ALLIANCE for ACADEMIC INTERNAL MEDICINE

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.

Point-of-Care Ultrasound for Internal Medicine Residency Training: A Position Statement from the Alliance of Academic Internal Medicine

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BACKGROUND

Point-of-care ultrasound (POCUS) is defined as ultrasound used at the bedside by the provider to answer directed clinical questions and guide clinical care. While POCUS first gained popularity in emergency medicine, its application is rapidly expanding in the field of internal medicine.[1] This method of ultrasound can conceptually be split into 2 groups: procedural and diagnostic. Procedural POCUS (ultrasound-guidance of common bedside procedures) improves patient safety and is now standard of care for many procedures.[2–6] Diagnostic POCUS has a wide range of specific applications including, but not limited to, cardiac, pulmonary, renal, abdominal, vascular, and musculoskeletal examinations.[7–9] Although the clinical evidence base is still being developed for diagnostic POCUS in internal medicine, analogous use of POCUS in other specialties has been shown to improve diagnostic accuracy, decrease time to diagnosis, and provide additional prognostic information.[10–12] Unlike many technological advances in medicine, POCUS brings the physician back to the bedside, and there is growing evidence that POCUS increases patient satisfaction and shared diagnostic understanding.[13,14]

POCUS is being integrated rapidly into internal medicine across the longitudinal training spectrum—through clinical curricula at both undergraduate medical education (UME) and graduate medical education (GME) levels and through continuing medical education (CME) courses and certificates for practicing internists.[15] Based on a recent national survey, over one-half of medical schools reported having formal ultrasound curriculum, usually in anatomy, physiology,

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and pathology courses.[16] Additionally, ultrasound-enhanced instruction is being taught as an adjunct to the traditional physical examination, because it has been shown to improve overall physical examination skills when used in parallel to traditional methods.[17,18] Some medical schools are now loaning incoming medical students a hand-held ultrasound device.[19]

Beyond foundational UME, internal medicine residency programs are recognizing that residents are seeking opportunities for training in POCUS; recent surveys of internal medicine residency programs show rapid creation of POCUS curricula and high level of interest among program leadership.[15] Beyond residency, POCUS is increasingly used in both inpatient and outpatient medical practice as well as within many subspecialties.

While many internal medicine training programs across the educational spectrum are trying to implement POCUS curricula, most face significant barriers. While programs increasingly may have individual champions for POCUS to help teach trainees, many programs face the dilemma of trainees who are more skilled in POCUS than their supervising physicians. In addition to the lack of POCUS-trained faculty, other barriers include lack of ultrasound equipment, a lack of standardized curriculum, and lack of crucial programmatic infrastructure, such as image archival systems and quality assurance mechanisms.

Given the trends, many programs are seeking guidance from leadership. Yet, unlike the curricular guidelines put into place by the American College of Emergency Physicians for POCUS training, there are currently no published guidelines from any internal medicine society. The goal of this statement is to offer a first step in addressing this need by outlining support and providing potential methods for programmatic implementation.

STATEMENT OF SUPPORT

The Alliance recognizes and supports the integration of POCUS across the longitudinal training environment of UME, GME, and CME for internal medicine. From helping to teach medical students anatomy and the physical examination to increasing diagnostic accuracy and decreasing procedural complications among residents, fellows, and practicing physicians, POCUS has demonstrated broad utility within internal medicine.[20–22] This broad and rapid uptake underscores the need for medical school and residency programs to better prepare their trainees for POCUS in postresidency careers. As the research base expands and training becomes more widespread, POCUS use will likely continue to grow and ultimately become a standard part of the internist's skill set.

PERSPECTIVES VIEWPOINTS

- The use of point-of-care ultrasound (POCUS) has shown clinical benefit to patient care within the field of internal medicine.
- The Alliance of Academic Internal Medicine (AAIM) supports the integration of POCUS across the longitudinal training environment.
- Training programs looking to incorporate POCUS training into the curricula should be supported.

For programs looking to develop POCUS education to address these trends, determining how to construct and deliver curriculum can be difficult. The Alliance recognizes that integration of POCUS into internal medicine training environments will take time, and the scope of practice may vary significantly from one environment to the next. Defining a specific POCUS curriculum for internal medicine training is outside the scope of this document. Nevertheless, the following sections offer an outline of some fundamentals for implementing successful internal medicine POCUS programs.

CURRICULUM DESIGN AND TEACHING METHODS

Teaching methods and goals will differ for POCUS training aimed at 1) augmentation of anatomy, physiology, pathophysiology, and physical examination portions of UME ("educational POCUS"); 2) use as a diagnostic tool to assess for emergent pathologies, refine differential diagnosis, and guide treatment; and 3) invasive procedural guidance ("clinical POCUS").

A major variant in existing internal medicine POCUS curricula is the structure of training. Multiple models of training exist, ranging from "crash course" bolus learning sessions to fully integrated, continually reinforced learning.[23] Regardless of method, longitudinal integration into training is superior to a single-session training model.[24]

One unique aspect of clinical POCUS is the need to integrate several different types of skills, knowledge, and behaviors. The I-AIM model[25] offers a mnemonic to remind learners that they must have the knowledge regarding *Indication* for the study, which can be thought of as knowing the focused question the provider is asking to narrow a differential diagnosis or guide a procedure. Additionally, learners must have the skill to *Acquire* the ultrasound images, the knowledge to *Interpret* the ultrasound images, and the knowledge and behaviors to utilize appropriate *Medical decision-making* regarding the patient based on acquired and interpreted images.

When teaching clinical POCUS use, a combination of didactic and hands-on practical experience is essential. In the current free open access medical education (FOAMed) landscape, most didactics do not need to be

created de novo and some didactics can be asynchronous. FOAMed resources include videos, blogs, case quizzes, etc. Because there is no quality assurance for FOAMed, the accuracy and internal medicine appropriateness of each resource should be assessed by primary faculty prior to use.

The technical or hands-on aspect of POCUS education is largely rooted in the scanning of other humans. For undergraduate and health professions student education, it is often peer scanning of classmates, which may raise ethical concerns.[26] When not acceptable or, in the case of paid courses, volunteers or standardized patients (also known as human ultrasound models [HUMs]) are utilized for hands-on practice. These individuals are often healthy volunteers with lower body mass index than the average patient and who lack significant pathology, and thus have limits for their translation of POCUS skills to patients. To develop adequate scanning skills and proficiency, mentored scanning of individuals with pathology, most often patients, is paramount. It is crucial to ensure that trainees have the skills to obtain adequate images across a spectrum of body types and possess the knowledge to interpret normal and abnormal images in real-world scenarios. Scanning could occur during planned educational activities or "in vivo" while taking care of patients. Procedural POCUS can be included with any procedural rotation or rotations with a high level of exposure to procedures, such as the intensive care unit. Simulation using task-trainers is a valuable tool to teach the steps of procedural ultrasound, but should not replace supervised, ultrasound-guided procedures until learners are deemed competent. Some companies now offer virtual scanning simulators, but similarly it should not replace proctored scanning of live patients.

Another component of ensuring adequate image acquisition skills is creation of an image portfolio. These images are ideally acquired with no proctor present to allow feedback on technique, findings (seen and missed), and discussion about potential decision-making and clinical course. Image portfolios lead to improved long-term skill retention,[27] likely because repetition in image acquisition and clinical integration is key to mastery. Experts agree that obtaining a quality-assured, basic minimum in number of scans along with direct observation of skills must be done prior to independent use.[28] It should be noted that differences in learning curves exist and have not been well described for internal medicine POCUS, but must be considered when determining minimum scans. Regardless of minimum requirements, comprehensive competency assessments that evaluate skills across the I-AIM framework are needed prior to independent use; additional training should be pursued for individuals who do not reach requisite skill level.

Use of POCUS in the training environment raises unique questions about supervision. Whereas in the nonteaching clinical environment, a provider can be privileged in the use of POCUS, depending on individual competency, use by trainees in the clinical environment is partially dependent on the competency of the supervising provider. Some argue that all faculty need to be skilled in all aspects of the I-AIM framework. However, as of 2018, there were over 200,000 active US American Board of Internal Medicine general medicine diplomates,[29] and the potential training needs currently far outstrip the availability. The idea of "cognitive POCUS," which trains providers in indications, interpretation, and medical decision-making but not acquisition, has been introduced to quickly develop faculty who can supervise POCUS-proficient trainees. For example, a course to educate senior faculty interested in learning the common sonographic terms and findings might not include any hands-on scanning, but rather simply orientation to concepts, basic image interpretation, the performance characteristics, and source of false positives and negatives of many definitive findings their learners may bring to them. While a potential alternative for faculty development, the adequacy of this approach has not yet been thoroughly explored.

RESOURCE AVAILABILITY

Certain resources are essential to safely and efficiently integrate POCUS across the educational and clinical spectrum of internal medicine. At a minimum, they include the availability of ultrasound machines and providers with expertise in POCUS.

Portable ultrasound devices have decreased in both size and cost in recent years. Nearly all devices sanctioned for clinical use by the US Food and Drug Administration are of sufficient quality to use for internal medicine POCUS applications. The most appropriate device depends on the POCUS application (eg, which probe types for various systems) and the use environment (eg, localization of patients, number of learners, hospital information technology infrastructure). However, across most scenarios, 2 constant requirements are availability and portability, because machines must be easy to access and use so they can be integrated into learning and clinical environments without disrupting workflow. Other considerations exist, such as the size of screen for educational environments when multiple learners, patients, or family members are viewing the screen. Within the clinical environment, considerations such as the ability to archive and review images may be necessary for documentation, billing, and quality assurance.

The presence of POCUS-trained supervising physicians is a necessity and often is a limiting step of POCUS integration into both educational and clinical internal medicine environments. While partnership with other subspecialties can help develop a program and leverage local expertise, it should be noted that the

use of POCUS in internal medicine has important differences from other specialties. The development of POCUS-trained internal medicine physicians is essential.[20] When trainees are using POCUS in clinical decision-making, it is their faculty who must supervise and be responsible for the use of POCUS on patients.

While POCUS is not currently a core competency for internal medicine residency, several opportunities for external certification are available.[30,31] Increasingly, health systems and hospitals are also offering faculty training pathways.[27] As a result, hospitals are increasingly offering privileging in POCUS, allowing providers to use and teach POCUS in the clinical environment, with the safety of both initial certification of competency and ongoing quality assessment. In some cases, these efforts are now supported by non-Accreditation Council on Graduate Medical Education-accredited internal medicine fellowships with a focus on ultrasound.[32]

Both equipment and faculty training require upfront financial investment. While device costs are decreasing rapidly, training of physicians in POCUS is still costly and time consuming. At present, most successful internal medicine programs have an ultrasound director with institutional support, modeled after the organization of most emergency medicine programs.[28]

MODEL PROGRAM

While many variations will inevitably exist, a model POCUS training program would have all the previously described components. Supervised by trained faculty, a longitudinal curriculum could be integrated into inpatient and outpatient experiences. Trainees would have introductory didactics and scanning experience. Individuals would have easy access to equipment to facilitate development of an image portfolio that would be tracked and reviewed within a learning management system. Individuals would ultimately be tested, certified, and follow use longitudinally. Admittedly, this type of program would take several years to build, and implementation would, in most cases, require a funded POCUS director.

Keeping this long-term goal in mind, basic curricular starting points could include a "bolus training" model, where POCUS instruction occurs in 1 or 2 settings. Procedural electives are another effective way to introduce POCUS into training; if no current curriculum exists, procedural POCUS is a good introduction to ultrasound concepts and skills upon which a diagnostic POCUS curriculum can be built.

FUTURE NEEDS

Integrating new technology into traditional internal medicine curricula can be challenging; formally supporting POCUS education in training is a first step in a much longer process.

The Alliance recognizes that many obstacles must be overcome before POCUS can become more widespread throughout internal medicine training programs. Many aspects of POCUS within internal medicine training need to be better defined, including the most effective curricula at various training levels, methods of adequate trainee supervision, and POCUS competency models for various levels of learners. To develop a standard curriculum, we need to understand the impact of various POCUS applications within the field. While the general scope of training may be inferred from looking at how POCUS is currently being used in patient care, there are currently no defined learning outcomes for US internal medicine trainees. International guidelines are beginning to emerge, but the applicability to US training is not known.[33] Additionally, the learning curves of internal medicine trainees has not been well established for the various POCUS applications. While this kind of information exists in other disciplines using POCUS, learning curves are likely unique to the specific field in which they are used due to differences in knowledge base, training techniques, and patient populations. The increasing amount of outcomes-based research available makes it imperative that future guidelines be evidence based.

Once there is further consensus on what should be taught, curricula will need to be built to meet the educational goals. Curriculum could be developed in-line with milestones and entrustable professional activities already in place within the Accreditation Council on Graduate Medical Education guidelines.[34]

Faculty development continues to be a pressing concern. POCUS training seems to be gaining traction more quickly within UME than GME or CME. As medical students transition from UME to GME, there need to be systems in place to ensure continued safe use, which will require POCUS-trained faculty. Once trainees begin to utilize POCUS and incorporate it into clinical care, the level of supervision must ensure appropriate use. Currently, there is a critical lack of POCUS-trained faculty in internal medicine. While internal and external training pathways are increasingly available, current options to train them are burdensome, costly, and of limited capacity; more options will be needed in the near future.

It is necessary to address these needs. Evidence increasingly suggests that POCUS adds value to clinical care, and uptake within UME and GME education is evident and rapid. It is unlikely that this trend will regress; many believe that handheld POCUS systems will eventually become a cornerstone of bedside evaluation. Programs should begin to prepare for the transition to POCUS-augmented clinical care by determining how basic POCUS can be integrated into training to ensure that trainees are best prepared for the future practice of internal medicine.

References

1. Kugler J. Point-of-care ultrasound in internal medicine: challenges and opportunities for expanding use. *South Med J* 2016;109(12):750–3.

2. Karakitsos D, Labropoulos N, De Groot E, et al. Real-time ultrasound-guided catheterisation of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. *Crit Care* 2006;10(6):R162.
3. Leung J, Duffy M, Finckh A. Real-time ultrasonographically-guided internal jugular vein catheterization in the emergency department increases success rates and reduces complications: a randomized, prospective study. *Ann Emerg Med* 2006;48(5):540–7.
4. O'Grady NP, Alexander M, Burns LA, et al. *Guidelines for the prevention of intravascular catheter-related infections, 2011*. Atlanta: Centers for Disease Control and Prevention; 2011.; . Available at: https://www.cdc.gov/infectioncontrol/guidelines/bsi/index.html. Accessed February 24, 2019.
5. Dancel R, Schnobrich D, Puri N, et al. Society of Hospital Medicine Point of Care Ultrasound Task Force, Soni NJ. Recommendations on the use of ultrasound guidance for adult thoracentesis: a position statement of the Society of Hospital Medicine. *J Hosp Med* 2018;13(2):126–35.
6. Cho J, Jensen TP, Rierson K, et al. Society of Hospital Medicine Point-of-Care Ultrasound Task Force. Recommendations on the use of ultrasound guidance for adult abdominal paracentesis: a position statement of the Society of Hospital Medicine. *J Hosp Med* 2019;14:E7–E15.
7. Soni NJ, Lucas BP. Diagnostic point-of-care ultrasound for hospitalists. *J Hosp Med* 2015;10(2):120–4.
8. Tierney DM, Becker JS, Post BD, Rosborough TK. Point-of-care sinus ultrasound: impact within a large internal medicine clinic and review of technique. *South Med J* 2018;111(7):411–7.
9. Chen KC, Lin AC, Chong CF, Wang TL. An overview of point-of-care ultrasound for soft tissue and musculoskeletal applications in the emergency department. *J Intensive Care* 2016;4:55.
10. Kameda T, Taniguchi N. Overview of point-of-care abdominal ultrasound in emergency and critical care. *J Intensive Care* 2016;4:53.
11. Zanobetti M, Scorpiniti M, Gigli C, et al. Point-of-care ultrasonography for evaluation of acute dyspnea in the ED. *Chest* 2017;151(6):1295–301.
12. Laffin LJ, Patel AV, Saha N, et al. Focused cardiac ultrasound as a predictor of readmission in acute decompensated heart failure. *Int J Cardiovasc Imaging* 2018;34(7):1075–9.
13. Howard ZD, Noble VE, Marill KA, et al. Bedside ultrasound maximizes patient satisfaction. *J Emerg Med* 2014;46(1):46–53.
14. Mathews BK, Miller PE, Olson APJ. Point-of-care ultrasound improves shared diagnostic understanding between patients and providers. *South Med J* 2018;111(7):395–400.
15. Schnobrich DJ, Gladding S, Olson AP, Duran-Nelson A. Point-of-care ultrasound in internal medicine: a national survey of educational leadership. *J Grad Med Educ* 2013;5(3):498–502.
16. Bahner DP, Goldman E, Way D, Royall NA, Liu YT. The state of ultrasound education in U.S. medical schools: results of a national survey. *Acad Med* 2014;89(12):1681–6.
17. Walrod BJ, Schroeder A, Conroy MJ, et al. Does ultrasound-enhanced instruction of musculoskeletal anatomy improve physical examination skills of first-year medical students? *J Ultrasound Med* 2018;37(1):225–32.
18. Kimura BJ. Point-of-care cardiac ultrasound techniques in the physical examination: better at the bedside. *Heart* 2017;103(13):987–94.
19. Imaging Technology News. Mount Sinai School of Medicine gives pocket ultrasound devices to its students; September 18, 2012. . Available at: https://www.itnonline.com/content/mount-sinai-school-medicine-gives-pocket-ultrasound-devices-its-students; September 18, 2012 [Accessed March 5, 2019.
20. Soni NJ, Schnobrich D, Matthews BK, et al. Point-of-care ultrasound for hospitalists: a position statement of the Society of Hospital Medicine. *J Hosp Med* 2019;14:E1–6.
21. Dversdal RK, Piro KM, LoPresti CM, Northcutt NM, Schnobrich DJ. Point-of-care ultrasound in the inpatient setting: a tale of four patients. *South Med J* 2018;111(7):382–8.
22. Bhagra A, Tierney DM, Sekiguchi H, Soni NJ. Point-of-care ultrasonography for primary care physicians and general internists. *Mayo Clin Proc* 2016;91(12):1811–27.
23. Clay RD, Lee EC, Kurtzman MF, Dversdal RK. Teaching the internist to see: effectiveness of a 1-day workshop in bedside ultrasound for internal medicine residents. *Crit Ultrasound J* 2016;8:11.
24. Kelm DJ, Ratelle JT, Azeem N, et al. Longitudinal ultrasound curriculum improves long-term retention among internal medicine residents. *J Grad Med Educ* 2015;7(3):454–7.
25. Bahner DP, Hughes D, Royall NA. I-AIM: a novel model for teaching and performing focused sonography. *J Ultrasound Med* 2012;31(2):295–300.
26. Siegel-Richman Y, Kendall JL. Incidental findings in student ultrasound models: implications for instructors. *J Ultrasound Med* 2017;36(8):1739–43.
27. Mathews BK, Reierson K, Vuong K, et al. The design and evaluation of the Comprehensive Hospitalist Assessment and Mentorship with Portfolios (CHAMP) ultrasound program. *J Hosp Med* 2018;13(8):544–50.
28. Ultrasound guidelines: emergency, point-of-care and clinical ultrasound guidelines in medicine. *Ann Emerg Med* 2017;69(5):e27–54.
29. American Board of Internal Medicine. Candidates certified. Available at: https://www.abim.org/~/media/ABIM%20Public/Files/pdf/statistics-data/candidates-certified-all-candidates.pdf. Accessed March 5, 2019.
30. Society of Hospital Medicine. Point of Care Ultrasound Certificate of Completion. Available at: https://www.hospitalmedicine.org/clinical-topics/ultrasonography-cert/. Accessed March 6, 2019.
31. American College of Chest Physicians. Point of Care Ultrasound Certificate of Completion. Available at: http://www.chestnet.org/Education/Advanced-Clinical-Training/Certificate-of-Completion-Program/SHM-COC. Accessed March 6, 2019.
32. Barron KR, Wagner MS, Hunt PS, et al. A primary care ultrasound fellowship: training for clinical practice and future educators. *J Ultrasound Med* 2019;38(4):1061–8.
33. Ma IWY, Arishenkoff S, Wiseman J, et al. Canadian Internal Medicine Ultrasound (CIMUS) Group. Internal medicine point-of-care ultrasound curriculum: consensus recommendations from the Canadian Internal Medicine Ultrasound (CIMUS) group. *J Gen Intern Med* 2017;32(9):1052–7.
34. Nasca TJ, Philibert I, Brigham T, Flynn TC. The next GME accreditation system–rationale and benefits. *N Engl J Med* 2012;366(11):1051–6.