

AAIM Perspectives

AAIM is the largest academically focused specialty organization representing departments of internal medicine at medical schools and teaching hospitals in the United States and Canada. As a consortium of five organizations, AAIM represents department chairs and chiefs; clerkship, residency, and fellowship program directors; division chiefs; and academic and business administrators as well as other faculty and staff in departments of internal medicine and their divisions.

Current Point of Care Ultrasound Use and Training Among Internal Medicine Residency Programs from the 2020 APDIM Program Director's Survey



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BACKGROUND

Point of care ultrasound (POCUS) training is increasingly being integrated into internal medicine residency curricula. This change is occurring in the context of strengthening evidence for POCUS applications,¹ marked improvements in technology and affordability,

increasing training and use by practicing internists, and growing interest in POCUS training among residents.²⁻⁴

A 2012 national survey of internal medicine residency programs demonstrated that the majority of programs already had (25%) or were developing (35%) a formal POCUS curriculum.⁵ Numerous residency programs have published descriptive studies of their POCUS training curricula with some reporting encouraging results regarding feasibility, acceptability, improvement in knowledge, and confidence of POCUS users.⁶⁻¹¹ Challenges and barriers that have been noted include a lack of trained instructors, equipment availability, and resident supervision. In 2019, the Alliance for Academic Internal Medicine (AAIM) published a position statement recognizing the clinical benefits of POCUS use and integrating POCUS training in internal medicine residency.¹²

Current POCUS training and use during residency as well as the important barriers to implementation have not been assessed systematically across internal medicine residency programs nationally. A 2015

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nationally representative survey of internal medicine program directors included limited questions on use of ultrasound guidance for procedures but did not gather data on diagnostic POCUS applications.¹³ In 2020, we collaborated to gather data on current POCUS use and training among internal medicine residency programs focusing primarily on diagnostic applications; this article reports key findings from the POCUS questions of the 2020 Association of Program Directors in Internal Medicine (APDIM) Survey and describes implications of these findings for future POCUS use within residency programs.

METHODS

Study Setting and Participants

APDIM is the aspect of the Alliance that focuses on residency program directors, faculty, and staff. The APDIM Survey Committee surveys internal medicine residency program directors annually. The complete methodology for fielding an APDIM Annual Survey has been previously published.¹⁴

Survey Instrument and Development

To develop the 2020 APDIM Survey, an open call for survey topics resulted in multiple groups submitting proposals for POCUS questions. The APDIM Survey Committee reviewed the blinded proposals for POCUS questions and voted unanimously to include them in an off-cycle survey planned for spring 2020. Due to the COVID-19 pandemic, the separate POCUS survey was cancelled, and the content was incorporated as a thematic section in the 2020 APDIM Annual Survey. Two committee members were appointed to co-develop the survey questions with nationally recognized POCUS subject matter experts.

The final POCUS section included 23 questions on POCUS use and training during internal medicine residency. Question types included multiple-choice, 5-point Likert scales, numerical entry, and free-text boxes when “other” was selected. Some questions included conditional (skip or display) logic.

From April to June 2020, the survey questions were drafted, pilot tested, and revised based on feedback. AAIM staff programmed the survey instrument in the Qualtrics Survey platform (Provo, Utah). The survey was pilot tested for content validity by the APDIM Survey Committee and the AAIM Research Committee

from late June through July 2020. The survey landing page served as the informed consent page, and the study (#20-AAIM-113) was deemed exempt by Pearl IRB (US DHHS OHRP #IRB00007772) under FDA 21 CFR 56.104 and 45CFR46.104 (b)(2).

PERSPECTIVES VIEWPOINTS

- Point of care ultrasound (POCUS) is increasingly prevalent within internal medicine training.
- A national survey of the Association of Program Directors in Internal Medicine found most residency training programs include POCUS education within their curriculum.
- Diagnostic POCUS education is valued and increasingly present, but barriers to continued integration into the standard curriculum exist, and are primarily related to faculty expertise and availability.

Statistical Analysis

The dataset was appended with data from external sources.¹⁵⁻

¹⁹ Frequencies and percentages were reported for categorical variables and means for continuous variables or medians when the variability was large. Characteristics of responding programs were compared with the complete survey-eligible population (Table 1). The adjusted Wald (Pearson) test of association was used to compare categorical variables. The

Mann-Whitney-Wilcoxon test was used to compare the means of continuous variables with dichotomous variables, and either a one-way analysis of variance ANOVA or the Kruskal-Wallis test was used to compare the means of continuous variables that exceeded 2 categories, depending on whether the distribution was normal or parametric. Comparisons based on residency program type were dichotomized into “university-based” and “all other program types” (community-based, university-affiliated, and military-based). Data analysis was conducted in Stata 16 SE (StataCorp, College Station, Tex), with an alpha level of .05 designated for statistical significance. Due to item non-response or survey conditional logic, some denominators do not sum to the total number of section respondents. Percentages were rounded to whole numbers for result reporting purposes.

RESULTS

Four hundred twenty-nine program directors of APDIM-member residency programs, representing 83% of all ACGME-accredited internal medicine residency programs, were invited to participate in the survey. The overall survey response rate was 61% (260 of 429). There were no significant differences in characteristics of responding and non-responding programs (Table 1). The median number of ACGME-approved resident positions for the 2019-2020 academic year for responding programs was 54 (± 43) and 52 (± 41) for the population ($P = .251$). Overall, program directors recognized POCUS training as a medium or high priority for their program to recruit applicants (82%), patient care during residency (90%), and resident preparation for future clinical practice (93%).

Table 1 Core Characteristics of Responding and Nonresponding Internal Medicine Residency Programs: 2020 Survey of US Internal Medicine Residency Program Directors

	Respondents (n = 260) No. (Column %)	Nonrespondents (n = 169) No. (Column %)	N = 429)	
			No. (Column %)	P Value*
Program type (AMA-FREIDA)				
Community-based, university-affiliated	112 (43.1)	94 (55.6)	206 (48.0)	.099
University-based	99 (38.1)	37 (21.9)	136 (31.7)	.071
Community-based	46 (17.7)	35 (20.7)	81 (18.9)	.569
Military-based	3 (1.2)	3 (1.8)	6 (1.4)	.465
Census region (US Census Bureau) [†]				
West	88 (33.9)	44 (26.4)	132 (30.9)	.399
Northeast	82 (31.5)	49 (29.3)	131 (30.7)	.712
Midwest	55 (21.2)	42 (25.2)	97 (22.7)	.483
South	35 (13.5)	32 (19.2)	67 (15.7)	.242
VA affiliation: yes (ACGME)	96 (36.9)	55 (32.4)	151 (35.2)	.422
Accreditation status (ACGME)				
Continued or continued with warning	243 (93.5)	161 (95.3)	404 (94.2)	.537
Initial or initial with warning	17 (6.5)	8 (4.7)	25 (5.8)	
	Mean (SD)	Mean (SD)	Mean (SD)	P Value [‡]
Program size: No. ACGME approved positions (median) [§]	54 (42.8)	48 (37.5)	52 (40.9)	.251
ABIM pass rate 2017-2019 (%); n = 231, n = 149, n = 380	92.4 (6.4)	89.7 (10.2)	91.3 (8.2)	.573
Program director tenure as of 2020 (years; ACGME)	5.7 (5.6)	6.2 (6.3)	5.9 (5.9)	.773
Program accreditation year (ACGME)	1976.4 (23.8)	1978.3 (24.9)	1977.1 (24.3)	.550
Average USMLE Step 1 Score (FREIDA); n = 211, n = 134, n = 345	212.6 (11.0)	213.7 (12.9)	213.0 (11.7)	.272

AMA-FREIDA = American Medical Association Residency and Fellowship Database; ACGME = Accreditation Council for Graduate Medical Education; ABIM = American Board of Internal Medicine; VA = Veterans Affairs; USMLE = United States Medical Licensing Examination; SD = standard deviation.

*Bivariate (adjusted Wald [Pearson]) test of association with 1 degree of freedom) used for categorical variables.

[†]Excludes programs from 2 US territories, due to small cell sizes and data confidentiality.

[‡]Mann-Whitney-Wilcoxon test.

[§]Equality-of-medians test (continuity corrected Pearson chi-square).

Procedural POCUS

Among programs that teach procedural POCUS applications to residents, 61% reported having a formal curriculum and 34% of programs reported providing exposure, such as during intensive care unit (ICU) or emergency department (ED) rotations. Only 2% reported that their program did not provide any exposure to ultrasound for procedural guidance; the remaining 3% reported “other” training. A higher percentage of university-based programs included procedural POCUS education as part of their formal curriculum compared with all other programs (82% vs 48%, $P = .023$). Conversely, a higher percentage (45%) of all other program types provided procedural POCUS training through exposure alone compared with university programs (45% vs 17%, $P = .035$). The most frequently taught procedures with ultrasound guidance were central line placement (97%), paracentesis (91%), thoracentesis (80%), arterial line placement (51%), and peripheral intravenous line placement (40%) (Table 2). The same 5 procedures were most often taught by programs that only provided exposure to POCUS (96%, 72%, 71%, 45%, and 31%, respectively). Among

programs that formally teach ultrasound-guided procedures, university-based programs were more likely to teach paracentesis (95% vs 87%, $P = .044$) and peripheral intravenous line insertion (54% vs 25%, $P = .043$) when compared to all other program types.

Diagnostic POCUS

The majority of internal medicine residents are currently exposed to some elements of diagnostic POCUS use with fewer than 5% of programs reporting that their residents receive no exposure. Of the 12 programs that reported providing no exposure, only 1 is a university-based program (1% vs 7%, $P = .018$). Of all the programs that reported providing exposure, 35% provided formal teaching to all of their residents, 28% provided formal teaching to some but not all of their residents (eg, via electives), and the remaining 38% provided exposure in some settings (eg, ED and ICU), but not as part of a formal curriculum. University-based programs were more likely to formally teach diagnostic POCUS compared with all others (82% vs 46%, $P < .001$). The median age of diagnostic POCUS programs was 3 years (range: <1 year to 20 years). Of all the programs that

Table 2 Common Procedural and Diagnostic POCUS Applications

Procedures Taught Using Procedural POCUS			
	Percent (#) of University Programs	Percent (#) of Other Programs	<i>P</i> Value*
Central line placement	96% (77)	97% (73)	.724
Paracentesis	95% (76)	87% (65)	.044
Thoracentesis	80% (64)	80% (60)	.999
Peripheral IV placement	54% (43)	25% (19)	.043
Arterial line placement	51% (41)	51% (38)	.964
Arthrocentesis	23% (18)	23% (17)	.986
Lumbar puncture	23% (18)	21% (16)	.894
Peripherally inserted central catheter placement	8% (6)	12% (9)	.306
Diagnostic POCUS topics taught			
	Percent (# respondents)		
Cardiac	94% (136)		
Lung	94% (135)		
Volume assessment	88% (126)		
Abdominal free fluid (ascites)	87% (125)		
Pleura	71% (102)		
Bladder (urinary retention)	42% (60)		
Lower extremity deep vein thrombosis	40% (58)		
Kidneys	36% (52)		
Musculoskeletal	26% (37)		
Skin and soft tissues	21% (30)		
Thyroid	8% (12)		
POCUS = point of care ultrasound.			
*Bivariate (adjusted Wald [Pearson]) test of association with 1 degree of freedom) used for categorical variables.			

reported not having a formal diagnostic POCUS curriculum, 48% said they will “very likely” have one in fewer than 5 years.

The most frequently taught diagnostic POCUS applications were cardiac (94%), lung (94%), volume assessment (88%), abdominal free fluid (87%), and pleural ultrasound (71%) (Table 2). Common settings to deliver diagnostic POCUS training were ICU rotations (81%), didactic sessions (59%), ward rotations (51%), POCUS elective rotations (48%), and ED rotations (47%). The most common teaching modalities were supervised scanning during patient care (84%); online videos, lectures, modules, and questions (77%); in-person classroom lectures (74%); procedure service opportunities (48%); and dedicated ultrasound teaching or scanning rounds (44%) (Figure 1).

Barriers to POCUS Training

Barriers to training residents in diagnostic POCUS were similar for both programs that are developing and those with an established diagnostic POCUS program. Only 4% of programs without a formal curriculum and 4% of programs with a formal curriculum felt that POCUS was not an educational priority. For programs without a formal curriculum, the 2 most commonly cited barriers to implementing training were lack of trained instructors (77%) and lack of POCUS

“champions” (51%). Lack of trained faculty as a barrier carried over to programs with established diagnostic POCUS curricula with the 2 most commonly cited barriers being lack of trained instructors (58%) and lack of financial support for faculty time (56%). Programs with dedicated diagnostic POCUS programs had a median of 2 (range: 0-8) POCUS champions with 35% of those programs providing 0.2 full-time equivalent (range 0.05-2.5) of combined faculty salary support. Programs that did not provide salary support for POCUS faculty were more likely to report they were “not satisfied” with their diagnostic POCUS program compared with programs that provide faculty salary support (24.7% vs 9.4%; $P = 0.017$).

Lack of financial support for ultrasound machines was the third most commonly cited barrier by both programs with and without formal curricula, but after removing programs that answered that “all of these [barriers] are an equal obstacle,” only 11% of programs without a formal curriculum and 10% of programs with a formal curriculum cited it as the single greatest barrier. The reported barriers are displayed in Figure 2.

Machines, Infrastructure, and Supervision

Among the programs with diagnostic POCUS training programs, respondents reported having ownership or primary use of a median of 1 cart-based

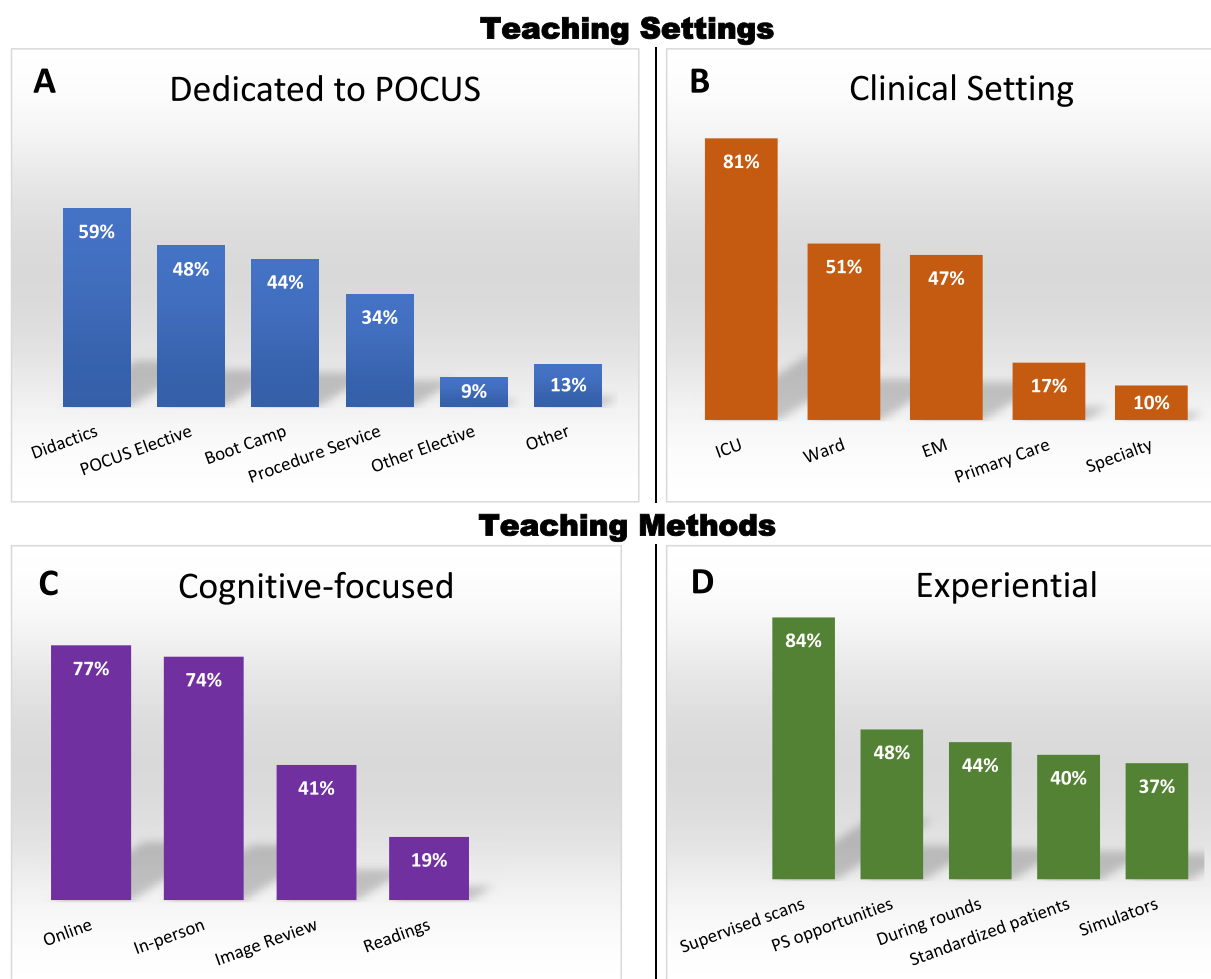


Figure 1 Rates of POCUS teaching settings dedicated to POCUS (A) and general clinical settings (B), and teaching methods using cognitive-focused (C) or experiential (D) approaches. ICU = intensive care unit; EM = emergency medicine; POCUS = point-of-care ultrasound; PS = procedure service.

ultrasound system and access to a median of 2 additional cart-based systems. Program directors also reported having ownership or primary use of a median of 2 handheld ultrasounds devices. When analyzed by program type, university-based programs were more likely to have an additional shared machine (median of 3 vs 2; $P < .003$), otherwise no other differences between program types were observed with respect to numbers of machines available for internal medicine resident POCUS training.

Of the 153 residency programs identified as having a current diagnostic POCUS curriculum, the majority (63%) reported that residents archive images for quality assurance “rarely” or “never.” A minority of programs with a diagnostic POCUS curriculum reported that their residents document POCUS findings (27%), archive images for quality assurance (12%), save images into the electronic health record (4%), or bill for POCUS use (2%) “most of the time” or “always.”

When asked whether having a diagnostic POCUS curriculum allowed their residents to use their diagnostic findings to make medical decisions without

direct supervision, 45% reported “no,” 13% reported “yes, without a specific POCUS competency assessment,” and 9% reported “yes, but only after passing a competency assessment.” The remaining 33% reported having not explicitly addressed this issue within their program. Of the 14 programs that reported using a competency assessment, 71% used direct observation of POCUS use on actual patients to sign off residents, 64% reported using a numeric threshold to define competency, and 50% reported requiring residents to develop an image portfolio before being allowed to use POCUS independently. Less commonly reported methods included formal POCUS skills evaluation (eg, objective structured clinical examination (OSCE)) (29%), direct observation in a simulated environment (21%), or completion of an ultrasound rotation (21%).

DISCUSSION

We have presented data from the largest national survey on POCUS training in internal medicine residency

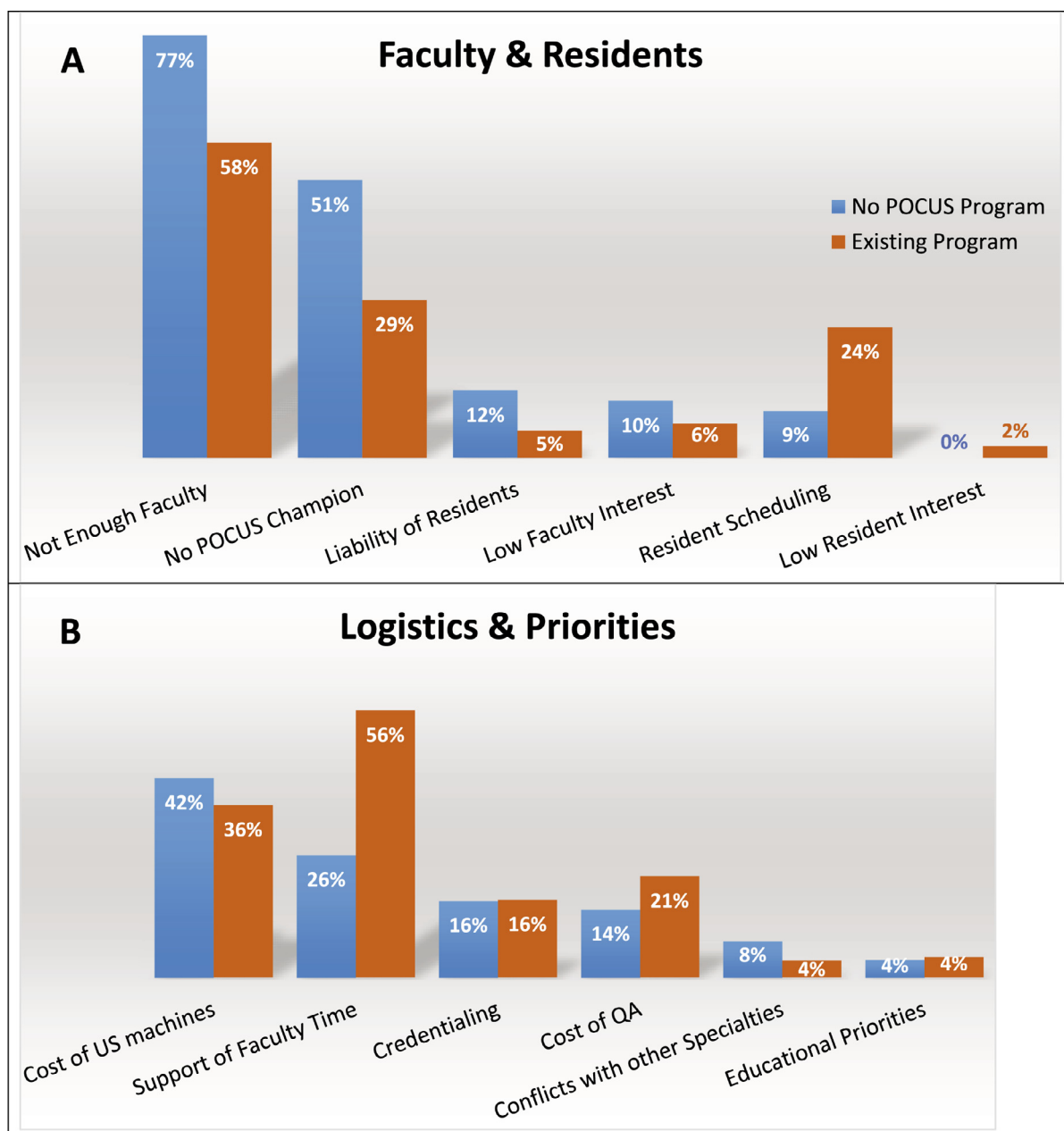


Figure 2 Barriers to establishing and optimizing a POCUS program categorized by faculty and residents (A) and logistics and priorities (B). POCUS = point-of-care ultrasound; QA = quality assurance; US = ultrasound.

programs. Procedural POCUS training is now ubiquitous with 94% of programs offering at least exposure to some POCUS-guided procedures. Although half of program directors felt that diagnostic POCUS training is a high priority for residents' future clinical practice, only one-third of residency programs had a formal curriculum to teach diagnostic POCUS to all internal medicine residents, and only 22% were satisfied with the current state of POCUS training for their residents. Currently, the majority of residency programs expose residents to diagnostic POCUS applications, but only a minority provide formal training to all residents. We identified important barriers to integrating POCUS

training into internal medicine residency, including lack of trained faculty, lack of support for faculty time, and limited ultrasound equipment availability.

Our survey findings demonstrate continued growth of formal POCUS curricula compared with previous surveys of internal medicine programs, from 25% reporting formal POCUS programs in 2013,⁵ to 37.5% in 2016,²⁰ and now 61% in 2020. A key finding of this national survey was that the vast majority of internal medicine residency programs have begun to teach diagnostic POCUS applications. This finding is aligned with AAIM's position statement endorsing the integration of POCUS training into residency;¹² however,

teaching diagnostic or procedural POCUS applications is not a current ACGME requirement for internal medicine residency programs. The rationale for teaching POCUS applications is partly explained by survey findings that most program directors felt teaching POCUS was a high priority for preparing residents for future practice of medicine, patient care during residency, and residency recruitment. Similar to AAIM, the American College of Physicians and the Society of Hospital Medicine have endorsed the use of POCUS by internal medicine-trained physicians.^{21,22} The American College of Physicians Clinical Guidelines Committee has published guidelines on the use of POCUS for the evaluation of patients with acute dyspnea.²³

Most internal medicine residency programs that reported teaching diagnostic POCUS are still in the early developmental phases as evidenced by the large percentage of programs who do not offer it to all of their residents. Additionally, nearly half of programs teaching diagnostic POCUS applications did not allow residents to make medical decisions based on findings if using POCUS unsupervised, and an additional one-third of programs have not addressed this issue. Resource-intensive infrastructure for documentation, image archiving, and quality assurance have not yet been established for the majority of internal medicine residency programs, which makes assessing competency difficult. Until comprehensive programmatic support is provided for POCUS training, residents with limited exposure and supervision will not be able to demonstrate competency for the wide variety of POCUS applications currently used.

Barriers preventing internal medicine residency programs from establishing or improving formal POCUS curricula have remained relatively unchanged since 2013, with lack of trained faculty being the greatest perceived barrier to implementation of POCUS. Barriers were consistent across program types. Resources are needed to support faculty training because achieving POCUS competency requires faculty to dedicate a significant amount of time to their own training. Internal medicine residency programs that supported their POCUS champions by funding training and providing protected time had higher levels of satisfaction regarding their POCUS training programs.

To overcome barriers and advance POCUS training within internal medicine as a specialty, residency programs will require ongoing support and advocacy from governing bodies. Statements of support provide some rationale for resource allocation, but POCUS curricula are unlikely to be fully realized until residency programs are required to provide POCUS training. For emergency medicine, incorporation of POCUS training into ACGME requirements led to integration of POCUS training into residency programs, and we foresee the same being true for internal medicine.

Diagnostic POCUS training during residency continues to make steady advancements with an increasing number of programs providing training to their residents. We anticipate this trend to continue as more internal medicine faculty receive POCUS training and certain POCUS applications become standard practice in medicine.

We would like to dedicate this article in remembrance of Dr. Daniel Schnobrich who tragically died shortly after submission of this manuscript. Dan was an early adopter and advocate for the advancement of POCUS within the field of internal medicine. He was a great colleague, a better friend, and an inspiration to many. He will be tremendously missed.

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