
Resident Training in Emergency Ultrasound: Consensus Recommendations from the 2008 Council of Emergency Medicine Residency Directors Conference

Saadia Akhtar, MD, Dan Theodoro, MD, Romolo Gaspari, MD, Vivek Tayal, MD, Paul Sierzenski, MD, Joseph LaMantia, MD, Sarah Stahmer, MD, and Chris Raio, MD

Abstract

Over the past 25 years, research performed by emergency physicians (EPs) demonstrates that bedside ultrasound (US) can improve the care of emergency department (ED) patients. At the request of the Council of Emergency Medicine Residency Directors (CORD), leaders in the field of emergency medicine (EM) US met to delineate in consensus fashion the model "US curriculum" for EM residency training programs. The goal of this article is to provide a framework for providing US education to EM residents. These guidelines should serve as a foundation for the growth of resident education in EM US. The intent of these guidelines is to provide *minimum* education standards for all EM residency programs to refer to when establishing an EUS training program. The document focuses on US curriculum, US education, and competency assessment. The use of US in the management of critically ill patients will improve patient care and thus should be viewed as a required skill set for all future graduating EM residents. The authors consider EUS skills critical to the development of an emergency physician, and a minimum skill set should be mandatory for all graduating EM residents. The US education provided to EM residents should be structured to allow residents to incorporate US into daily clinical practice. Image acquisition and interpretation alone are insufficient. The ability to integrate findings with patient care and apply them in a busy clinical environment should be stressed.

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INTRODUCTION

Over the past 25 years, research performed by emergency physicians (EPs) has demonstrated that bedside ultrasound (US) can improve care

From the Department of Emergency Medicine, Beth Israel Medical Center, Albert Einstein College of Medicine, (SA) New York, NY; Division of Emergency Medicine, Barnes-Jewish Hospital, Washington University School of Medicine, (DT) St. Louis, MO; Department of Emergency Medicine, University of Massachusetts Medical School, (RG) Worcester, MA; Department of Emergency Medicine, Carolinas Medical Center, (VT) Charlotte, NC; Department of Emergency Medicine, Christiana Care Health System, (PS) Newark, DE; Department of Emergency Medicine, North Shore University Hospital, (JL, CR) Manhasset, NY; Division of Emergency Medicine, Duke University Medical Center, (SS) Durham, NC.

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Address for correspondence and reprints: Saadia Akhtar, MD; e-mail: SAKhtar@chpnet.org.

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of emergency department (ED) patients.¹⁻²⁶ In 2007, the *Model of the Clinical Practice of Emergency Medicine* considered bedside ultrasonography to be a "skill integral to the practice of emergency medicine."²⁷ In response to the adoption of US technology, emergency medicine (EM) residency programs increased resources and dedicated time to teaching competency in US applications.^{28,29} However, at the present time there is wide variability in the emergency medicine US (EM US) training that residents experience at various programs, which has led to the perception that some graduates lack adequate training.³⁰⁻³³ Therefore, at the request of the Council of Emergency Medicine Residency Directors (CORD), leaders in the field of EM US met to delineate in consensus fashion the model US curriculum for EM residency training programs.

The goal of this article is to provide a framework for providing US education to EM residents. These guidelines should serve as a foundation for the growth of resident education in EM US. As EPs integrate US into patient care in the ED, we expect that these suggestions

will adapt to the EM training environment. The intent of these guidelines is to provide *minimum* education standards for all EM residency programs to refer to when establishing an EM US training program. Although many of these resources are not widely available to all programs, the consensus conference participants believe that these guidelines can serve as a “best practices” template to assist residency programs in their planning and development efforts.

Conference Planning

At the 2007 annual meeting of the *Society for Academic Emergency Medicine* (SAEM), several members approached the SAEM Emergency Medicine Ultrasound interest group with the goal of devising a model curriculum for EM US education. With support from the CORD Board of Directors, a portion of the CORD Annual Academic Assembly was devoted to organizing a group that would meet to delineate in consensus fashion a model US curriculum, outline “best practices” of implementing US education, and identify methods to assess competency. Approximately 5 months before the consensus conference, members of the organizing committee drafted three outlines of preliminary recommendations. To facilitate communication and discussion among participating members and organizers, an online discussion blog was created that allowed for open comment and discussion in each of the principal areas before the conference. Organizers incorporated online comments into the elements that were presented at the consensus conference. The pre-conference online blog consisted of 46 members who represented the EM US education community.

Conference Structure and Content

More than 40 members of CORD, SAEM, and the American College of Emergency Physicians (ACEP) attended the 3-hour consensus conference in New Orleans in 2008. Participants consisted of EM Program Directors, EM US Directors, and educators responsible for US education at their respective institutions. The organizers posted each element of each section online for open comment and discussion. A scribe collected comments specifically related to each element. Each element of the document was altered whenever the group reached consensus agreement. After the conference, a draft document was revised and then posted again online for further open discussion. The draft version was next presented to the CORD membership in October 2008 and then posted again for open online commentary on the CORD mailing list server at the end of 2008 and beginning of 2009. The document underwent one final revision before submission for publication.

Ultrasound Curriculum The core applications for EM US mirror the field of EM in its breadth. These core applications are:

1. Evaluation of the trauma patient
2. Imaging in pregnancy
3. Aortic imaging
4. Emergent cardiac imaging
5. Biliary imaging
6. Renal imaging
7. Evaluation of deep venous thrombosis
8. Thoracic imaging
9. Soft-tissue and musculoskeletal imaging
10. Procedural imaging

From these core applications, EPs can broadly divide US applications into two categories, each integral to the practice of EM. One category involves the medical care of critically injured patients or patients who face a potentially life-threatening condition. In these time-sensitive scenarios, the ability to acquire and interpret US images immediately can be life saving. The second category involves the use of focused US in situations that may not be immediately life threatening but ultimately may provide benefit and improve patient care and outcomes.

The CORD Emergency Ultrasound Consensus Committee (EUCC) recognizes that EM US figures prominently in critical, life-threatening scenarios. In light of the effect of sonography in such scenarios, all EM residency programs will aim to ensure the competency of their graduates in the following core EM US applications.

- 1) Focused assessment with sonography for trauma (FAST)
- 2) Emergent cardiac imaging
- 3) Evaluation of the aorta for abdominal aortic aneurysm (AAA)
- 4) Identification of early intrauterine pregnancy via transabdominal and transvaginal sonography
- 5) Procedural guidance for ED procedures

The CORD EUCC recognizes that EM US figures prominently in other patient encounters in which patient care improves with information from focused bedside US examinations. In these scenarios, EM US provides significant information that facilitates decision-making in emergency cases. In recognition of the benefits of EM US for patients who present to the ED, we highly recommend that all residents graduate with the following EM US skills: identification of gallbladder pathology; detection of deep venous thrombosis; recognition of hydronephrosis and determination of bladder volume; detection of subcutaneous fluid collection, abscess, and foreign body; identification of pneumothorax; and identification of ocular pathology.

Ultrasound Education

Resources. It is recommended that all EM residency programs specifically identify a full-time faculty member as its EM US Director or Coordinator, with the institutional support and skill sets capable of implementing all aspects of the educational program as described below. In addition to the EM US Director or Coordinator, it is recommended that a minimum of 50% of the required number of “core faculty” members at all EM residency programs be designated as “core US faculty” and be credentialed by the host institution in the use of US. For example, if a program has a core faculty requirement of 12, then a minimum of six core US faculty should be designated. This may be inclusive

of the EM US Director or Coordinator. Also, the core US faculty may be selected from EM core or non-core faculty. Each program should develop, demonstrate, and retain performance measures for the core US faculty. This faculty group should be available to supervise and educate its residents in EM US and teach the core applications.

All EM residency training programs should provide access to appropriate US equipment (systems with an adequate array of transducers and imaging resolution), and these US systems should be available during a resident's clinical experience at all times. All EM residency programs should maintain textbooks covering at least EM US and US physics in their respective libraries. In addition, residents should be exposed to the current and historical literature concerning all EM US applications, and faculty should make every attempt to involve the residents in any current or future research projects.

Educational Program All EM residents shall be provided introductory instruction in EM US early in their EM training programs. This training should include didactic and hands-on sessions covering critical EM US examinations and procedures and interpretation, as well as basic US physics and knobology. It is recommended that this orientation be given in the form of a 1-day course. During residency, a minimum of 2 weeks in a dedicated EM US rotation, or an equivalent of 80 hours, should be completed. A portion of this time should ideally occur in the first year of residency training. The residents should be offered educational sessions and hands-on workshops in addition to US scanning time in the ED with active patients. Recommendations for the rotation experience include:

- Didactic sessions covering basic and advanced EM US.
- Scheduled reading assignments in preferred textbooks or journals.
- Access to other educational modalities, including CD/DVD.
- Access to a question bank on EM US applications.
- Scheduled shifts devoted to performing US examinations and procedures. A significant portion of these shifts should be done with a qualified faculty member to provide direct instruction on US scanning technique.
- Direct or indirect review of a majority of the resident's images by qualified faculty to provide feedback on scanning technique, image acquisition, and interpretation.
- Educational sessions aimed specifically at helping the resident to incorporate US into daily clinical practice.
- Components of US education spread over the entire course of residency training. A single block rotation with no integration into routine clinical practice is not sufficient.

Competency assessment can be performed using several methods, although most experts recognize that the performance of at least 150 US examinations in "critical" or "life-saving" situations promotes a minimum acceptable level of exposure. Although the completion of this set number of examinations does not, in and of

itself, delineate competency, residency programs should dedicate their efforts to meeting this level of experience to allow residents the best opportunity to achieve competency.

A system should be in place at all EM residency training programs in which faculty members review a portion of the examinations performed by EM residents (via still images or video capture) to provide quality assurance and timely feedback to the residents in training. Information regarding total numbers of US examinations completed and educational progress should be made available to residents on a regular basis.

Emergency medicine ultrasound didactic education should be incorporated into the core educational program for all EM residency programs. In addition to the introductory training, longitudinal, didactic, and hands-on instruction should be provided to EM residents throughout their residency training. This may include scheduled sessions during normal EM conference hours. It is felt that a minimum of 20 hours of scheduled educational sessions should be given over the course of a 3- or 4-year EM residency training program.

Competency Assessment The goal of competency assessment in EM US is to ensure that all EM residents have a basic set of skills to allow for integration of US into their daily clinical practice after residency training is completed. The CORD EUCC suggests that competency assessment in EM US should be performed. The following methods are recommended tools for competency assessment in EM US during EM training.

Assessment of US Technique

A practical examination consisting of a direct assessment of the skills necessary to obtain and record appropriate US images for the following studies:

- 1) FAST examination
- 2) Emergent cardiac imaging
- 3) Evaluation of the aorta for AAA
- 4) Identification of early intrauterine pregnancy via transabdominal and transvaginal sonography
- 5) Procedural guidance for ED procedures
- 6) Identification of gallbladder pathology
- 7) Detection of deep venous thrombosis
- 8) Recognition of hydronephrosis and determination of bladder volume
- 9) Detection of subcutaneous fluid collection, abscess, and foreign body
- 10) Identification of pneumothorax
- 11) Identification of ocular pathology

The practical examination should include assessment of proper machine settings, probe positioning, image acquisition, and documentation. US images obtained during the practical examination should be assessed for technical merit and not interpretative merit, including but not limited to image quality, image framing, identification of landmarks, and completeness of imaging protocol.

The practical examination can be performed on ED patients (recommended) or in a simulation setting. The practical examination may include various methods

to assess for adequacy of skill, including but not limited to Objective Structured Clinical Examination, Standardized Direct Observation Tool, and videotape of person performing US examination for later review.

Assessment of Image Interpretation

Each EM residency training program should have an educational program established providing static image or dynamic video review (preferred method) to assess competency of residents in performing and interpreting focused EM US examinations. This will allow faculty members to evaluate residents' abilities to perform these examinations during their clinical exposure. This can be a tool to evaluate US technique and image interpretation because examinations can be checked for completion of scanning protocols, identification of anatomic and sonographic landmarks, and recognition of normal and pathologic findings. The medical decision-making process following these examinations can also be assessed.

It is the goal of this committee to develop a standardized multiple-choice examination as a nationwide question bank that the US Director or Coordinator at each EM residency program can access (in a secure manner). This test will also be used as a tool to assess resident competency in clinical decision-making based on the interpretation of images and video.

The CORD EUCC suggests that the above-mentioned competency assessment tools be used (at a minimum) at the end of each US rotation and in the last year of residency training. Different aspects of competency assessment may be performed at various intervals to allow better integration of US education into the overall EM residency education schedule. US skills may degrade over time, and competency assessment may be repeated for an individual when a significant time period has elapsed (e.g., for a resident on rotations where US is not used or encouraged) or deficiencies are identified that indicate a deterioration of skill.

CONCLUSIONS

The use of US in the management of critically ill patients will improve patient care and thus should be viewed as a required skill set for all graduating EM residents. We consider EM US skills critical to the development of an EP, and a minimum skill set should be mandatory for all graduating EM residents. The US education provided to EM residents should be structured to allow residents to incorporate US into daily clinical practice. Image acquisition and interpretation alone are insufficient. The ability to integrate findings with patient care and apply them in a busy clinical environment should be stressed.

References

- Kuhn M, Bonnin RL, Davey MJ. Emergency department ultrasound scanning for abdominal aortic aneurysm: accessible, accurate, and advantageous. *Ann Emerg Med.* 2000; 36:219–23.
- Jehle D, Guarino J, Karamanoukian H. Emergency department ultrasound in the evaluation of blunt abdominal trauma. *Am J Emerg Med.* 1993; 11(4):342–6.
- Blaivas M, Harwood RA, Lambert MJ. Decreasing length of stay with emergency ultrasound examination of the gallbladder. *Acad Emerg Med.* 1999; 6:1020–3.
- Blaivas M, Batts M, Lambert M. Ultrasonographic diagnosis of testicular torsion by emergency physicians. *Am J Emerg Med.* 2000; 18(2):198–200.
- Blaivas M, Lambert MJ, Harwood RA, Wood JP, Konicki J. Lower-extremity Doppler for deep venous thrombosis—can emergency physicians be accurate and fast? *Acad Emerg Med.* 2000; 7:120–6.
- Blaivas M, Sierzenski P, Plecque D, Lambert M. Do emergency physicians save time when locating a live intrauterine pregnancy with bedside ultrasonography? *Acad Emerg Med.* 2000; 7:988–93.
- Blaivas M. Incidence of pericardial effusion in patients presenting to the emergency department with unexplained dyspnea. *Acad Emerg Med.* 2001; 8:1143–6.
- Blaivas M, Fox JC. Outcome in cardiac arrest patients found to have cardiac standstill on the bedside emergency department echocardiogram. *Acad Emerg Med.* 2001; 8:616–21.
- Blaivas M, Sierzenski P, Lambert M. Emergency evaluation of patients presenting with acute scrotum using bedside ultrasonography. *Acad Emerg Med.* 2001; 8:90–3.
- Rosen CL, Brown DF, Chang Y, et al. Ultrasonography by emergency physicians in patients with suspected cholecystitis. *Am J Emerg Med.* 2001; 19(1):32–6.
- Miller AH, Roth BA, Mills TJ, Woody JR, Longmoor CE, Foster B. Ultrasound guidance versus the landmark technique for the placement of central venous catheters in the emergency department. *Acad Emerg Med.* 2002; 9:800–5.
- Moore CL, Rose GA, Tayal VS, Sullivan DM, Arrowood JA, Kline JA. Determination of left ventricular function by emergency physician echocardiography of hypotensive patients. *Acad Emerg Med.* 2002; 9:186–93.
- Jones AE, Tayal VS, Sullivan DM, Kline JA. Randomized, controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients. *Crit Care Med.* 2004; 32(8):1703–8.
- Kendall JL, Blaivas M, Hoffenberg S, Fox JC. History of emergency ultrasound. *J Ultrasound Med.* 2004; 23(8):1130–3.
- Theodoro D, Blaivas M, Duggal S, Snyder G, Lucas M. Real-time B-mode ultrasound in the ED saves time in the diagnosis of deep vein thrombosis (DVT). *Am J Emerg Med.* 2004; 22(3):197–200.
- Chen L, Hsiao AL, Moore CL, Dziura JD, Santucci KA. Utility of bedside bladder ultrasound before urethral catheterization in young children. *Pediatrics.* 2005; 115(1):108–11.
- Costantino TG, Bruno EC, Handly N, Dean AJ. Accuracy of emergency medicine ultrasound in the evaluation of abdominal aortic aneurysm. *J Emerg Med.* 2005; 29(4):455–60.

18. Lyon M, Blaivas M, Brannam L. Use of emergency ultrasound in a rural ED with limited radiology services. *Am J Emerg Med.* 2005; 23(2):212–4.
19. Milling TJ Jr, Rose J, Briggs WM, et al. Randomized, controlled clinical trial of point-of-care limited ultrasonography assistance of central venous cannulation: the Third Sonography Outcomes Assessment Program (SOAP-3) trial. *Crit Care Med.* 2005; 33(8):1764–9.
20. 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; 48:540–7.
21. McGregor M, Rashid A, Sable N, Kurian J. Impact of NICE guidance on the provision of ultrasound machines for central venous catheterization. *Br J Anaesth.* 2006; 97(1):117–8.
22. Moore C, Todd WM, O'Brien E, Lin H. Free fluid in Morison's Pouch on bedside ultrasound predicts need for operative intervention in suspected ectopic pregnancy. *Acad Emerg Med.* 2007; 14:755–8.
23. Gaspari RJ, Dickman E, Blehar D. Learning curve of bedside ultrasound of the gallbladder. *J Emerg Med.* 2009; 37(1):51–6.
24. Moore CL, Holliday RS, Hwang JQ, Osborne MR. Screening for abdominal aortic aneurysm in asymptomatic at-risk patients using emergency ultrasound. *Am J Emerg Med.* 2008; 26(8):883–7.
25. Melniker LA, Leibner E, McKenney MG, Lopez P, Briggs WM, Mancuso CA. Randomized controlled clinical trial of point-of-care, limited ultrasonography for trauma in the emergency department: the first sonography outcomes assessment program trial. *Ann Emerg Med.* 2006; 48:227–35.
26. Salen P, Melniker L, Chooljian C, et al. Does the presence or absence of sonographically identified cardiac activity predict resuscitation outcomes of cardiac arrest patients? *Am J Emerg Med.* 2005; 23(4):459–62.
27. Thomas HA, Binder LS, Chapman DM, et al. The 2003 Model of the clinical practice of emergency medicine: the 2005 update. *Ann Emerg Med.* 2006; 48:e1–e17.
28. Witting MD, Euerle BD, Butler KH. A comparison of emergency medicine ultrasound training with guidelines of the Society for Academic Emergency Medicine. *Ann Emerg Med.* 1999; 34:604–9.
29. Moore CL, Gregg S, Lambert M. Performance, training, quality assurance, and reimbursement of emergency physician-performed ultrasonography at academic medical centers. *J Ultrasound Med.* 2004; 23(4):459–66.
30. Mandavia DP, Aragona J, Chan L, Chan D, Henderson SO. Ultrasound training for emergency physicians: a prospective study. *Acad Emerg Med.* 2000; 7:1008–14.
31. Noble V, Nelson B, Sutingco AN, Marill KA, Cranmer H. Assessment of knowledge retention and the value of proctored ultrasound exams after the introduction of an emergency ultrasound curriculum. *BMC Med Education.* 2007; 7(1):40.
32. Moore CL, Molina AA, Lin H. Ultrasonography in community emergency departments in the United States: access to ultrasonography performed by consultants and status of emergency physician-performed ultrasonography. *Ann Emerg Med.* 2006; 47:147–53.
33. Dean AJ, Breyer MJ, Ku BS, Mills AM, Pines JM. Emergency ultrasound usage among recent emergency medicine residency graduates of a convenience sample of 14 residencies. *J Emerg Med.* 2008; Aug 22 [Epub ahead of print] doi: 10.1016/j.jemermed.2007.12.028.