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ORIGINAL ARTICLE

Point-of-Care Ultrasound and Procedural Instruction in the Family Medicine Clerkship: A CERA Study

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ABSTRACT

Background and Objectives: Point-of-care ultrasound (POCUS) education has become a mainstay in resident education in multiple specialties, including family medicine (FM), but literature regarding the use of POCUS during clinical medical student education is lacking. The purpose of this study was to investigate whether and how POCUS education is conducted in FM clerkships in the United States and Canada and how it compares to more traditional FM clinical procedural instruction.

Methods: As part of the 2020 Council of Academic Family Medicine's Educational Research Alliance survey of FM clerkship directors, we surveyed clerkship directors in the United States and Canada about whether and how POCUS education, as well as other procedural instruction in their institutions and FM clerkships, was conducted. We included questions regarding POCUS and other procedural use by preceptors and faculty.

Results: We found that 13.9% of clerkship directors reported structured POCUS education during clerkship, while 50.5% included other procedural training. The survey revealed that 65% of clerkship directors felt that POCUS was an important component of FM, but this was not a predictor of POCUS use in personal or preceptor practice nor of its inclusion in FM clerkship education.

Conclusions: Structured POCUS education is a rare component of FM clerkship education; while more than half of clerkship directors felt that POCUS was important for FM, few used it personally or included it in clerkship education. As POCUS continues to be integrated into medical education in FM, the clerkship may represent an opportunity to expand POCUS exposure for students.

BACKGROUND

Clinicians use point-of-care ultrasound (POCUS) at the time of a patient encounter to answer specific clinical questions through performance and immediate interpretation of ultrasonography.[1,2] As early as 1988, ultrasound technology was discussed as a possible routine examination tool or stethoscope of the future. Gradually, ultrasound was introduced into US and Canadian medical education, often in conjunction with basic science coursework (ie, anatomy and physiology), as a tool for developing enhanced understanding. Some employed ultrasound for assisting physical examination skill development and diagnostic accuracy.[3] Though the effects of incorporating ultrasound on nonultrasound specific knowledge have been unclear, medical students have "enjoy[ed] ultrasound education and want[ed] more of it in their curricula."[4] As ultrasound technology improved, particularly over the past 10 years, some medical schools worldwide began instituting ultrasound imagery, POCUS, and simulation-based ultrasound training into their curricula for teaching procedural skills.[5] Despite widespread adoption, a great deal of variability remains from school to school.[3]

A relative paucity of medical education literature describing the use of POCUS in medical students' clinical education exists compared to preclinical and residency education. Individualized institutional reports describing curricular innovations reveal that some institutions are making concerted efforts to integrate ultrasound training,[3] but no nationwide data detailing student clerkship year POCUS use is available. The American Institute of Ultrasound in Medicine created a crowdsourced table of ultrasound use in various worldwide medical institutions,[6] but those data are incomplete. In the 2018-2019 annual curriculum inventory of the Association of American Medical Colleges (AAMC), 20.6% of responding schools reported having some type of required ultrasound content in level 3, which is a rough approximation to year 3 of medical school when clerkships are typically offered.[7]

The report did not differentiate specialty-specific education. Our medical education literature review found scant literature exploring the use of POCUS in family medicine clinical education and clerkships in undergraduate medical education, though we did find descriptions of some work in other specialties. Emergency medicine, an early adopter of POCUS in clerkships, is represented most in the clerkship literature.[8,9] Several institutions include POCUS curricula linked to longitudinal specialty education across the 4 years of medical school.[10–12]

The purpose of this study was to investigate the nature of POCUS education in US and Canadian family medicine clerkships by surveying clerkship directors regarding whether and how medical student POCUS education is conducted in their clerkships and institutions, and how that compares to more traditional instruction in FM clinical procedures. Additionally, we sought to determine whether institutional characteristics and clerkship directors' opinions regarding education and POCUS were associated with incorporating POCUS into the family medicine clerkship.

METHODS

Data were gathered and analyzed as part of the 2020 Council of Academic Family Medicine's (CAFM's) Educational Research Alliance (CERA) survey of family medicine clerkship directors. CAFM is a joint initiative of four major academic family medicine organizations, including the Society of Teachers of Family Medicine, the North American Primary Care Research Group, the Association of Departments of Family Medicine, and the Association of Family Medicine Residency Directors. The survey methodology has been described in detail elsewhere,[13] so it is not reiterated here.

CERA distributed the survey via email to 147 US and 16 Canadian family medicine clerkship directors between June 1, 2020, and June 25, 2020. The email included an invitation, explanation, and link to the online survey, which was conducted through SurveyMonkey. Nonrespondents received two weekly requests to complete the survey plus one final request 2 days before survey closing.

The survey asked clerkship directors questions about themselves, their institutions, and their FM clerkship education structure. For this study, we submitted 10 additional questions that covered the use of POCUS by clerkship directors, FM preceptor practice patterns regarding POCUS and other procedures, clerkship formal education devoted to POCUS and other procedures, perceptions of the value of POCUS in family medicine, knowledge of POCUS education in other portions of medical student education, and perceptions of the importance of structured curriculum in influencing student choice of specialty. In May 2020, the American Academy of Family Physicians Institutional Review Board approved our study.

We aggregated, described, and analyzed survey responses using SAS software version 9.4. We calculated the number of postresidency years for clerkship directors as the difference between the year the survey was administered and their graduation year. We used this calculation in all analyses involving clerkship director postresidency training. Due to small sample sizes, we used Fisher's exact tests to determine associations between the use of POCUS education and training and other procedural education and training, as well as other categorical survey variables. We used independent t-tests, or a nonparametric equivalent if normality was violated, to compare use of POCUS education and training and class size to the data that clerkship directors reported on current practices and postresidency years. Percentages displayed in the tables that follow are representative of the total number of survey responses and nonresponses for each question. The percentages in the Results section are calculated out of the total number of responses to individual questions.

RESULTS

Respondent Characteristics

Out of 163 clerkship directors across a wide US and Canadian geographic area, 105 (64.4%) responded to the survey. Table 1 shows characteristics of the respondents. The average number of years postresidency for responding clerkship directors was 17 years (range 4-41 years, SD=9.6 years). Seventy-one percent directed single block clerkships with the remainder providing a combination block/longitudinal clerkship (24%) or only a longitudinal clerkship (4.8%). Most FM clerkships occurred in year 3. Nearly all directors were physicians who provided patient care, and two-thirds of respondents were from public institutions.

Use of structured POCUS education and training did not significantly vary between public and private medical schools or by clerkship director gender or race (P>.05; Table 1). These characteristics were similar for other procedure education and training with the exception of race; although statistically significant, the small number of non-White respondents resulted in a spurious relationship (P=.0002; Table 1). Class size did not significantly differ between clerkship directors using POCUS education and training and those that did not (mean=128.5, SD=54.6 vs mean=161.3, SD=65.2; P=.052). Clerkship directors' percentage of protected time did not significantly differ between clerkship directors using POCUS and/or other procedure education and training and those that did not (mean=31.4%, SD=16.6 vs mean=31.0%, SD=13.6; P=.579).

POCUS and Procedural Training During FM Clerkship

Clerkship directors were asked about structured POCUS and other procedural instruction in their clerkships. In the survey questions, "structured" was specifically defined as experiences that were guaranteed for all students, not just those that occurred through patient care. Only 14 of responding clerkship directors (13.9%) reported structured POCUS education during FM clerkship. Of those incorporating POCUS, the average number of years POCUS had been used was 2.4 (SD=1.0). Half of the respondents taught POCUS primarily in the vascular and/or cardiovascular system setting, such as abdominal aorta, vena cava, or venous evaluation, and 35.7% taught primarily

TABLE 1. Respondent Characteristics by POCUS Education and Other Procedural Education

	n (%)	POCUS education, n (%)		Other procedural education, n (%)	
	Overall (N=105)	Yes (n=14)	No (n=87)	Yes (n=49)	No (n=48)
Is your medical school considered to be public or private?					
Public	68 (65)	9 (64)	56 (64)	32 (65)	30 (63)
Private	35 (33)	5 (36)	30 (34)	17 (35)	17 (35)
No response	2 (2)	0 (0)	1 (1)	0 (0)	1 (2)
In what state/province is your school located?					
New England (NH, MA, ME, VT, RI, CT) and Middle Atlantic (NY, PA, NJ)	20 (19)	3 (21)	17 (20)	7 (14)	13 (27)
South Atlantic (PR, FL, GA, SC, NC, VA, DC, WV, DE, MD)	21 (20)	4 (29)	17 (20)	11 (22)	9 (19)
East South Central (KY, TN, MS, AL) and West South Central (OK, AR, LA, TX)	18 (18)	1 (7)	16 (18)	8 (16)	8 (17)
East North Central (WI, MI, OH, IN, IL) and West North Central (ND, MN, SD, IA, NE, KS, MO)	23 (22)	4 (29)	19 (22)	11 (27)	10 (15)
Mountain (MT, ID, WY, NV, UT, AZ, CO, NM) and Pacific (WA, OR, CA, AK, HI)	13 (13)	1 (7)	12 (14)	7 (14)	6 (13)
Canada	10 (10)	1 (7)	6 (7)	3 (6)	2 (4)
What is your gender?					
Female	62 (59)	9 (64)	51 (59)	29 (59)	30 (63)
Male	41 (39)	5 (36)	35 (40)	19 (39)	18 (38)
No response	2 (1)	0 (0)	1 (1)	1 (2)	0 (0)
How do you identify yourself? (ethnicity)					
Not Hispanic or Latino	100 (95)	14 (100)	83 (95)	47 (96)	47 (98)
Hispanic or Latino	2 (92)	0 (0)	2 (2)	1 (2)	1 (2)
No response	3 (3)	0 (0)	2 (2)	1 (2)	0 (0)
How do you identify yourself? (race)*					
Asian	13 (12)	0 (0)	12 (14)	3 (6)	9 (19)
Black or African American	8 (8)	1 (7)	7 (8)	0 (0)	7 (15)
White	80 (76)	13 (93)	65 (75)	44 (90)	32 (67)
No response	4 (4)	0 (0)	3 (3)	2 (4)	0 (0)
Are you a physician?					
Yes	103 (98)	14 (100)	86 (99)	49 (100)	49 (100)
No	1 (1)	0 (0)	1 (1)	0 (0)	0 (0)
No response	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)

Notes: Percentages shown are representative of the total number of survey respondents, and the nonresponses to each question are noted. Percentages are rounded to the nearest whole number. Also, 10 additional survey questions are available by contacting the author.

*Race was significantly different between those that had structured other procedural education and those that did not (P=.0002). Abbreviation: POCUS, point-of-care ultrasound

in the musculoskeletal system setting. Other teaching was reported in the abdominal (trauma/nontrauma), obstetrics, and pulmonary systems.

Clerkship directors were queried regarding other structured procedural education. Overall, 50.5% of clerkship directors reported providing structured education in other (non-POCUS) procedures in their clerkships. While more clerkship directors teaching POCUS reported teaching other procedures compared to those who did not teach POCUS, this difference was not statistically significant (62% vs 48.8%, *P*=.553).

POCUS and Other Procedures Performed by FM Clerkship Directors and Preceptors

Relatively few responding clerkship directors with clinical practices (15.2%) used POCUS in their practice, though the majority performed other procedures (Table 2). While POCUS use is a relatively new addition to FM practice, time since graduation training was not associated with the likelihood of performing POCUS in a clerkship director's clinical practice (Yes: 17.3 years [SD=9.4 years] vs No: 20.3 years [SD=12.0 years], *P*=.533). All clerkship director respondents indicated that either most or some of their FM clerkship preceptors performed other procedures. Most respondents (70%) indicted that at least some of their preceptors used POCUS in practice, but 16% reported that none do, and 15% were unaware of whether this was being used in preceptor practices.

Other Ultrasound Education in Undergraduate Medical Education

Clerkship directors were queried about their knowledge of where POCUS education occurred outside the FM clerkship within their institution's medical school curriculum. Twenty-six percent of clerkship director respondents were unaware of where and whether any POCUS education was occurring outside of the FM clerkship. Twenty-eight percent believed that no student POCUS education was occurring outside of their clerkship. The remaining 46% reported that medical students received required structured education in POCUS outside the FM clerkship, either in preclerkship education (ie, year 1 or 2) and/or other required clerkships or clinically based activities.

Clerkship Directors' Perspectives on Education and Specialty Choice

Though a majority (65%) of responding clerkship directors reported feeling that POCUS was an important skill in FM, this opinion was not associated with whether POCUS education and training was included (77% vs 63%, *P*=.6; Table 3). Similarly, while 54% of clerkship directors responded that they strongly agreed or agreed that structured clerkship educational content influences student specialty choice, this agreement did not significantly differ between those providing structured POCUS education and training and those who did not (46% vs 56%, respectively, *P*=0.4; Table 3).

DISCUSSION

This survey revealed that relatively few FM clerkships included structured POCUS education, though a slight majority included structured education in other procedures traditionally performed in FM. This finding is in stark contrast to the education recently described at the FM residency level, where 53% of residency program directors reported established or newly developed core educational POCUS opportunities in their programs; another 14% have elective experiences only.[14] Also, both clerkship directors and family physician preceptors reported rarely performing POCUS in their own practices. Previous reports have indicated that few practicing family physicians have embraced using POCUS in nonacademic practices.[15] Reported estimates in 2015 and 2017 revealed use of POCUS by fewer than 10% of practicing physicians outside of obstetrics.[16]

Previously described barriers to POCUS implementation in medical education have included limited curricular time, lack of access to technology and appropriately skilled trainers, and lack of understanding of ultrasound.[17] In a recent CERA survey of program directors regarding resident education in POCUS, "My faculty lacks appropriate training in performing POCUS" was the most commonly cited barrier.[3] Access to equipment, feeling uncomfortable interpreting images without radiology overread, and reimbursement were the next most commonly cited concerns. Because most clerkship directors serve within academic FM departments, these barriers might be shared across the spectrum of FM education. Nonacademic practicing physicians without high-quality POCUS training during their residency may face similar barriers to incorporating POCUS in their practices; and ultrasound skills, even when learned well in the short-term, may not be retained when not used regularly.[18,19] These issues may further influence the number of family physicians currently using POCUS in their practices, as reflected in clerkship directors' descriptions of preceptor practices in our study.

We previously hypothesized that clerkship directors who more recently completed residency training would more likely report using POCUS and other procedures in their practices and perhaps more often incorporate it into clerkship education. We did not find this to be true; however, due to the small number of respondents reporting using POCUS education and training in their programs (n=14), statistical comparisons were not powerful and further stratification was not possible. Similarly, we were unable to demonstrate that specific institutional factors (ie, size, geographical location) were associated with inclusion of POCUS education in clerkship. We also were unable to demonstrate with any degree of certainty that institutions whose clerkships included POCUS and/or procedural instruction recruited more students into family medicine. This question may be of interest for exploration in future studies because the specialty continues to increase student interest in FM through initiatives such as the 25 × 2030 campaign.[20]

More than half of clerkship director respondents believed that no POCUS occurred outside of their own clerkship or were unaware whether and when this was occurring, while smaller numbers were aware of preclinical and clinical POCUS learning opportunities. Given the complexity of medical education,

TABLE 2. POCUS and Other Procedure Practices in Clerkship Director and Preceptor's Practice

	n (%)
Regarding your current medical practice of POCUS and other procedures	
I don't have a clinical practice (not applicable).	5 (5)
I perform both POCUS and other procedures in my practice.	12 (11)
I do not perform POCUS, but I perform other procedures in my practice.	69 (66)
I perform POCUS but do not perform other procedures in my practice.	2 (2)
I perform neither POCUS nor other procedures in my practice.	9 (9)
No response	8 (8)
Do the physician preceptors for the family medicine clerkship perform POCUS as a part of their practices?	
Yes, most do.	1 (1)
Yes, some do.	66 (63)
No, none do.	15 (14)
I don't know.	14 (13)
No response	9 (9)
Do your preceptors for the family medicine clerkship perform other procedures, such as skin, musculoskeletal, contraceptive, or endoscopic procedures, as a part of their practices?	
Yes, most do.	50 (48)
Yes, some do.	47 (45)
No response	8 (8)

Notes: Percentages shown are representative of the total number of survey respondents, and the nonresponses to each question are noted. Percentages are rounded to the nearest whole number. Also, 10 additional survey questions are available by contacting the author.
Abbreviation: POCUS, point-of-care ultrasound.

TABLE 3. Clerkship Directors' Perspectives on Education and Specialty Choice by Structured POCUS and/or Other Procedural Education or Training

	n (%)	POCUS education n (%)		Other procedural education n (%)	
	Overall	Yes	No	Yes	No
	(N=105)	(n=14)	(n=87)	(n=49)	(n=48)
POCUS is an important skill for family physicians.					
Strongly disagree or disagree	6 (6)	1 (7)	5 (6)	3 (6)	3 (6)
Neither agree nor disagree	28 (27)	2 (14)	26 (30)	14 (29)	14 (29)
Strongly agree or agree	62 (59)	10 (71)	52 (60)	31 (63)	31 (65)
No response	9 (9)	1 (7)	4 (4)	1 (2)	0 (0)
Structured education delivered during clerkship significantly influences student specialty choice.					
Strongly disagree or disagree	12 (12)	0 (0)	12 (14)	6 (12)	6 (13)
Neither agree nor disagree	32 (31)	7 (50)	25 (29)	17 (35)	15 (31)
Strongly agree or agree	52 (50)	6 (43)	46 (53)	25 (51)	27 (56)
No response	9 (9)	1 (7)	4 (4)	1 (2)	0 (0)

Notes: Percentages shown are representative of the total number of survey respondents, and the nonresponses to each question are noted. Percentages are rounded to the nearest whole number. Also, 10 additional survey questions are available by contacting the author. Abbreviation: POCUS, point-of-care ultrasound

the finding that FM clerkship directors are not fully aware of what occurs in other curricular areas is not surprising. Attempting to get a broader picture of the scope of ultrasound training across institutions, we requested data from AAMC's curriculum inventory of US allopathic medical schools accredited by the Liaison Committee on Medical Education (LCME). In the 2018-2019 academic year, among 107 schools that provided ultrasound education data, 22 schools (20.6%) reported some type of required US educational experiences across year 3 curriculum, with education occurring in an average of 1.73 separate courses or blocks per school that included ultrasound education.[7] With 14% of FM clerkship directors reporting POCUS instruction in our survey, assuming that the FM clerkship may represent a large portion of this education is tempting; however, this assumption is likely not accurate. The AAMC data is compiled using curriculum data, often from a curriculum or learning management system, rather than from the direct reports from course directors about course content. Additionally, the AAMC data report did not specify ultrasound in the context of patient care and therefore may not represent POCUS, but rather exposure to more traditional radiology department-based use of ultrasound in general.

Structured procedural education for non-POCUS procedures, such as skin, joint and gynecologic, were more likely than POCUS to be taught through formal clerkship activities, and the majority of student preceptors were reported to perform these procedures in their clinical activities. POCUS exposure during clerkship clinical preceptor experiences was much less certain. Given the lag between academic and nonacademic POCUS use in family medicine practices, it may be a number of years before a critical mass of trained family physicians are performing POCUS and modeling this for clerkship students as a routine part of their practices.

Our study faced some limitations. While the response rate (64.42%) was very strong, our findings were insufficient for making meaningful comparisons between several characteristics that might be associated with POCUS incorporation into clerkship education. Osteopathic medical schools are not included in CERA surveys and are therefore not reflected in our data. In addition, bias may have been reflected in those who chose to answer the survey and/or in POCUS questions. This concern is mitigated by the fact that POCUS questions were just one section of a larger survey, which included questions about preceptor sites, sexual health education, physical activity, and active learning methods. Our survey did not assess barriers to POCUS and other procedural education in the clerkship, which could be explored in further studies. We also queried clerkship directors regarding knowledge of their institution's overall curriculum, as well as the scope of practice of their precepting family physicians. Depending on factors such as clerkship and curricular design, geographical distribution of students for clinical experiences, and the clerkship director's individual level of involvement in the larger institutional curriculum, clerkship directors may not have had access to this information or may have had inaccurate perceptions of their students' experiences. While some respondents admitted not knowing, others may have inaccurately believed that they knew how POCUS education was occurring in their institution. Lastly, because years of postresidency were calculated from graduation year, this calculation did not account for any time the clerkship director may have taken off nor account for years spent in private practice vs academic medicine, and may have confounded the results associated with this variable.

In the past, some researchers have challenged assumptions about the benefits and rationales for incorporating ultrasound education in early undergraduate medical education based on poor-quality evidence for improvements in knowledge, physical exam skills, or diagnostic accuracy.[21] While a growing body of evidence supports POCUS use in clinical practice, a need remains for high-quality research into the best educational practices for learners across the medical spectrum. Learners clearly enjoy and desire POCUS training, but establishing what skills are optimal for which outcomes of interest will be important. Fortunately, POCUS technology is likely to continue to improve in quality, portability, and affordability, improving access for both academic departments of institutions and practicing clinicians.

Our study showed that most clerkship director respondents believed that POCUS is an important skill for family physicians, yet relatively few were structurally including it in their clerkship. This finding provides a clear opportunity to ensure that our students learn that POCUS is part of a family physician's skill set. Adding this experience to clerkship activities, particularly when not reliably experienced in general clinical encounters, can bridge the gap between medical school training experiences and expectations for the future reality of practice. As evidence continues to guide the incorporation of POCUS into FM practice, the community must continue to critically evaluate POCUS usefulness and effects on patient-oriented outcomes, and to use this knowledge to establish the ideal timing and mechanisms for teaching these skills.

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