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Recommended Curriculum Guidelines for Family Medicine Residents

Point-of-Care Ultrasound

This document is endorsed by the American Academy of Family Physicians (AAFP).

Introduction

Each family medicine residency program is responsible for its own curriculum. The AAFP Commission on Education's Subcommittee on Graduate Curriculum has created this guide as an outline for curriculum development, and it should be tailored to the needs of the program.

Through a series of structured and/or longitudinal experiences, the curricula below will support the overall achievement of the core educational competencies defined by the Accreditation Council for Graduate Medical Education (ACGME) and provide guideposts to program requirements specific to family medicine. For updates and details, please refer to the ACGME website at www.acgme.org. Current AAFP Curriculum Guidelines may be found online at www.aafp.org/cg. These guidelines are periodically updated and endorsed by the AAFP and, in many instances, other specialty societies, as indicated on each guideline.

Preamble

Point-of-care ultrasound (POCUS) may be the biggest advance in bedside diagnosis since the advent of the stethoscope 200 years ago. Evolution of ultrasound technology has allowed for its widespread adoption.

Current evidence clearly demonstrates that using POCUS improves clinical outcomes, reduces procedure failures and complications,[1] rapidly narrows differential diagnoses,[2] shortens times to definitive treatment,[3] lowers costs,[4] and reduces the use of ionizing radiation of computed tomography imaging.[5] Involving patients in their diagnosis at the bedside by showing them their anatomy enhances the patient-physician experience, engenders confidence in the physician's diagnosis, and has been shown to improve patient satisfaction.[6] In 2012, POCUS became one of the required milestone competencies to graduate residency in Emergency Medicine.[7] Medical schools are integrating POCUS into their curricula, resulting in students desiring more POCUS

training during residency.[8,9] Lastly, POCUS is especially useful for family medicine clinicians in resource-constrained environments where advanced imaging and specialists may be unavailable.

Competencies

At the end of residency training, a family medicine resident should be able to:

- Know the indications, benefits, and limitations of POCUS (Patient Care)
- Assess anatomy, physiology, and pathology with POCUS (Medical Knowledge)
- Advance POCUS knowledge with appropriate precepting, electives, and use of website resources (Practice-Based Learning and Improvement)
- Communicate the results of a POCUS scan to the patient and treatment team, and document the results appropriately in the medical record (Interpersonal and Communication Skills)
- Talk to the patient about the risks and benefits of POCUS and alternatives to POCUS, and obtain verbal consent prior to a POCUS scan (Professionalism)
- Utilize POCUS to decrease time to properly diagnose, decrease procedure complications, and expedite medical care (Systems-Based Practice)

Patient Care

At the completion of residency training, a family medicine resident should show proficiency and understanding in the following areas:

- POCUS aids in diagnosis like an electrocardiogram (ECG), chest x-ray, or blood test, and is not a substitute for a good history and physical exam.
- POCUS is utilized in addition to physical exam and offers additional anatomic, functional, and physiologic information to guide patient care. (Patient Care, Medical Knowledge)
- POCUS enhances procedural competency and efficacy (e.g., paracentesis, thoracentesis, placement of central line, joint injections). (Practice-Based Learning and Improvement, Patient Care)
- POCUS is a limited, focused exam that should be quick and relatively easy to obtain, and it is utilized to address a few clinically relevant questions.
- The family medicine resident should understand the “As Low As Reasonably Achievable” (ALARA) principle and specific safety issues as they apply to ultrasound exposure (e.g., ocular settings, avoidance of first trimester Doppler or color use), as well as understanding probe cleaning and which studies need normal versus high-level disinfection. (Medical Knowledge, Systems-Based Practice)

Medical Knowledge

In the appropriate setting, a family medicine resident should demonstrate the ability to

apply knowledge of the following:

1. Basic ultrasound
    a. Physics: Use of piezoelectric effect and generation of ultrasound images; the frequency, wavelength, amplitude, power, and intensity as it relates to ultrasound
    b. Images: Ultrasound representation of fluid, soft tissues, solid organs, air, foreign bodies, and bone
    c. Transducers: Four main types are linear, curvilinear, phased array, and endocavitary; each probe has a different crystal arrangement, size, and footprint that determines its preferred applications. There are also newer "chip technology" probes that are available and use different technology than traditional piezoelectric crystal transducers. These will likely be more influential as their technology continues to improve.
    d. Orientation: Sagittal, transverse, and coronal planes; probe marker position and its relation to the patient's body and screen image
    e. Image optimization: Depth (near and far field), gain, and power
    f. Ultrasound image terminology: Echogenicity, artifacts, and anisotropy
    g. Scanning techniques: Sliding, fanning, rotating, and rocking
    h. Modes: Two-dimensional, M-mode, B-Mode, and Doppler imaging
    i. Applications: Basic core applications of POCUS and incorporation into patient care. Advanced applications are optional and reserved for clinicians who have mastered the basic core applications.
    j. Documentation: Importance and methods of archiving and retrieving images; applicability to clinical decision making and quality improvement (Interpersonal and Communication Skills, Systems-Based Practice)

2. Basic core applications of POCUS
    a. Obstetrics and gynecology (OB/GYN)
    b. Cardiac
    c. Trauma
    d. Aorta
    e. Biliary
    f. Renal/genitourinary tract
    g. Deep venous thrombosis (DVT)
    h. Soft tissue/musculoskeletal
    i. Thoracic/pulmonary
    j. Ocular
    k. Procedural guidance
    l. Clinical protocols (see examples below)

NOTE: "Basic" and "advanced" applications of POCUS are based on consensus opinion and are not meant to be all-inclusive or exclusive. It is anticipated that a family medicine residency will utilize this document to create its own POCUS curriculum based on its specific needs, clinical focus, and credentialing process. Other than the OB/GYN section, ultrasound skills/competencies listed below are only described for the basic

applications of POCUS.

Interpersonal and Communication Skills

At the completion of residency, a family medicine resident should be able to:

- Communicate the indications, risks, benefits, and alternatives of a POCUS exam to the patient (Professionalism, Interpersonal and Communication Skills)
- Accurately and appropriately document findings of a POCUS exam in the medical record and relay information to other members of the care team

Systems-Based Practice

At the completion of residency, a family medicine resident should be able to:

- Integrate the use of POCUS with other available health care resources
- Understand the role of POCUS in the clinical setting, as well as medicolegal ramifications related to POCUS
- Understand the requirements for billing for POCUS

Practice-Based Learning and Improvement

Learning takes place through a variety of modalities (see Implementation section). At the completion of residency, a family medicine resident should show proficiency and understanding in the following areas:

1. OB/GYN
    a. Limited first trimester evaluation: Essential ultrasonography components
        i. Transabdominal and transvaginal scanning techniques
        ii. Presence of intrauterine pregnancy (IUP): Utilize Fundal, Eccentric, Elliptical, Decidual reaction, Size of gestational sac (FEEDS) criteria or other documentable criteria to assess for presence of IUP
        iii. Viability of IUP (see Doubilet PM, Benson CB, Bourne T, et al. Diagnostic criteria for nonviable pregnancy early in the first trimester. N Engl J Med. 2013;369(15):1443-1451)
        iv. Detection of fetal heart rate in all stages of pregnancy using M-mode. Color imaging and Doppler are not recommended for heart rate detection in first trimester.
        v. First trimester pregnancy gestational age assessment by crown rump length
        vi. Detection of free fluid in the pelvis: Obtain suprapubic, transverse, and longitudinal views to assess for any free fluid anterior or posterior to the uterus
    b. Limited second/third trimester evaluation: Essential ultrasonography components
        i. Determine placenta position (fundal, anterior, posterior, low-lying, previa) and know when transvaginal follow-up imaging is indicated

(Medical Knowledge)
   ii. Fetal presentation: Vertex, breech, or transverse
   iii. Amniotic fluid volume: Identify the single deepest pocket of fluid on third trimester ultrasound and appropriately calculate an amniotic fluid index
   iv. Placenta abruption: Identification of chorionic hemorrhage
c. Advanced OB ultrasonography skills (optional)
   i. Recognition of molar pregnancy: Identify “snowstorm appearance/cluster of grapes” of molar pregnancy
   ii. Components of the standard second/third trimester scan
      1. Gestational age assessment and fetal weight estimation using abdominal circumference (AC), biparietal diameter (BPD), and femur length (FL)
   iii. Evaluation of cervical insufficiency: Preterm labor assessment; measure of cervical length transabdominal/transcervical
   iv. Estimation of fetal weight
   v. Assessment of maternal anatomy
   vi. Fetal anatomy
   vii. Gender of fetus: Identify penis or labia during 18- to 20-week ultrasound and inform parents, if they wish to be made aware
d. Specialized examinations/special situations
   i. Fetal well-being during third trimester, biophysical profile: Ultrasound assessment of amniotic fluid index (AFI), fetal breathing movements, gross body movements, and tone
   ii. Confirmation of fetal death: Absent fetal heart tones and fetal movement, skull deformity, maceration, and echogenic amniotic fluid
e. Gynecology ultrasound skills
   i. Intrauterine device (IUD) position: Presence or absence of IUD in uterus
   ii. Dysfunctional uterine bleeding: Measurement of endometrial stripe
   iii. Adnexal mass: Simple, complex, hemorrhagic cysts
   iv. Breast mass: Differentiate a simple cyst from a complex cyst/solid mass

2. Cardiac
   a. Echocardiograph (cardiac ultrasound) basic skills
      i. Detection of pericardial effusion: Subxiphoid view
      ii. Assessment of global left ventricle (LV) contractility to assess systolic function (e.g., hyperdynamic/increased, normal, or reduced): Parasternal long/short, apical four-chamber view
      iii. Assessment of right ventricle (RV) size to assess for right heart strain and possibility of pulmonary embolism (PE) in appropriate clinical setting: Parasternal long/short, apical four-chamber view
      iv. Measurement of inferior vena cava (IVC) to approximate volume status: Size and respiratory variation in subxiphoid view

b. Echocardiograph (cardiac ultrasound) advanced skills (optional)
    i. Calculation of ejection fraction
    ii. Regional wall motion abnormalities
    iii. Diastolic dysfunction
    iv. Left ventricular mass for left ventricular hypertrophy (LVH) diagnosis
    v. Valvular abnormalities: Mitral/aortic regurgitation and stenosis

3. Trauma
    a. Assessment of free fluid in the abdominal cavity/focused assessment with sonography for trauma (FAST) exam: Hemoperitoneum; right upper quadrant – Morison's pouch; left upper quadrant – subdiaphragmatic and splenorenal view; suprapubic – fluid outside of bladder. Ascites can have similar appearance.
    b. Assessment of free fluid around the heart: Hemopericardium – subxiphoid view
    c. Assessment of a pneumothorax: Assess for evidence of lung sliding and M-mode variation; know differential diagnosis for lack of lung sliding (Medical Knowledge, Practice-Based Learning and Improvement)
    d. Assessment for a hemothorax: Assess for free fluid above the diaphragm and visualization of the thoracic spine

4. Aorta
    a. Aorta basic ultrasound skills
        i. Abdominal aortic aneurysm (AAA): Screening using U.S. Preventive Services Task Force (USPSTF) recommendations versus diagnostic
            1. Identification of vertebral shadow, aorta, IVC, and iliac bifurcation with proximal, mid, and distal imaging views
            2. Scan from xiphoid to umbilicus in transverse and longitudinal views to assess for fusiform versus saccular aneurysm and proximal iliac artery aneurysm; evaluate for intramural thrombus detection
            3. Use of Doppler waveform imaging/color Doppler
    b. Aorta advanced ultrasound skills (optional)
        i. Proximal aortic root aneurysm or dissection
        ii. Abdominal aortic dissection

5. Biliary/abdominal
    a. Biliary/abdominal basic ultrasound skills
        i. Assess for symptomatic cholelithiasis: Identify presence of gallstone versus polyp or artifact
        ii. Assess for acute cholecystitis: Presence of stones, sonographic Murphy sign, anterior gallbladder wall thickening, and pericholecystic fluid
        iii. Assess for common bile obstruction: Choledocholithiasis – measure

common bile duct (CBD) diameter
    b. Biliary/abdominal advanced ultrasound skills
        i. Appendicitis
        ii. Hepatosplenomegaly
        iii. Small bowel obstruction
        iv. Inguinal hernia

6. Renal/genitourinary tract
    a. Genitourinary basic ultrasound knowledge
        i. Evidence of ureteral stone or obstructive process: Identify mild, moderate, and severe hydronephrosis
        ii. Urinary retention and post-void residual volume: Calculate bladder volume and post-void residual
    b. Genitourinary advanced ultrasound skills (optional)
        i. Renal cysts/ masses
        ii. Stone identification
        iii. Acute versus chronic obstruction
        iv. Use of Doppler waveform imaging/color Doppler
        v. Hydrocele
        vi. Varicocele
        vii. Testicular torsion
        viii. Ovarian torsion
        ix. Epididymitis
        x. Orchitis
        xi. Prostate volume

7. DVT
    a. DVT basic ultrasound skills (lower extremities)
        i. Use of Doppler waveform imaging/color Doppler
        ii. DVT: Know difference between vein, artery, nerve, and lymph node
            1. Low-risk: Ambulatory patient, utilize two-zone discrimination technique – compression at proximal femoral vein zone and popliteal vein zone
            2. High-risk patient: Complete compression of lower extremity from the common femoral vein to the popliteal vein
        iii. Differentiate DVT from cellulitis of lower extremity (see large lymph nodes and soft tissue swelling), superficial thrombophlebitis (deep versus superficial veins), and Baker cyst (cystic, no color flow)
    b. DVT advanced ultrasound skills (upper extremities) (optional)
        i. Anatomy of internal jugular, subclavian, axillary, brachial, basilic, and cephalic veins

8. Soft tissue/musculoskeletal
    a. Soft tissue/musculoskeletal basic ultrasound skills
        i. Cellulitis versus abscess in soft tissue: “Cobble stoning” (fluid in subcutaneous fat) versus discrete, hypoechoic, walled-off fluid

collection in subcutaneous tissue
    ii. Foreign body: Hyperechoic material with shadowing
    iii. Joint effusions/bursitis: Hypoechoic fluid collection in joint space or bursa
    iv. Fractures: Cortical disruption with hematoma
    v. Tendon rupture/tear: Anisotropy versus tear
    vi. Tendonitis/tendinopathy: Fluid collection around tendon and hyperemia on color/Doppler imaging. Some may consider this an advanced application.
    vii. Risks, benefits, indications, and contraindications to ultrasound-guided injection and aspiration (Patient Care, Systems-Based Practice)
  b. Soft tissue/musculoskeletal advanced ultrasound skills (optional)
    i. Shoulder: Rotator cuff integrity and scanning protocols
    ii. Knee: Medial collateral ligament (MCL), lateral collateral ligament (LCL), and patellar tendon integrity
    iii. Ankle: Anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and posterior talofibular ligament (PTFL) integrity
    iv. Median nerve area and ultrasound features suggestive of carpal tunnel syndrome

9. Pulmonary
  a. Pulmonary basic ultrasound skills
    i. Pulmonary ultrasound anatomy: Ribs, pleura, lung tissue, diaphragm, description of lung zones for scanning
    ii. Pulmonary ultrasound artifacts: A-line pattern, B-line pattern, and pleura ultrasound artifacts; evidence of lung sliding (see Trauma section)
    iii. In the appropriate clinical presentation, utilize pulmonary ultrasound anatomy and artifacts to assess for:
      1. Congestive heart failure (CHF): Presence of bilateral B lines in multiple lung zones
      2. Pneumonia: Focal B-line pattern and other sonographic sign
      3. Pneumothorax: Lack of lung sliding (see Trauma section)
      4. Asthma/chronic obstructive pulmonary disease (COPD) exacerbation: Predominant A-line pattern
      5. Pleural effusion and hemothorax (see Trauma section)
  b. Pulmonary advanced ultrasound skills
    i. Acute respiratory distress syndrome (ARDS)
    ii. Chronic interstitial lung disease
    iii. Pleural-based masses
    iv. Interstitial pneumonia

10. Ocular
  a. Ocular basic ultrasound skills
    i. Detached retina: Serpentine, undulating, hyperechoic, and linear

density that appears above and tethered to retina
    ii. Vitreous detachment: No tethering, different than hemorrhage
    iii. Vitreous hemorrhage: Heterogeneous material that may layer above retina and “tumble” with ocular movement like “clothes in a washing machine”
b. Ocular advanced ultrasound skills (optional)
    i. Intraocular foreign body
    ii. Papilledema
    iii. Lens dislocation
    iv. Eccentric pupillary light reflex in ocular trauma

11. Procedural guidance

The physician should be able to identify appropriate ultrasound anatomy, including nerve, artery, vein, muscle, bone, and subcutaneous tissue, to aid the procedure. Use of ultrasound images in performing the procedure should be noted in the consent form and procedure note. (Systems-Based Practice, Professionalism)

a. Procedural basic skills
    i. Thoracentesis
    ii. Paracentesis
    iii. Peripheral IV placement
    iv. Central line placement
    v. Lumbar puncture
    vi. Knee aspiration and injection
    vii. Foreign body identification and removal
b. Procedural advanced skills (optional)
    i. Nerve blocks
    ii. Fine needle aspiration/biopsy
    iii. Shoulder, ankle, hip, and wrist aspiration/injection

12. Clinical protocols

POCUS clinical protocols are systematic exams that serve as an adjunct to improve diagnostic acumen. Clinical protocols do NOT substitute for an appropriate history, physical exam, or other tests, such as ECG, blood tests, and other appropriate radiographic modalities.

a. FAST/E-FAST: Focused assessment with sonography for trauma
b. RUSH: Rapid ultrasound for shock and hypotension
c. BLUE: Bedside lung ultrasound in emergency
d. CLUE: Cardiac limited ultrasound exam
e. FEEDS criteria (see OB/GYN section)

Professionalism

At the completion of residency, a family medicine resident should be able to:

- Maintain high levels of excellence and integrity in their knowledge and use of POCUS

- Understand and know when to utilize POCUS versus referring an exam

- Maintain patient privacy and confidentiality, as appropriate

Implementation

This curriculum should be taught during both focused and longitudinal experiences throughout the residency curriculum. Specifics of certain approaches have been described in the literature, with consensus being that a POCUS curriculum should contain the following components[10,11]:

- Faculty champion: A key component of a successful POCUS curriculum is the presence of a skilled and motivated faculty champion. It is recommended that at least one faculty member should be designated as the curriculum leader for ultrasound education and given adequate protected time to develop as a competent POCUS ultrasonographer. Protected time also will be needed to develop and implement the curriculum and train other faculty members as the curriculum progresses.

- Customized curriculum: Because POCUS education in family medicine training is in its early stages, each residency will develop its own POCUS curriculum that is based on its particular residents and the residency's specific needs, clinical focus, and credentialing process. It is recommended that all curricula contain some aspect of focused and longitudinal experiences, and some combination of didactics, hands-on learning, knowledge/skill assessment, and competency evaluation. Implementation of a POCUS curriculum can include offering a two-day workshop, starting an ultrasound elective, and/or integrating a longitudinal three-year curriculum.

- Didactic education: POCUS didactics can be taught through traditional live lectures or through asynchronous learning in the style of the "flipped classroom." The flipped classroom can be especially useful when skilled faculty time is limited because it is better to allocate teaching time for hands-on learning. Consider starting a journal club to discuss the benefits and limitations of POCUS. Also, there are many excellent (and often free) POCUS educational videos and books available (see Resources section).

- Hands-on education: Visuomotor skills needed to competently perform POCUS can be developed under direct supervision by a faculty member or through self-directed learning during educational ultrasound sessions. Other options for hands-on education include the use of simulation and models. There are several good simulators available to help demonstrate pathology when patients are not available. It is best to have more direct supervision early in a resident's learning process and then transition to self-directed scanning as the resident's skills improve.

- Educational ultrasound: An educational ultrasound is intended for teaching

purposes and gives the trainee hands-on experience. No clinical decisions should be based on educational ultrasounds unless first confirmed with a formal ultrasound examination or discussed with a credentialed health care professional. Patients should provide informed verbal consent before they are subjected to an educational ultrasound. Patients should be informed that it is for education only and that they will not be informed of the results. If anything concerning is found, a credentialed health care professional should be notified immediately. Ideally, all educational ultrasound images should be reviewed by faculty, either during the scan or later by image review.

- Knowledge and skill assessment: Knowledge and skill assessment provides residents with formative feedback throughout the curriculum and helps them focus on areas for improvement. Knowledge is best assessed using multiple-choice tests that include images and video loops of ultrasound images. The resident should be asked to interpret images and use this information to guide patient management in clinical vignettes. Skill assessment is best done under direct observation by the faculty member. This can include informal evaluation, but it is helpful to have some sort of structured evaluation as well. Structured assessments utilize evaluation forms with a system of scoring and can either be performed on the spot while the resident is scanning a patient or scheduled and performed as part of an observed structured examination.

- Quality improvement/assessment: The implementation of POCUS training within a residency setting should be accompanied by ongoing assessment of quality, including, but not limited to, image storage and archiving; periodic review and audit of a certain number/percentage of completed exams; attention to training and documentation of clinical activity for those providing instruction in POCUS; and ongoing continuing medical education (CME).

- Competency assessment: Competency assessment is utilized to provide the resident with summative feedback and determine recommendations for privileges upon graduation. Each family medicine residency program should develop its own criteria to quantify the number of precepted scans needed to assess their learners for POCUS competency. In general, the number of precepted ultrasounds performed correlates with a resident's competency level. Family medicine residency programs with well-established POCUS curricula have used 150 to 300 total scans for general point-of-care ultrasound competency, 25 to 50 supervised exams for a specific diagnostic exam, and 5 to 10 supervised scans for ultrasound-guided procedures.

  These numbers are consistent with recommendations from other specialty societies, such as the American College of Emergency Physicians (ACEP).[12,13] Programs and residents should understand recommendations for training, skill performance, and documentation from other organizations, such as the American Institute of Ultrasound in Medicine (AIUM) and the American College of Obstetricians and Gynecologists (ACOG), and how those are similar to, and

differ from, protocols utilized in POCUS. Consideration should be given to utilizing a summative knowledge exam and skill assessment in this process. In the end, residents must be deemed to be competent by the ultrasound faculty and program director on a case-by-case basis.

Resources

Bornemann P, ed. *Ultrasound in Primary Care*. Wolters Kluwer; 2018.

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Rodney JR, ed. *Family Medicine: Obstetrical Ultrasound*. Dog Ear Publishing; 2014.

Shah SP, Price DD, eds. *Partners in Health Manual of Ultrasound for Resource - Limited Settings*. Partners in Health; 2011.

Soni NJ, Artnfield R, Kory P. *Point-of-Care Ultrasound*. Elsevier; 2015.

Website Resources

American Academy of Family Physicians (AAFP). Point-of-Care Ultrasound Member Interest Group. www.aafp.org/membership/welcome-center/involve/connect/mig/ultrasound.mem.html

American College of Emergency Physicians (ACEP). Ultrasound Guidelines. www.acep.org/globalassets/new-pdfs/policy-statements/ultrasound-guidelines---emergency-point-of-care-and-clinical-ultrasound-guidelines-in-medicine.pdf

American Institute of Ultrasound in Medicine (AIUM). www.aium.org

Core Ultrasound. www.coreultrasound.com/5ms

- Ultrasound of the Week. www.coreultrasound.com/category/ultrasound-of-the-week/

European Society of Musculoskeletal Radiology (ESSR). www.essr.org

International Society of Ultrasound in Obstetrics and Gynecology (ISUOG). www.isuog.org

Society for Academic Emergency Medicine. Academy of Emergency Ultrasound (AEUS) Narrated Lecture Series. www.saem.org/about-saem/academies-interest-groups-affiliates2/aeus/education/aeus-narrated-lecture-series

Sonoguide. www.acep.org/sonoguide

SonoSpot: Topics in Bedside Ultrasound. http://sonospot.com

Toronto General Hospital Department of Anesthesia Perioperative Interactive Education. Virtual Transthoracic Echocardiography. http://pie.med.utoronto.ca/TTE/index.htm

Ultrasound Ninja. www.ultrasoundninja.com

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1. Kanji HD, McCallum J, Sirounis D, et al. Limited echocardiography-guided therapy in subacute shock is associated with change in management and improved outcomes. *J Crit Care*. 2014;29(5):700-705.
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3. Al Deeb M, Barbic S, Featherstone R, et al. Point-of-care ultrasonography for the diagnosis of acute cardiogenic pulmonary edema in patients presenting with acute dyspnea: a systematic review and meta-analysis. *Acad Emerg Med*. 2014;21(8):843-852.
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5. Parker L, Nazarian LN, Carrino JA, et al. Musculoskeletal imaging: medicare use, costs, and potential for cost substitution. *J Am Coll Radiol*. 2008;5(3):182-188.
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11. Flick D. Bedside ultrasound education in primary care. *J Ultrasound Med*. 2016;35(7):1369-1371.
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https://www.emra.org/uploadedFiles/EMRA/committees-divisions/ultrasound/ACEP-2008-EUS-Guidelines.pdf

13. Contra Costa Family Medicine Residency. POCUS at Contra Costa. Accessed October 26, 2017. http://cchealth.org/residency/ghf/pocus.php

Developed 12/2016 by Contra Costa Family Medicine Residency Program, Martinez, CA
Updated 09/2021 by Baylor University Medical Center Family Medicine Residency, Dallas, TX