                      | 18 (95)                       | 0.44    |
| Medical students     | 43 (62)                      | 14 (74)                       | 0.43    |
| None, no trainees    | 8 (12)                       | 1 (5)                         | 0.68    |
| Prior self-reported training in point of care ultrasound   |                              |                               |         |
| Extensive            | 5 (7)                        | 2 (11)                        | 0.05    |
| Some, minimal        | 28 (41)                      | 9 (47)                        |         |
| No prior training    | 36 (52)                      | 8 (42)                        |         |

* Participants may choose more than one response.
largely untrained in POCUS. As such, their interests may not reflect realistic expectations about what POCUS can and cannot do. While our participant responses did not statistically differ between trained versus untrained participants except for one item: trained office-based participants reported higher interest in “assessing for fetal lie” than untrained participants (mean 4.78 ± 0.61 vs 3.97 ± 1.20; p = 0.03, adjusted for multiple comparisons), we cannot exclude the possibility that learning interests may clinically differ between groups. Therefore, curriculum development should take into account prior learner training. Third, although our participants

| Table 2. Participants’ interest in learning point of care ultrasound applications, assessed using a 5-point Likert scale, where 1 = not at all interested and 5 = very interested |
|-------------------------------------------------|-------------------------------------------|---------------------------------------------|
| Confirming fetal heart rate (n = 69) | Hospital-based; mean (standard deviation) (n = 19) | P-value |
| 4.48 (0.96) | 2.94 (1.67) | 0.001 |
| Assessing for fetal lie (n = 104) | 4.36 (1.04) | 2.68 (1.66) | 0.0004 |
| Confirming presence of intrauterine pregnancy (n = 114) | 4.41 (1.14) | 2.95 (1.72) | 0.002 |
| Determining if there is a superficial abscess collection in soft tissues (n = 127) | 3.84 (1.27) | 4.79 (0.42) | <0.0001 |
| Looking for very obvious deep vein thrombosis (n = 146) | 3.81 (1.46) | 4.11 (1.45) | 0.43 |
| Looking for a distended bladder (n = 138) | 3.48 (1.38) | 4.21 (0.98) | 0.01 |
| Looking for joint effusion (knee) (n = 142) | 3.42 (1.42) | 4.05 (1.08) | 0.07 |
| Looking for gallstones (n = 150) | 3.39 (1.50) | 4.21 (0.92) | 0.005 |
| Looking for cystic breast lesions (n = 151) | 3.31 (1.51) | 2.58 (1.39) | 0.06 |
| Looking for ascites (n = 153) | 3.29 (1.53) | 4.32 (0.95) | 0.008 |
| Looking for abdominal aortic aneurysm (n = 154) | 3.27 (1.62) | 3.84 (1.39) | 0.15 |
| Looking for pneumonia (n = 162) | 3.27 (1.16) | 4.16 (1.07) | 0.007 |
| Joint effusion (shoulder) (n = 154) | 3.21 (1.54) | 3.95 (1.08) | 0.06 |
| Looking for hydrenephrosis (n = 147) | 3.11 (1.47) | 4.11 (1.10) | 0.003 |
| Looking for enlarged spleen (n = 156) | 3.10 (1.56) | 3.89 (1.23) | 0.051 |
| Looking for enlarged liver (n = 155) | 3.07 (1.55) | 3.84 (1.42) | 0.06 |
| Confirming palpable thyroid abnormalities (i.e. nodules) (n = 151) | 3.02 (1.51) | 2.89 (1.37) | 0.76 |
| Assessing for lymph node size (n = 154) | 3.01 (1.54) | 3.26 (1.33) | 0.53 |
| Identifying pleural effusion (n = 150) | 2.85 (1.50) | 4.16 (1.26) | 0.0005 |
| Joint effusion (other than knee/shoulder) (n = 152) | 2.81 (1.52) | 2.94 (1.57) | 0.77 |
| Confirming volume status of the patient (n = 149) | 2.69 (1.49) | 4.32 (1.29) | <0.0001 |
| Looking for pericardial effusion (n = 142) | 2.58 (1.42) | 3.68 (1.49) | 0.008 |
| Looking at heart function (gross estimates only) (n = 148) | 2.52 (1.48) | 3.83 (1.47) | 0.002 |
| Looking for retinal detachment, vitreous hemorrhage/detachment (n = 131) | 2.07 (1.31) | 2.16 (1.34) | 0.84 |
| Looking for optic nerve sheath diameter (for increased intracranial pressure) (n = 124) | 2.01 (1.24) | 2.26 (1.28) | 0.45 |
indicated their primary practice setting, many practiced both hospital- and office-based medicine. For these, a comprehensive course may still be warranted. Fourth, results from our survey serve as only a first step in the faculty curriculum implementation process and do not provide full guidance into curriculum design (Kern, Thomas, & Hughes, 2009). Additional research will be required to assess the effectiveness of various methods of training for ultrasound skills for faculty development purposes, such as didactic training, web-based training, simulation-based learning, mastery-based learning and blended learning (Cook et al., 2011; Knudson & Sisley, 2000; Lewisw, Hoffmann, Beaulieu, & Phelan, 2014; McGaghie, Issenberg, Barsuk, & Wayne, 2014).

These limitations notwithstanding, as indicated previously, to our knowledge, our study is one of the larger studies documenting the needs of family practitioners. Given that the lack of trained faculty is a large barrier to expanding POCUS in family medicine training (Hall et al., 2015), our results help prioritize the learning needs of practicing clinicians. Future research should evaluate additional learning needs in an iterative manner, as POCUS and experience of family practitioners increase over time. In conclusion, based on the results of our survey, notwithstanding a low response rate, we recommend tailoring faculty development efforts to the needs of the clinicians. Designing separate hospital- and office-based streams may allow for a more targeted approach to training.

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Table 3. Participants’ interest in learning ultrasound-guided procedures, assessed using a 5-point Likert scale, where 1 = not at all interested and 5 = very interested

| Procedure                                | Office-based; mean (standard deviation) (n = 60) | Hospital-based; mean (standard deviation) (n = 15) | P-value |
|------------------------------------------|-----------------------------------------------|------------------------------------------------|---------|
| Incision and drainage for superficial abscesses | 4.15 (1.15)                                    | 4.53 (0.64)                                    | 0.09    |
| Joint aspiration or injections           | 3.97 (1.33)                                    | 4.33 (0.82)                                    | 0.19    |
| Breast lesion biopsies                   | 2.72 (1.60)                                    | 2.07 (1.44)                                    | 0.15    |
| Intravenous access (peripheral or central venous access) | 2.43 (1.52)                                    | 3.87 (1.25)                                    | 0.001   |
| Paracentesis                             | 2.35 (1.45)                                    | 3.53 (1.30)                                    | 0.005   |
| Thoracentesis                            | 2.28 (1.42)                                    | 3.47 (1.36)                                    | 0.005   |
| Thyroid biopsies                         | 2.03 (1.28)                                    | 1.73 (1.22)                                    | 0.41    |
| Arterial blood gas sampling              | 1.97 (1.29)                                    | 2.93 (1.58)                                    | 0.02    |
| Lumbar puncture                          | 1.82 (1.13)                                    | 3.20 (1.70)                                    | 0.008   |
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