


CONCEPTS

Education

Advanced practice providers proficiency-based model of ultrasound training and practice in the ED

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Abstract

Competency in the application of point-of-care ultrasound (POCUS) has come to be an expected fundamental skill set for advanced practice providers (APPs) in the emergency department. Both American College of Emergency Physicians and the Society of Emergency Medicine Physician Assistants approve of and endorse POCUS use by APPs. However, clinical exposure to and practice of ultrasound in this setting is often variable and without structure. POCUS training must be evolved into a system where developed skills are compatible with clinical need and expectations of APPs. At our institution, we developed a formal, structured POCUS training program for emergency medicine (EM) APPs (including physician assistants and nurse practitioners) and evaluated its efficacy quantitatively by means of a proficiency index. This report examines the EM POCUS training most common to physician assistants and nurse practitioners before practicing at our institution and explores the components of our POCUS training program that have affected program development.

KEYWORDS

clinical practice, emergency medicine, nurse practitioner, point-of-care systems, physician assistants, ultrasonography

1 | INTRODUCTION

Point-of care ultrasound (POCUS) is recognized as a vital tool in the practice of emergency medicine (EM) with specific regard to early diagnosis of pathology and performance of critical, lifesaving procedures. POCUS is reliable, timesaving, cost effective, and safe in different modalities, all of which contribute to the growing ubiquity of POCUS use in emergency departments around the world. In 1990, the American College of Emergency Physicians (ACEP) recognized ultrasound as an important tool among emergency physicians.¹ By 1994,

the Society for Academic Emergency Medicine (SAEM) published the first model POCUS education curriculum, the success of which led to expansion of the training into emergency department (ED) residency programs.² In 2001, ACEP formally published the first policy statement establishing guidelines for emergency ultrasound training and credentialing, which was revised in 2016 and subsequently endorsed by the Society of Emergency Medicine Physician Assistants (SEMPA), a branch of ACEP, the next year.^{3,4,5,6} This endorsement is crucial for the interdisciplinary ED team as it formally extends the POCUS skill set to advanced practice providers (APPs) including physician assistants (PAs) and nurse practitioners (NPs). In a June 2019 policy, ACEP further established their support of the training, practice, and integration of

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APP emergency POCUS programs, supplementing their previous statements regarding credentialing and granting privileges for APP use of POCUS on an institutional level.⁷ However, despite the expansion of training and credentialing guidelines for APPs in EM POCUS programs, models are lacking for incorporating them into practice.

APPs occupy an essential position alongside physicians in the busy ED as a rapidly expanding supplemental work force. Nationally, there are over 26,000 APPs who primarily practice EM.^{8,9} The scope of practice for APPs is currently based on their training and institutional regulation and credentialing, through which they may not receive consistent training or develop appropriate skill sets required to competently use POCUS in the EM setting. In this article, we aim to (1) evaluate current educational guidelines and credentialing processes regarding POCUS for APPs going into EM, and (2) offer an examination of our own APP POCUS training program as an example of successful implementation of ACEP and SEMPA POCUS guidelines.

2 | APP EDUCATION AND TRAINING

The educational and experiential foundations of PA and NP programs vary with regard to prerequisites for program acceptance, requirements for satisfactory completion, and final examinations and certifications. The vast majority of PA programs require 4 years of undergraduate education with attainment of a bachelor's degree and coursework in basic and behavioral sciences. Most programs also require 2000 hours or 3 years of health care experience before application. Prospective students in the United States can apply to 1 of 267 accredited 24- to 36-month PA master's programs to continue classroom education and gain clinical competency through an additional 2000 hours of clinical rotations through a vast array of specialties. Although all PAs complete a clinical rotation in EM, there are no standards or minimum requirements for POCUS training or number of POCUS exams required for graduation.¹⁰ The didactic and clinical years of PA master's programs are designed and accredited by the Accreditation Review Commission on Education for the Physician Assistant, Inc. (ARC-PA). Upon program completion and a satisfactory score on the Physician Assistant National Certifying Exam, the new PA-certified (PA-C) earns a valid and unrestricted license to practice under the supervision of a physician sponsor. Certification maintenance requires annual continued medical education (CME).¹¹

NP program prerequisites also include 4 years of undergraduate education but with coursework in both nursing science and general liberal arts. Satisfactory completion awards graduates a bachelor of science in nursing. They must then pass the National Council Licensure Examination and apply for registered nurse (RN) licensure in their state. RNs then have the option of obtaining a master of science in nursing or a doctor of nursing practice (DNP). On completion of either program, an NP candidate can seek certification from 1 of 2 credentialing bodies (the American Academy for Nurse Practitioners Certification Board or the American Nurses Credentialing Center), both of which offer certification in family or adult/gerontology specialties. It is

notable that NPs are not required to complete a rotation in EM, nor are there minimum standards with training in POCUS or the number of POCUS exams required for graduation. Further, there are no specific routes or established requirements for NPs to practice EM, but most receive certification as family nurse practitioners (FNPs) or consider supplemental certification by the American Association of Critical Care Nurses as an acute care adult NP.¹² Like PAs, NPs are also required to complete annual CME to maintain their certifications.

Conversely, POCUS is taught widely in medical schools. A 2017 review evaluating 112 articles called for formal guidelines and standardization in medical school undergraduate education.¹³ The American Institute of Ultrasound Medicine lists over 200 medical schools that include POCUS in their curriculum, although less than 20% in the United States actually have a full 4-year integration in their curriculum.¹⁴ In a 2017 study of 218 ARC-PA certified PA master's programs, only 23% had integrated any POCUS training into medical education for PAs.¹⁵ NP programs currently do not have any formal ultrasound training requirements.¹⁶

Dedicated training in bedside ultrasound is fundamental to EM, and emergency physicians receive comprehensive, time-dedicated training in POCUS during residency. Typically, this experience is a 2–4 week block of time during which there are no other clinical responsibilities, although training during residency may vary.

In summary, neither the PA-C certification exam or APP postgraduate training programs delineate specifics of training in POCUS, and none of the NP or DNP programs, certification degrees, or exams have POCUS requirements. To provide optimal patient care for everyone, all practitioners who see patients in the emergency setting should have formal training and experience with POCUS.

3 | EM POCUS EDUCATION FOR APPS

There are several paths to advance education in POCUS for APPs interested in EM. PAs have the opportunity to obtain an EM Specialty Certificate for Added Qualifications (CAQ) but this examination lists ultrasound-guided vascular access as the only POCUS knowledge requirement.¹⁷ NPs certified as family or adult/gerontology practitioners can obtain emergency NP certification through the American Association of Colleges of Nursing, and FNPs specifically can obtain an emergency nurse practitioner certification through the American Academy of Nurse Practitioners Certification Board; however, neither certification lists a POCUS knowledge requirement.

APPs can apply for 1 of 30 postgraduate EM programs that range from 12 to 24 months of additional training with varying amounts of ultrasound education and training.¹⁸ Current training standards for EM PA postgraduate training programs are established by SEMPA. These standards specify that the student must obtain 40 hours of bedside ultrasound experience but do not further delineate that experience or describe additional guidelines (Table 1).¹⁹ The ARC-PA approved Clinical Post-graduate Accreditation Standards as of January 2020 for postgraduate institutions and programs seeking voluntary validation of their curriculum and standards, which are further reviewed on an

TABLE 1 The training standard for EM PA postgraduate training programs established by SEMPA

| Procedure | Minimum number |
|-------------------------------|-------------------|
| Endotracheal intubation | 15 |
| Central line | 10 |
| Bedside ultrasound | 40 hours |
| Paracentesis | 3 |
| Intraosseous needle placement | 2 |
| Laceration repair | 25 |
| Joint/fracture reduction | 10 |
| Arthrocentesis | 5 |
| Corneal foreign body removal | 3 |
| Lumbar puncture | 8 |
| Abscess incision and drainage | 10 |
| Procedural sedation | 5 |
| Chest tube insertion | 3 |
| Adult resuscitation | 10 |
| Pediatric resuscitation | 5 |
| Splinting | 10 each extremity |
| Use of slit lamp | 20 |
| Cricothyroidotomy | 3 |
| A-line placement | 4 |

Abbreviations: EM, emergency medicine; PA, physician assistant; SEMPA, Society of Emergency Physician Assistants.

institutional basis, but again, they do not include standards on POCUS education.²⁰

4 | ON-THE-JOB POCUS EDUCATION FOR APPS

Given that 58% of graduates from PA programs enter the work force soon after graduation, it follows that the majority of PAs are in need of on-the-job training alongside other experienced PAs and emergency physicians rather than through a postgraduate training program. In fact, only 17.5% of recently certified PAs choose to seek additional postgraduate training or education in their first 3 years.²¹ In a 2009 survey, 80% (1000/1255) of PA respondents received on-the-job EM training, as opposed to ~11% (134/1255) who entered a postgraduate training program.²² This survey also found that only 28% of PAs have performed EM POCUS, 32% have never performed EM POCUS, and 35% were not credentialed to perform EM POCUS at all. Prior studies have shown that less than 3% of NPs have used POCUS after graduation.^{23,24}

It is clear that the majority of APPs entering into EM are in need of on-the-job training and, with the lack of prior POCUS experience, it is important to establish an on-the-job POCUS training program for APPs as well. There are training efficiency benefits including working alongside POCUS-trained physicians, which boosts skill acquisition. PAs are full-time employees and therefore spend more continuous time in the

ED than fellows or residents and have more longevity as they do not have off-service rotations and/or a set graduation date. As such, training can be distributed throughout the year and over many more years than that for fellows/residents who have a finite time frame before graduation.

5 | APPS EDUCATIONAL OUTLOOK

5.1 | Creating a POCUS education program for APPs

Understanding the benefits of a trained APP staff in the ED and the values of POCUS in EM have led our institution to look for guidance through our department's ultrasound division. To exemplify the main components of a successful program setting, we describe our institutional planning and organization.

5.2 | POCUS education for APPs at Massachusetts General Hospital

The Massachusetts General Hospital Center for Ultrasound Research and Education (CURE) oversees all POCUS that is performed in the ED by physicians, residents, medical students, APP students, and APPs. Ultrasound education and quality assurance programs are embodied in the work of this division. CURE has incorporated and established a training and education model to provide ongoing POCUS education for our robust APP staff. Identification of APPs with specific POCUS interest is also essential to the longevity of such training. Our institution is a large academic tertiary care center with approximately 120,000 ED visits per year. We share an EM residency program with a second academic site but have our own dedicated Emergency Ultrasound Fellowship. There are currently 4 full-time ultrasound faculty physicians and 2 adjunct faculty members. Our EM APPs include 45 PAs and 20 NPs. These APPs are directly supervised by attending physicians who personally evaluate every patient. APPs work in parallel with EM residents and see just over 50% of the ED volume each year.

5.3 | Advanced POCUS APP leadership team

We have a leadership team of 6 POCUS APPs (5 PAs, 1 NP) who have chosen to specialize in POCUS as an advanced role within the EM APP group. To qualify for this advanced role, APPs need a minimum of 3 years of experience at our institution. They are dedicated to and skilled with POCUS, and they have an essential role within the ultrasound division where they work closely with all faculty and fellows of the CURE group. This role is authorized and financially supported by ED leadership and administration. POCUS APPs are each provided 10 hours of monthly protected time to dedicate to the ultrasound division for the benefit of research, education, or advancement of their own ultrasound skills. They hold leadership roles within the EM APP group as advanced

ultrasound mentors and educators. They provide support to the ultrasound division as adjunct faculty members. This role is essential to the onboarding and longitudinal training of the entire APP group; additionally, they further the academic mission of the ultrasound division.²⁵

5.4 | APP POCUS onboarding

When starting in the ED, all APPs are scheduled to attend an introduction to ultrasound hands-on training as part of the new hire process. Run by our POCUS APP leadership team, this session is 4 hours long and includes introductions to ultrasound machine “knobology” and terminology, basic cardiac echocardiogram, the extended Focused Assessment with Sonography in Trauma (E-FAST) exam, soft tissue ultrasound, and ultrasound -guided procedures, specifically ultrasound -guided peripheral intravenous placement. Our departmental minimum imaging criteria are reviewed to ensure adequate image acquisition and interpretation. Algorithms for incorporation of POCUS into clinical care are reviewed. APPs are instructed how to properly document POCUS findings for clinical decision-making and billing purposes. Each clinician is provided review materials in advance and scanning is performed with a live ultrasound model. Finally, the new-hire APPs perform additional supervised cardiac, E-FAST, and soft-tissue POCUS on consenting patients in the ED who require POCUS scans for clinical reasons.

5.5 | Quality assurance

Once an APP has completed initial training, they can then use POCUS in the clinical setting. All ultrasound examinations performed in the ED are recorded as images or clips and documented in the patient’s chart. Although image acquisition can be performed semi-independently, all recorded images are reviewed in real time by the attending physician of record who is supervising patient care. Minimum criteria for image acquisition of each ultrasound application have been established. POCUS scans are secondarily reviewed by the ultrasound division as part of a quality assurance (QA) process. Scans are categorized as true positive (TP), true negative (TN), false positive (FP), false negative (FN), or technically limited study (TLS). The POCUS APPs attend weekly faculty and fellow QA sessions to gain experience and knowledge about the process and to also further their interpretation skills. The POCUS APP is responsible for providing email feedback for any inadequate scans (TLS) or inaccurate interpretations (FP or FN) identified during the QA session to the EM APP individually as needed. During this feedback, any need for patient callback or communication with the patient’s regular medical team for follow-up study is performed. A physician member of the ultrasound faculty is also available for arbitration in case questions arise regarding scan adequacy or interpretation. All final EM APP scan numbers and QA categorization are entered into an ultrasound credentialing database and overall performance is tracked. This allows for the identification of any trends to guide longitudinal EM APP POCUS education.

5.6 | Credentialing

As there is no national standard regarding credentialing of PAs or NPs to perform POCUS, our current guidelines for APP education are based upon our EM resident physician standards, which were designed to meet or surpass Accreditation Council for Graduate Medical Education and ACEP recommendations.^{5,26} To demonstrate diagnostic ultrasound competency, each EM APP must perform a total of 30 ultrasound examinations (either TP and/or TN) for each diagnostic application (eg, cardiac). At least 3 of these 30 studies must be TP. Credentialing is divided into core, extended, and advanced studies (Table 2). Core studies include lung, cardiac, abdominal FAST, abdominal aorta, deep vein thrombosis (DVT), and venous access. Extended studies include biliary, renal, pelvic, and soft tissue scans. Advanced scans include musculoskeletal, ocular, and gastrointestinal scans. Upon acquiring the required number of ultrasound examinations per credentialing level, EM APPs must then complete an Observed Structured Clinical Examination (OSCE) supervised by an approved ultrasound trainer. For example, once an APP has obtained 30 studies of lung, cardiac, FAST, aorta, and DVT studies each, they will complete the core OSCE and by doing so demonstrate competency (Figure 1).

Although at our institution PAs and NPs do not practice independently, EM APPs competent in POCUS would be considered to have achieved a level of proficiency adequate to obtain and interpret POCUS studies without direct supervision. This may be helpful if EM-trained APPs go on to take care roles in another specialty that has a less developed ultrasound training curriculum, or if the APP were to remain in EM but move to another institution. APPs who move on to other positions are provided with a letter commensurate with their level of demonstrated competence.

5.7 | Advanced and continued training

After 2 years of practice, our EM APPs are, with internal approval, given the opportunity to work in the “acute” area of the ED. This is a specialized, high-acuity area pod where critically ill patients with acute infectious, traumatic, cardiac, respiratory, or neurologic illness and injury are triaged. This area often boards ICU-level patients for extended periods of time in the case of hospital overcrowding. Before working in acute, EM APPs are required to attend a refresher and advanced ultrasound hands-on training session scheduled and managed by our POCUS APPs. This session includes a review of core and extended POCUS with more formal instruction of additional studies including lung, aortic, biliary, DVT, and pelvic ultrasound. Ultrasound-guided venous access is reviewed with attention to the relevant anatomy of central venous lines. This is also an opportunity for EM APPs to ask questions and work on any deficiencies they may have. This session lasts 4 hours and is structured similarly to the initial training, with both practice scanning on a live model as well as supervised scanning on consenting patients in the department who already require POCUS exams.

TABLE 2 Credentialing requirement based on competency in performing and interpreting core, extended, and advanced ultrasound applications

| | | | |
|----------|--|---|--|
| Core | Lung | <ul style="list-style-type: none"> • Lung sliding • B-lines • Pleural fluid | |
| | Cardiac | <ul style="list-style-type: none"> • Ejection fraction • Pericardial effusion • Right ventricular strain | |
| | Abdominal Focused Assessment with Sonography in Trauma | <ul style="list-style-type: none"> • Free fluid | |
| | Abdominal aorta | <ul style="list-style-type: none"> • Diameter • Iliac vein diameter | |
| | Deep vein thrombosis | <ul style="list-style-type: none"> • Flow • Compressibility | |
| | Venous access | | |
| | Extended | Biliary | <ul style="list-style-type: none"> • Cholelithiasis • Cholecystitis • Gallbladder wall thickening • Common bile duct dilatation |
| | | Renal | <ul style="list-style-type: none"> • Hydronephrosis pelvis (transabdominal or transvaginal) • Free fluid • Intrauterine pregnancy • Fetal heart rate |
| | | Bladder | <ul style="list-style-type: none"> • Volume |
| | | Soft tissue | <ul style="list-style-type: none"> • Tissue edema • Fluid collection • Foreign body • Subcutaneous air |
| Advanced | | Musculoskeletal | <ul style="list-style-type: none"> • Dislocation • Fracture • Joint fluid • Tendinopathy |
| | | Gastrointestinal | <ul style="list-style-type: none"> • Diverticulitis • Bowel obstruction • Appendicitis |
| | | Ocular | <ul style="list-style-type: none"> • Nerve sheath diameter • Retinal detachment • Vitreous hemorrhage |

In total, 82 APPs have been trained using this model with 25 (30%) credentialed in core applications, 10 (12%) reaching the extended level, and 5 (6%) meeting the criteria for advanced. At the time of writing, 22 core, 9 extended, and 5 advanced credentialed APPs remain at our institution.

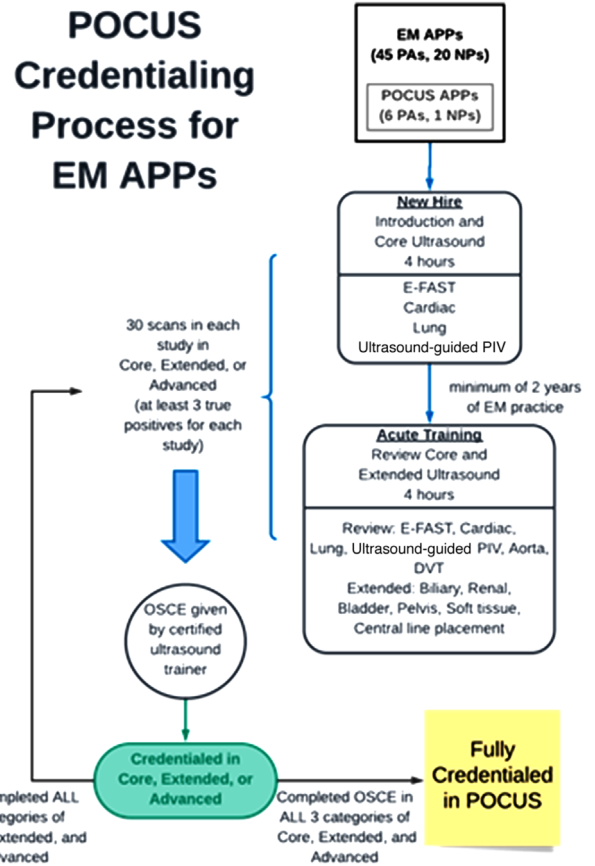


FIGURE 1 POCUS credentialing process for EM APPs. Abbreviations: APP, advanced practice provider; DVT, deep vein thrombosis; E-FAST, extended Focused Assessment with Sonography in Trauma; EM, emergency medicine; NP, nurse practitioner; OSCE, Observed Structured Clinical Examination; PA, physician assistant; PIV, peripheral intravenous access; POCUS, point-of-care ultrasound

6 | CONCLUSION

Although POCUS is a critical tool used in the care of patients in the ED, training standards and guidelines for APPs are lacking. Significant time and effort are needed to achieve competency in this skill. The POCUS curriculum we have developed for our APPs provides a pathway for competence and meets or exceeds the current training guidelines for residents set by ACEP and SAEM. Our training program provides comprehensive education and knowledge for our dedicated team of over 65 APPs of full-time staff in the ED to be credentialed in emergency ultrasound, yet does not require APPs to take additional CAQs or enter into a formal emergency ultrasound program or postgraduate training program. Limitations of this program are that it is contingent on both the setting of a tertiary care academic center and the existence of an active POCUS fellowship and division. Future considerations may include national level of certification for APP POCUS based upon academic site longitudinal training, scan number requirements, and demonstration of competency in image acquisition, image interpretation, and clinical integration. Until then, the described APP academic training can be a concept to be used by other ultrasound divisions to support and expand

APP POCUS use within the ED, as well as to enhance and forward the educational mission of ultrasound programs.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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