



Sonography

The purpose of structured education is to provide the opportunity for individuals to develop mastery of discipline-specific knowledge that, when coupled with selected clinical experiences, helps to document qualifications. The *Structured Education Requirements for Sonography* is provided to assist candidates with these requirements.

Candidates for sonography certification and registration must document at least 16 hours of structured education¹. The activities must be earned within the 24-month period immediately prior to submission of an application for certification and registration. Structured education activities may be academic courses from an institution accredited by a mechanism recognized by the ARRT², CE opportunities approved by a RCEEM or RCEEM+, or a combination of the two.

Structured education documentation must include at least one CE credit or its equivalent in each content category listed below (i.e., Patient Care, Safety, Image Production, and Procedures). The remaining hours may be earned from any one or more of the content areas. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	Minimum Credit Hours
Patient Care (includes) <i>Patient Interactions and Management</i>	1
Image Production (includes) <i>Basic Principles of Ultrasound</i> <i>Image Formation</i> <i>Evaluation and Selection of Representative Images</i>	1
Procedures (includes) <i>Abdomen</i> <i>First Trimester Obstetrics</i> <i>Second/Third Trimester and High Risk Obstetrics</i> <i>Gynecology</i> <i>Superficial Structures and Other Sonographic Procedures</i>	1
Total	16

Acceptable Examples:

Example 1
Patient Care – 3 hours Image Production – 6 hours Procedures – 7 hours
TOTAL – 16 hours

Example 2
Patient Care – 1 hour Image Production – 1 hour Procedures – 14 hours
TOTAL – 16 hours

Example 3
Patient Care – 1 hour Image Production – 10 hours Procedures – 5 hours
TOTAL – 16 hours

¹. If there is a structured education requirement document with a newer effective date, you may either use the new document or continue to use this document if you have completed at least one educational activity prior to the effective date of the new version. For more information access the online clinical experience tool, where structured education is also reported.

². Activities meeting the definition of an approved academic course will be awarded credit at the rate of 12 CE credits for each academic **quarter** credit or 16 CE credits for each academic **semester** credit. See the ARRT *Continuing Education Requirements* document for additional information.



Patient Care

1. Patient Interactions and Management

A. Ethical and Legal Aspects

1. patient's rights
 - a. informed consent
(*e.g., written, oral, implied)
 - b. confidentiality (HIPAA)
 - c. American Hospital Association (AHA) Patient Care Partnership (Patients' Bill of Rights)
 1. privacy
 2. extent of care (e.g., DNR)
 3. access to information
 4. living will, health care proxy, advance directive
 5. research participation
 - d. legal Issues
 - a. verification (e.g., patient identification, compare order to clinical indication, exam coding)
 - b. common terminology (e.g., battery, negligence, malpractice, beneficence)
 - c. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
 - d. restraints versus immobilization
 3. ARRT Standards of Ethics
- #### B. Interpersonal Communications
1. modes of communication
 - a. verbal/written
 - b. nonverbal (e.g., eye contact, touching)
 2. challenges in communication
 - a. interactions with others
 1. language barriers
 2. cultural and social factors
 3. physical and sensory impairments
 4. age
 5. emotional status, acceptance of condition
 - b. explanation of medical terms
 - c. strategies to improve understanding

3. patient education
 - a. explanation of current procedure (e.g., risks, benefits)
 - b. pre- and post-examination instructions (e.g., preparations, diet, medications, discharge instructions)
 - c. respond to inquiries about other imaging modalities (e.g., CT, MRI, mammography, nuclear medicine, radiography, bone densitometry)

C. Physical Assistance and Monitoring

1. patient transfer and movement
 - a. body mechanics (balance, alignment, movement)
 - b. patient transfer techniques
2. assisting patients with medical equipment
 - a. infusion catheters and pumps
 - b. oxygen delivery systems
 - c. other (e.g., nasogastric tubes, urinary catheters)
3. routine monitoring
 - a. vital signs
 - b. physical signs and symptoms (e.g., motor control, severity of injury)
 - c. fall prevention
 - d. documentation
4. operator ergonomics

D. Medical Emergencies

1. allergic reactions (e.g., contrast, latex)
2. cardiac/respiratory arrest (e.g., CPR)
3. physical injury or trauma
4. other medical disorders (e.g., seizures, diabetic reactions)

* The abbreviation "e.g.," is used to indicate that examples are listed in parenthesis, but that it is not a complete list of all possibilities.

(Patient Care continues on the following page.)



Patient Care (continued)

E. Infection Control

1. chain of infection (cycle of infection)
 - a. pathogen
 - b. reservoir
 - c. portal of exit
 - d. mode of transmission
 1. direct
 - a. droplet
 - b. direct contact
 2. indirect
 - a. airborne
 - b. vehicle-borne (fomite)
 - c. vector-borne (mechanical or biological)
 - e. portal of entry
 - f. susceptible host
2. asepsis
 - a. equipment disinfection
 - b. equipment sterilization
 - c. medical aseptic technique
 - d. sterile technique
 - e. proper gel handling
3. CDC Standard Precautions
 - a. hand hygiene
 - b. use of personal protective equipment (e.g., gloves, gowns, masks)
 - c. safe handling of contaminated equipment/surfaces
 - d. disposal of contaminated materials
 1. linens
 2. needles
 3. patient supplies
 4. blood and body fluids

4. transmission-based precautions

- a. contact
- b. droplet
- c. airborne

5. additional precautions

- a. neutropenic precautions (reverse isolation)
- b. healthcare associated (nosocomial) infections

F. Patient Monitoring and Safety

1. ultrasound bioeffects and safety
2. pressure and intensity measurement
 - a. thermal index (e.g., soft tissue, cranium, bone)
 - b. mechanical index
3. research on biological effects
4. AIUM recommendations

G. Interventional Procedures

1. patient preparation
2. time-out
3. informed consent
4. sterile technique
5. follow-up instructions



Image Production

1. Basic Principles of Ultrasound

A. Generation of Signal

1. transducers
 - a. construction and properties
 1. crystal thickness, wavelength
 2. frequency spectrum, resonance
 3. damping
 - b. operation
 1. focusing
 2. beam diameter
 3. piezoelectric effect
 - c. types
2. beam configuration
 - a. near and far field
 - b. focal zone
 - c. beam profile
3. pulse characteristics
 - a. pulse repetition frequency
 - b. pulse repetition period
 - c. spatial pulse length
 - d. duty factor
 - e. frequency
 - f. resolution
 1. axial
 2. lateral
 3. temporal
 4. elevational
 5. contrast

4. technical factors

- a. frequency, bandwidth, Q factor
- b. power
- c. pressure
- d. intensity
- e. amplitude

5. modes

- a. B-mode
- b. M-mode
- c. Doppler
 1. color
 2. spectral
 - a. pulse wave Doppler
 - b. continuous wave Doppler
 3. power/energy

B. Machine and Transducer Use

1. selection
2. care
3. malfunctions

(Image Production continues on the following page.)



Image Production (continued)

2. Image Formation

- A. Technical Factors for Diagnostic Quality Images
 - 1. power
 - 2. focal zone
 - 3. depth
 - 4. compensation/TGC
 - 5. gain
 - 6. frame rate
 - 7. Doppler gain
 - 8. Doppler angle
 - 9. gate (sample volume) size/placement
 - 10. wall filter
 - 11. scale
 - 12. color box (size and steering)
 - 13. dynamic range
 - 14. line density
 - 15. spectral baseline
 - 16. harmonics
 - 17. spatial compounding
- B. Beam Interactions
 - 1. speed of sound in soft tissue
 - a. density
 - b. stiffness
 - 2. time and distance (range equation)
 - 3. acoustic impedance
 - 4. normal and oblique incidence
 - 5. reflection
 - 6. transmitted/refracted waves
 - 7. intensity
 - 8. scattering
 - 9. absorption and attenuation

- C. Detection and Display of Echoes
 - 1. receiver
 - 2. amplitude
 - 3. dynamic range and compression
 - 4. analog-to-digital converter (ADC)
 - 5. digital-to-analog converter (DAC)
 - 6. brightness
 - 7. contrast
 - 8. post-processing (e.g., smoothing, edge enhancement, filtering, read magnification)
 - 9. panoramic imaging
 - 10. write magnification
 - 11. 3D/4D imaging
- D. Bioeffects
 - 1. thermal
 - 2. mechanical (e.g., cavitation)
 - 3. output measures (e.g., MI, TIS, TIC, TIB, SPTA)
 - 4. ALARA
- E. Measurements from Spectral Analysis
 - 1. peak systolic velocity (PSV)
 - 2. end diastolic velocity (EDV)
 - 3. resistive index (RI)/pulsatility index (PI)
 - 4. tardus parvus waveform

(Image Production continues on the following page.)



Image Production (continued)

3. Evaluation and Selection of Representative Images

- A. Criteria for Diagnostic Quality
 - 1. proper demonstration of anatomical structures
 - 2. proper demonstration of pathological conditions
 - 3. artifacts
 - a. gray scale (e.g., reverberation, mirror image, shadowing, posterior enhancement, comet tail)
 - b. Doppler (e.g., aliasing, twinkling, mirror image)
 - 4. improvement of suboptimal images
- B. Image Archiving
- C. Color and Spectral Analysis
 - 1. direction of flow
 - 2. presence or absence of flow
 - 3. differentiation of normal and abnormal spectral waveforms
- D. Real-Time Imaging
 - 1. echogenicity of reflectors
 - 2. echotextures



Procedures

TYPE OF EXAM

1. Abdomen

- A. Abdominal and Transplant Vasculature
 1. aorta and branches
 2. inferior vena cava (IVC) and confluences
 3. portal veins and confluences
 4. kidney transplant(s)
 5. liver transplant
- B. Abdominal Organs
 1. biliary system
 - a. gallbladder
 - b. bile ducts (e.g., CBD, extra-hepatic)
 2. urinary tract
 - a. kidneys
 - b. ureters
 - c. bladder
 3. spleen
 4. pancreas
 5. liver
 6. other
 - a. lymph nodes
 - b. adrenal glands
 - c. gastrointestinal tract (e.g., appendix)
 - d. hernia
 - e. prostate
 - f. peritoneal cavity

FOCUS OF QUESTIONS

Practice Guidelines (e.g., AIUM, ACR)

- clinical indications
- patient preparation
- patient positioning
- instrumentation (e.g., transducer, stand-off pads)
- technical factors
- evaluation and documentation of visualized anatomy
- optimizing image quality

Anatomy and Physiology

- normal
- normal variant
- abnormal
- measurements

Abnormalities

- pathology
- congenital anomalies
- lab values
- differential diagnosis

Doppler Applications/Blood Flow Characteristics

- normal
- normal variant
- abnormal
- measurements

(Procedures continues on the following page.)



Procedures (continued)

TYPE OF EXAM

2. First Trimester Obstetrics

- A. Standard Measurements (e.g., heart rate, CRL, MSD)
- B. Maternal Anatomy
 - 1. uterus
 - 2. cervix
 - 3. adnexa
 - 4. ovaries (corpus luteum)
- C. Embryonic Anatomy and Physiology
 - 1. fetal number
 - 2. gestational age
 - 3. gestational sac
 - 4. decidual layer
 - 5. amnion
 - 6. chorion
 - 7. yolk sac
 - 8. embryonic pole
 - 9. cardiac activity
- D. Key Abnormalities (e.g., anembryonic pregnancy, spontaneous abortion, ectopic pregnancy, embryonic demise)

3. Second/Third Trimester and High Risk Obstetrics

- A. Standard Measurements (e.g., BPD, HC, AC, FL)
- B. Maternal Anatomy
 - 1. uterus
 - 2. cervix
 - 3. ovaries
- C. Fetal Anatomy and Physiology
 - 1. fetal number
 - 2. position, presentation and lie
 - 3. gestational age and weight
 - 4. amniotic fluid volume
 - 5. cord
 - 6. placenta
 - 7. cardiac activity
 - 8. anatomic systems visualized (e.g., GI, CNS, cardiovascular)
 - 9. nuchal fold
- D. Chromosomal Abnormalities (e.g., trisomies, triploidy)
- E. Genetic Abnormalities (e.g., polycystic kidney disease, skeletal dysplasias)
- F. Infection (e.g., TORCH)

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(Procedures continues on the following page.)



Procedures (continued)

TYPE OF EXAM

3. Second/Third Trimester and High Risk Obstetrics (continued)

- G. Abnormal Growth and Development (e.g., club foot, atresia, anencephaly, macrocephaly, renal agenesis, gastroschisis, VSD)
- H. Neoplasm (e.g., blastoma, teratoma)
- I. Multiple Gestations (e.g., chorionicity, amnionicity, twin-to-twin transfusion syndrome, conjoined)
- J. Assisted Reproduction/Implantation
- K. Fetal Biophysical Profile
- L. Placenta (e.g., trophoblastic disease, previa, accreta, insufficiency, abruption)
- M. Amniotic Fluid (e.g., polyhydramnios, oligohydramnios, PROM)
- N. Hydrops (immune & non-immune)
- O. Intrauterine Growth Restriction (symmetric and asymmetric)
- P. Umbilical Cord (e.g., 2-vessel cord, knots, vasa previa, prolapse)
- Q. Cervical Incompetence
- R. Maternal Disease and Abnormality (e.g., diabetes, uterine anomaly)

4. Gynecology

- A. Uterus
 - 1. myometrium
 - 2. endometrium
 - 3. cervix
- B. Adnexa
 - 1. ovaries
 - 2. fallopian tubes
 - 3. para-ovarian structures
 - 4. pelvic varices
- C. Cul-de-Sac
- D. Vagina
- E. Pelvic Floor

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(Procedures continues on the following page.)



Procedures (continued)

TYPE OF EXAM

5. Superficial Structures and Other Sonographic Procedures

- A. Neck
 - 1. thyroid
 - 2. parathyroid
 - 3. salivary glands/parotid glands
 - 4. lymph nodes
- B. Scrotum and Testes
- C. Breasts/Axilla
- D. Vascular Exams
 - 1. venous extremity Doppler (lower and upper)
 - 2. carotid Doppler
 - 3. post catheterization complications
- E. Pediatric Exams
 - 1. neonatal (head, spine, hips)
 - 2. gastrointestinal tract (e.g., appendix, pylorus, intussusceptions)
 - 3. abdomen/adrenal/renal
- F. Ultrasound Guided Interventional Procedures (e.g., fine needle aspiration, biopsy, catheter placement, paracentesis, thoracentesis, intraoperative)
- G. Miscellaneous
 - 1. musculoskeletal
 - 2. superficial masses
 - 3. noncardiac chest (e.g., pleural space, lung)
 - 4. abdominal wall

FOCUS OF QUESTIONS

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- optimizing image quality

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