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EDUCATIONAL ADVANCE

The Core Content of Clinical Ultrasonography Fellowship Training

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Abstract

The purpose of developing a core content for subspecialty training in clinical ultrasonography (US) is to standardize the education and qualifications required to provide oversight of US training, clinical use, and administration to improve patient care. This core content would be mastered by a fellow as a separate and unique postgraduate training, beyond that obtained during an emergency medicine (EM) residency or during medical school. The core content defines the training parameters, resources, and knowledge of clinical US necessary to direct clinical US divisions within medical specialties. Additionally, it is intended to inform fellowship directors and candidates for certification of the full range of content that might appear in future examinations. This article describes the development of the core content and presents the core content in its entirety.

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In 1999, the American Medical Association passed Resolution 802 and Policy H-230.960 stating that ultrasound (US) is "within the scope of practice of appropriately trained physicians" and that this scope of practice should be developed "in accordance with recommended training and education standards developed by each physician's respective specialty."[1] Clinical US, performed at the bedside by the treating clinician, is

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now employed to some degree by most medical specialties.[2] For more than two decades, the specialty of emergency medicine (EM) has incorporated clinical US as a key modality for care of the patient in the acute setting, and it is now considered a core competency for residency training.[3–6]

Fellowships in EM clinical US have been formed to provide physicians with the skills to oversee the education, use, and administration of clinical US and to provide training for research in the field. The first recognized emergency US fellowship was offered in 1993, and there are currently emergency US fellowships listed at 90 institutions, many of which accept multiple fellows (James Mateer, MD, personal communication, August 23, 2012; http://eusfellowships.com). While guidelines for emergency US fellowships have been developed and approved by the American College of Emergency Physicians (ACEP),[7] emergency US fellowships are not currently accredited by the Accreditation Council of Graduate Medical Education (ACGME).

In 2007, a subcommittee for subspecialty development under the Ultrasound Section of ACEP was formed to explore a certification or board examination process for fellowship training in clinical US. In October 2011, members of the ACEP Ultrasound Section and the Academy of Emergency Ultrasound (AEUS) of the Society for Academic Emergency Medicine (SAEM) voted in favor of pursing an application for ACGME accreditation of clinical US fellowships. As a step toward this goal, the subcommittee formed the writing group that generated this document. The document was created in close communication with ACEP, SAEM, and the American Board of Emergency Medicine (ABEM).

TERMINOLOGY

The term "clinical ultrasonography" is used throughout this document to maintain clarity. Clinical US refers to the use of US as a focused diagnostic test, with image archiving and reporting in the medical record, by clinicians who are directly involved with the care of the patient. Associated terms such as "point-of-care ultrasound," "bedside ultrasound," "focused ultrasound," "emergency ultrasound," "limited ultrasound," or others are not used here, although they may describe aspects of clinical US. While this document focuses on applications of clinical US in the acute setting, clinical US may apply to a broad range of specialties.

GOALS AND CURRICULUM OVERVIEW

This document proposes core content for clinical US fellowship training (see Data Supplement S1). The outline is consistent with previously published national US and fellowship development guidelines and should be considered a template for clinical US fellowship training, especially in EM.[7,8] A detailed document that describes a scanning protocol, a normal anatomy and pathology review, and an integration strategy for clinical care of the patient is available as an online resource through the ACEP US section Web site. The technical report is divided into four broad categories: 1) image acquisition and interpretive skills, 2) education skills, 3) research skills, and 4) administrative skills. Basic resident-level skills are included as they serve as a foundation for advanced skills. While the core content described here reflects the field of emergency clinical US, many medical specialties incorporate clinical US, and they may share significant components of the clinical US subspecialty curriculum.

RECOGNITION OF THIS CURRICULUM

ACEP supports this document. The AEUS of SAEM and SAEM board of directors endorse this document. The board of directors of the American Society of Clinical Ultrasound Fellowships (formerly known as Eusfellowships.com) endorses this document.

FUTURE DEVELOPMENT OF THE CORE CONTENT

An organized structure for fellowship training in clinical US applications, clinical education, research, and administration skills is provided in this document. This document will serve to instruct and guide fellowship directors and candidates on the clinical US fellowship core content and will serve as the basis for future examination questions and certification development. This article provides the basis for a potential multispecialty ABMS clinical US subspecialty. The core content is intended to be a living document in keeping with the ever-evolving practice of clinical US.

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CURRICULUM

1. Image Acquisition and Interpretation Skills
1.1 Clinical Ultrasonography Fellow Applications Content
1.1.1 Physics
1.1.1.1 Basic
1.1.1.1.1 Artifacts
1.1.1.1.2 Knobs
1.1.1.1.3 Planes
1.1.1.1.4 Properties of sound waves
1.1.1.1.1 Background physics
1.1.1.1.2 Display and monitors
1.1.1.1.3 Image resolution
1.1.1.1.4 Transducers
1.1.1.1.5 Ultrasound beam
1.1.1.2 Advanced
1.1.1.2.1 Aliasing
1.1.1.2.2 Doppler techniques
1.1.1.2.2.1 Color
1.1.1.2.2.2 Spectral
1.1.1.3 Biological effects and safety
1.1.1.4 Performance testing
1.1.2 Cardiac
1.1.2.1 Basic
1.1.2.1.1 Asystole
1.1.2.1.2 Global left ventricular function
1.1.2.1.3 Global right ventricular size
1.1.2.1.4 Pericardial fluid
1.1.2.1.5 Tamponade physiology
1.1.2.2 Advanced
1.1.2.2.1 Advanced views
1.1.2.2.2 Aortic root assessment
1.1.2.2.3 Cardiac output assessment
1.1.2.2.4 Chamber size, pressure, and comparison
1.1.2.2.5 Regional wall motion
1.1.2.2.6 Valvular assessment
1.1.3 Chest and lung
1.1.3.1 Basic
1.1.3.1.1 Pleural fluid
1.1.3.1.2 Pneumothorax
1.1.3.2 Advanced
1.1.3.2.1 Consolidation
1.1.3.2.2 Alveolar interstitial syndrome
1.1.3.2.3 Pleural disease
1.1.3.2.4 Rib and sternal fracture
1.1.4 Aorta
1.1.4.1 Basic
1.1.4.1.1 Abdominal aortic aneurysm
1.1.4.2 Advanced
1.1.4.2.1 Aortic arch assessment
1.1.4.2.2 Aortic dissection
1.1.4.2.3 Aortic root assessment
1.1.4.2.4 Descending aorta assessment
1.1.4.2.5 Thoracic aneurysm
1.1.5 Renal
1.1.5.1 Basic
1.1.5.1.1 Hydronephrosis
1.1.5.1.2 Qualitative bladder volume
1.1.5.2 Advanced
1.1.5.2.1 Artifacts
1.1.5.2.1.1 Twinkling
1.1.5.2.2 Cysts
1.1.5.2.2.1 Simple
1.1.5.2.2.2 Complex
1.1.5.2.3 Congenital renal abnormalities
1.1.5.2.4 Masses
1.1.5.2.5 Quantitative bladder volume
1.1.5.2.6 Renal Doppler
1.1.5.2.7 Renal parenchymal assessment
1.1.5.2.8 Renal transplant
1.1.5.2.9 Stone assessment
1.1.5.2.10 Ureteral jets
1.1.6 Male genito-urinary
1.1.6.1 Basic
1.1.6.2 Advanced
1.1.6.2.1 Scrotum and scrotal contents
1.1.6.2.1 Abscess and cellulitis
1.1.6.2.2 Hydrocele
1.1.6.2.3 Varicocele
1.1.6.2 Testicle
1.1.6.2.1 Cysts
1.1.6.2.2 Epididymo-orchitis
1.1.6.2.3 Masses
1.1.6.2.4 Parenchymal assessment
1.1.6.2.5 Torsion
1.1.7 Hepatobiliary
1.1.7.1 Basic
1.1.7.1.1 Cholelithiasis
1.1.7.2 Advanced
1.1.7.2.1 Gallbladder and biliary tree
1.1.7.2.1 Ductal assessment
1.1.7.2.2 Masses
1.1.7.2.3 Polyps
1.1.7.2.4 Sludge
1.1.7.2.5 Wall assessment
1.1.7.2.5.1 Adenomyomatosis
1.1.7.2.5.2 Emphysematous cholecystitis
1.1.7.2.5.3 Global and focal wall thickening
1.1.7.2.5.4 Pericholecystic fluid
1.1.7.2.5.5 Porcelain gallbladder
1.1.7.2.2 Liver
1.1.7.2.2.1 Cysts
1.1.7.2.2.2 Disruption of internal architecture
1.1.7.2.2.3 Masses
1.1.7.2.2.4 Parenchymal assessment
1.1.7.2.3 Portal vein Doppler
1.1.7.2.4 Portal venous thrombosis
1.1.8 Other abdomen
1.1.8.1 Trauma
1.1.8.1.1 Basic (see integrated examinations section)
1.1.8.1.2 Advanced (see integrated examinations section)

1.1.8.2 Non-trauma
1.1.8.2.1 Basic
1.1.8.2.1.1 Peritoneal fluid assessment
1.1.8.2.2 Advanced
1.1.8.2.1 Appendix
1.1.8.2.2 Bowel
1.1.8.2.2.1 Ileus
1.1.8.2.2.2 Intussusception
1.1.8.2.2.3 Obstruction
1.1.8.2.2.4 Pyloric stenosis
1.1.8.2.3 Hernias
1.1.8.2.4 Pancreas
1.1.8.2.4.1 Masses
1.1.8.2.4.2 Pseudocysts
1.1.8.2.5 Pneumoperitoneum
1.1.8.2.6 Spleen
1.1.8.2.5.1 Cysts
1.1.8.2.5.2 Disruption of internal architecture
1.1.8.2.5.3 Masses
1.1.8.2.5.4 Parenchymal assessment

1.1.9 Ocular
1.1.9.1 Basic
1.1.9.1.1 Undifferentiated vitreous chamber pathology
1.1.9.2 Advanced
1.1.9.2.1 Extra-ocular muscle assessment
1.1.9.2.2 Foreign body
1.1.9.2.3 Lens dislocation
1.1.9.2.4 Optic nerve sheath diameter
1.1.9.2.5 Peri-orbital emphysema
1.1.9.2.6 Pupillary assessment
1.1.9.2.7 Retinal detachment
1.1.9.2.8 Retro-bulbar hematoma
1.1.9.2.9 Vitreous detachment and hemorrhage

1.1.10 Female pelvis
Transabdominal and/or transvaginal approaches
1.1.10.1 Basic obstetrics
1.1.10.1.1 First trimester assessment
1.1.10.1.1.1 Intra-uterine pregnancy
1.1.10.1.1.1 Gestational sac
1.1.10.1.1.2 Yolk sac
1.1.10.1.1.3 Fetal assessment
1.1.10.1.1.2 Free fluid
1.1.10.2 Basic gynecology
1.1.10.3 Advanced obstetrics
1.1.10.3.1 First trimester assessment
1.1.10.3.1.1 Blighted ovum
1.1.10.3.1.2 Fetal dating
1.1.10.3.1.3 Subchorionic hemorrhage
1.1.10.3.2 Second trimester assessment
1.1.10.3.2.1 Fetal dating
1.1.10.3.3 Third trimester assessment
1.1.10.3.3.1 Adnexa (see below)
1.1.10.3.3.2 Amniotic fluid assessment
1.1.10.3.3.3 Fetal dating
1.1.10.3.3.4 Fetal station
1.1.10.3.3.5 Placental location
1.1.10.4 Advanced gynecology
1.1.10.4.1 Adnexa
1.1.10.4.1.1 Abscess
1.1.10.4.1.2 Cysts
1.1.10.4.1.3 Ectopic pregnancy
1.1.10.4.1.4 Masses
1.1.10.4.1.5 Torsion
1.1.10.4.2 Uterus
1.1.10.4.2.1 Cysts
1.1.10.4.2.2 Endometritis
1.1.10.4.2.3 Masses
1.1.10.4.2.4 Retained products of conception

1.1.11 Procedures
1.1.11.1 Basic
1.1.11.1.1 Abscess drainage
1.1.11.1.2 Foreign body removal
1.1.11.1.4 Paracentesis
1.1.11.1.5 Pericardiocentesis
1.1.11.1.6 Thoracentesis
1.1.11.1.7 Vascular access
1.1.11.2 Advanced
1.1.11.2.1 Arthrocentesis
1.1.11.2.2 Cardiac pacer wire placement
1.1.11.2.3 Endotracheal tube evaluation
1.1.11.2.4 Guiding and verifying tube and catheter placement
1.1.11.2.4.1 Foley
1.1.11.2.4.2 Gastrostomy
1.1.11.2.4.3 PICC catheter
1.1.11.2.5 Lumbar puncture
1.1.11.2.6 Regional anesthesia

1.1.12 Venous/Arterial assessment
1.1.12.1 Basic
1.1.12.1.1 Deep venous thrombosis lower extremity
1.1.12.1.2 Inferior vena cava
1.1.12.2 Advanced
1.1.12.2.1 Deep venous thrombosis neck
1.1.12.2.2 Deep venous thrombosis upper extremity
1.1.12.2.3 Doppler evaluation
1.1.12.2.3.1 Arterial flow
1.1.12.2.3.2 Pseudoaneurysm

1.1.13 Soft tissue
1.1.13.1 Basic
1.1.13.1.1 Abscess
1.1.13.1.2 Cellulitis
1.1.13.1.3 Foreign body detection
1.1.13.2 Advanced
1.1.13.2.1 Fasciitis
1.1.13.2.2 Lymph node assessment
1.1.13.2.3 Myositis
1.1.13.2.4 Peritonsillar abscess
1.1.13.2.5 Soft tissue masses

1.1.14 Musculoskeletal
1.1.14.1 Basic
1.1.14.2 Advanced
1.1.14.2.1 Bones
1.1.14.2.2 Joints
1.1.14.2.3 Ligaments
1.1.14.2.4 Muscles
1.1.14.2.5 Tendons

1.1.15 Pediatrics
Assessment would include the relevant applications contained within the curriculum; however specific focus on the following:

1.1.15.1 Basic
1.1.15.2 Advanced
1.1.15.2.1 Appendix
1.1.15.2.2 Hip assessment
1.1.15.2.3 Intussusception
1.1.15.2.4 Lumbar puncture
1.1.15.2.5 Pyloric stenosis

1.1.16 Head and neck
1.1.16.1 Basic
1.1.16.2 Advanced
1.1.16.2.1 Neck masses
1.1.16.2.2 Salivary glands
1.1.16.2.3 Thyroid cysts
1.1.16.2.4 Vocal cords

1.1.17 Integrated examinations and syndromes
1.1.17.1 Basic
Trauma primary survey
1.1.17.1 Pericardial fluid
1.1.17.2 Peritoneal fluid
1.1.17.3 Pleural fluid
1.1.17.4 Pneumothorax
1.1.17.2 Advanced
Trauma secondary survey
1.1.17.2.1 Limited solid organ injury
1.1.17.2.2 Musculoskeletal
1.1.17.2.3 Optic nerve sheath diameter
1.1.17.2.4 Soft tissue
1.1.17.3 Undifferentiated abdominal pain
1.1.17.4 Undifferentiated chest pain and/or dyspnea
1.1.17.5 Undifferentiated hypotension

1.2 Clinical Ultrasonography Training with Non-Emergency Medicine Specialties

Specialties with potential collaborative training opportunities for clinical ultrasonography fellows include and are not limited anesthesiology, cardiology, critical care medicine, general surgery, obstetrics gynecology, radiology, and vascular surgery. The specialty-specific guidelines vary in terms of time devoted to ultrasound training, requisite number of scans, didactic instruction, and demonstration of competency.

2. Education Skills

2.1 Development of educational content
2.1.1 Assessment of content and curricular development
2.1.2 Didactic lecture preparation
2.1.3 Utilization of social media and mixed media

2.2 Presentation of educational content
2.2.1 Assessment of presentation content and organization
2.2.2 Oral presentation and speaking skills
2.2.3 Visual presentation skills

2.3 Bedside hands-on instruction
2.3.1 Assessment of hands-on education methods

2.4 Competency assessment of hands-on and theoretical skills
2.4.1 Evaluation of competency pathway comprehension
2.4.1.1 Accreditation
2.4.1.2 Certification
2.4.1.3 Credentialing
2.4.2 Evaluation of functional knowledge and cognitive abilities
2.4.2.1 Chart review
2.4.2.2 Image review
2.4.2.3 Lectures
2.4.2.4 Written or online examinations
2.4.3 Evaluation of psychomotor skills
2.4.3.1 Ethics
2.4.3.2 Observed structured clinical examinations
2.4.3.3 Procedural competence
2.4.3.4 Scanning sessions
2.4.3.5 Simulator sessions
2.4.4 Evaluation of teaching skills
2.4.4.1 Direct observation
2.4.4.2 Lectures
2.4.4.3 Written evaluations

3. Research Skills

3.1 Research didactic and coursework
3.1.1 Critical analysis of medical literature
3.1.2 Fundamental knowledge of epidemiology and biostatistics
3.1.3. Informed consent, legal, and ethics regulations
3.1.4 Research acquisition, analysis, and interpretation skills

3.2 Research project development
3.2.1 Question and hypothesis development
3.2.2 Literature search and review
3.2.3 Methodology, data collection, management, and analysis
3.2.4 Institutional review board submission

3.3 Research project abstract and manuscript preparation

3.4 Research education and administration

3.5 Fellowship research evaluation and assessment

4. Administration Skills

4.1 Quality improvement principles and program
4.1.1 Assessment and feedback strategy
4.1.2 Critical findings
4.1.3 Peer review
4.1.4 Sampling
4.1.5 Risk management

4.2 Leadership
4.2.1 Administrative oversight
4.2.2 Communication
4.2.3 Education oversight
4.2.3.1 Non-physicians
4.2.3.2 Physicians
4.2.4 Equipment oversight
4.2.5 Research oversight
4.2.6 Risk Management oversight
4.2.7 Workflow solution oversight

4.3 Program systems
4.3.1 Disinfection principles
4.3.2 Equipment and hardware
4.3.2.1 Purchase
4.3.2.2 Maintenance and cleaning
4.3.3 Safety principles
4.3.4 Workflow design, software and solutions
4.3.4.1 Electronic and digital interfaces

4.3.4.2 Image archiving
4.3.4.3 Policies and procedures
4.4 Relationships and networks
4.4.1 Biomedical engineering
4.4.2 Coders and billers
4.4.3 Departmental physicians and non-physicians
4.4.4 Hospital credentialing and privileging committees
4.4.5 Hospital purchasing
4.4.6 Industry
4.4.7 Infection control
4.4.8 Information technologists
4.4.9 Institutional review board
4.4.10 International organizations
4.4.11 Legal and risk management
4.4.12 Local organizations
4.4.13 Materials management
4.4.14 Medical staff services
4.4.15 Other departments
4.4.15 National organizations
4.4.15.1 Non-governmental
4.4.15.1.1 Multi-specialty
4.4.15.1.2 Specialty-specific
4.4.15.2 Governmental
4.4.15.2.1 Government agencies
4.4.15.2.2 Public health agencies
4.4.16 Quality Improvement committee
4.5 Coding and billing
4.5.1 Coding
4.5.2 Documentation
4.5.3 Payer structure
4.5.4 Policy
4.5.4.1 State
4.5.4.2 National
4.5.5 Terminology
4.6 Economics
4.6.1 Microeconomics
4.6.1.1 Allocation of resources
4.6.1.2 Basic accounting
4.6.1.3 Principles of department and division budgeting
4.6.2 Macroeconomics
4.6.2.1 Allocation of resources
4.6.2.2 Billing
4.6.2.3 Departmental revenue
4.6.2.4 Hospital revenue