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.

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<td>Total</td>
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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. Confirmation of Exam Requisition
      1. verification of patient identification
      2. comparison of request to clinical indications
      3. verification of exam coding
   B. Legal Issues
      1. common terminology
         (*e.g., negligence, malpractice)
      2. legal doctrines (e.g., respondeat superior, res ipsa loquitur)
   C. Patient’s Rights
      1. informed consent (written, oral, implied)
      2. confidentiality (HIPAA)
      3. Patient’s Bill of Rights
         (e.g., privacy, access to information, health care proxy, research participation)
   D. ARRT Standards of Ethics
   E. Interpersonal Communications
      1. modes of communication
         a. verbal, written
         b. nonverbal
            (e.g., eye contact, touching)
      2. challenges in communication
         a. patient characteristics
            (e.g., cultural factors, physical or emotional status)
         b. strategies to improve understanding
      3. patient education
         a. pre-procedural preparation
         b. explanation of procedure
            (e.g., risks, benefits)
         c. follow-up instructions
         d. referral to other services
         4. medical terminology
   F. Patient Monitoring and Safety
      1. ultrasound bioeffects and safety
         a. pressure and intensity measurement
            1. thermal index (soft tissue, cranium, bone)
         2. mechanical index
         b. research on biological effects
         c. AIUM recommendations
      2. routine monitoring
         a. fall prevention
         b. vital signs
         c. physical signs and symptoms
      3. interventional procedures
         a. patient preparation
         b. time-out
         c. informed consent
         d. sterile technique
         e. follow-up instructions
      4. patient transfer and movement
         a. operator ergonomics
         b. body mechanics (balance, alignment, movement)
         c. patient transfer
      5. assisting patients with medical equipment
         a. infusion catheters and pumps
         b. pacemakers
         c. oxygen delivery systems
         d. other (e.g., nasogastric tubes, urinary catheters)
      6. response to common emergencies
         a. allergic reactions
            (e.g., contrast, latex)
         b. cardiac/respiratory arrest
            (e.g., CPR)
         c. physical injury or trauma
         d. other medical disorders
            (e.g., seizures, diabetic reactions)

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

(Patient Care continues on the following page.)
Patient Care (continued)

G. Infection Control

1. terminology and basic concepts
   a. types of asepsis
   b. sterile technique
   c. pathogens
      (e.g., fomites, vehicles, vectors)
   d. nosocomial infections

2. cycle of infection
   a. pathogen
   b. source or reservoir of infection
   c. susceptible host
   d. method of transmission (contact, droplet, airborne, common vehicle, vector-borne)

3. CDC Standard Precautions (general patient contact)
   a. handwashing
   b. gloves, gowns
   c. masks
   d. medical asepsis/disinfection

4. additional or transmission-based precautions (e.g., hepatitis B, HIV, MRSA, tuberculosis)
   a. blood borne
   b. airborne (e.g., negative ventilation)
   c. droplet (e.g., mask)
   d. contact (e.g., gloves, gown)

5. reverse isolation

6. disposal of contaminated materials
   a. linens
   b. needles
   c. patient supplies
   d. blood and body fluids

7. equipment
   a. sterilization
   b. disinfection
Image Production

1. Basic Principles of Ultrasound and Equipment
   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
         g. transducer malfunctions
      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
            3. power/energy
   B. Image Formation
      A. Tissue Interactions
         1. beam interactions
            a. speed of sound in soft tissue
               1. density
               2. stiffness
            b. time and distance - range equation
            c. acoustic impedance
            d. normal and oblique incidence
            e. reflection
            f. transmitted/refracted waves
            g. intensity
            h. causes of artifacts
      2. attenuation of signal
         a. frequency dependence
         b. absorption
         c. scattering
      3. bioeffects
         a. thermal
         b. mechanical (e.g., cavitation)
         c. output measures
            (e.g., MI, TIS, TIC, TIB, SPTA)
         d. ALARA
      B. Technical Factors for Diagnostic Quality Images
         1. power
         2. focal zone
         3. depth
         4. gain
         5. compensation
         6. harmonics
         7. spatial compounding
      C. Detection and Display of Echoes
         1. transducer
         2. receiver
         3. amplitude
         4. dynamic range and compression
         5. analog-to-digital converter (ADC)
         6. digital-to-analog converter (DAC)
         7. brightness
         8. contrast
         9. write magnification
         10. post-processing
            (e.g., smoothing, edge enhancement, filtering, read magnification)
         11. emerging technologies
            (e.g., 3D imaging, panoramic imaging)

(Image Production continues on the following page.)
Image Production (continued)

3. Evaluation and Selection of Representative Images

A. Display Modes
   1. real-time imaging
      a. echogenicity of reflectors
      b. echotextures
      c. artifacts
   2. Doppler
      a. angle of incidence
      b. flow direction
      c. flow velocity
      d. spectral display (e.g., RI, PI, scale, wall filter)
      e. hemodynamics

B. Appearance and Causes of Artifacts
   1. gray scale (e.g., reverberation mirror imaging, shadowing, posterior enhancement, comet tail)
   2. Doppler (e.g., aliasing, twinkle, mirror image)

C. Improvement of Suboptimal Images

D. Image Archiving
## Procedures

### TYPE OF EXAM

1. **Abdominal and Transplant Vasculature**
   - **A. Aorta and Branches**
   - **B. Inferior Vena Cava (IVC) and Confluences**
   - **C. Portal Veins and Confluences**
   - **D. Transplants (i.e., kidney, liver)**
   - **E. Abdominal Organs**
     1. biliary system
        - gallbladder
        - bile ducts
        - (e.g., CBD, extra-hepatic)
     2. urinary tract
        - kidneys
        - ureters
        - bladder
     3. spleen
     4. pancreas
     5. liver
     6. other
        - lymph nodes
        - adrenal glands
        - gastrointestinal tract
        - prostate
        - peritoneal cavity

### FOCUS OF QUESTIONS

1. **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

2. **Anatomy and Physiology**
   - normal
   - normal variant
   - abnormal
   - measurements

3. **Abnormalities**
   - pathology
   - congenital anomalies
   - lab values
   - differential diagnosis

4. **Doppler Applications/Blood Flow Characteristics**

(Procedures continue 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** (e.g., uterus, cervix, adnexa, 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
  10. nuchal translucency
- **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** (e.g., uterus, cervix, adnexa)
- **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 dysplasia)
- **F. Infection** (e.g., TORCH)

### FOCUS OF QUESTIONS

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4. **Doppler Applications/Blood Flow Characteristics**

(Procedures continue on the following page.)
Procedures (continued)

**TYPE OF EXAM**

G. Abnormal Growth and Development (e.g., club foot, atresia, anencephaly, renal agenesis, gastroschisis, VSD)

H. Neoplasm (e.g., teratoma)

I. Multiple Gestations (e.g., chorionicity, amnionicity, twin-to-twin transfusion syndrome, conjoined)

J. Assisted Reproduction/Implantation

K. Amniocentesis

L. Fetal Biophysical Profile

M. Placenta (e.g., trophoblastic disease, previa, accreta, insufficiency, abruption, hematoma)

N. Amniotic Fluid (e.g., polyhydramnios, oligohydramnios, PROM)

O. Hydrops (immune & non-immune)

P. Intrauterine Growth Restriction (symmetric and asymmetric)

Q. Umbilical Cord (e.g., 2-vessel cord, knots, vasa previa, prolapse)

R. Cervical Incompetence

S. Maternal Disease and Abnormality (e.g., diabetes, uterine anomaly)

**FOCUS OF QUESTIONS**

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

2. Anatomy and Physiology
   - normal
   - normal variant
   - abnormal
   - measurements

3. Abnormalities
   - pathology
   - congenital anomalies
   - lab values
   - differential diagnosis

4. Doppler Applications/Blood Flow Characteristics

(Procedures continue on the following page.)
Procedures (continued)

TYPE OF EXAM

5. Superficial Structures and Other Sonographic Procedures
   A. Neck, Thyroid, and Parathyroid
   B. Scrotum and Testes
   C. Breasts
   D. Other Sonographic Procedures
      1. vascular exams
         a. venous extremity Doppler (lower and upper)
         b. carotid Doppler
         c. post catheterization complications
      2. pediatric exams
         a. neonatal (head, spine, hips)
         b. gastrointestinal tract (e.g., appendix, pylorus, intussusceptions)
         c. adrenal/renal
      3. ultrasound guided interventional procedures (e.g., fine needle aspiration, biopsy, catheter placement)
      4. miscellaneous
         a. musculoskeletal
         b. superficial masses
         c. noncardiac chest (e.g., pleural space)
         d. abdominal wall

FOCUS OF QUESTIONS

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   • patient preparation
   • patient positioning
   • instrumentation (e.g., transducer, stand-off pads)
   • technical factors
   • evaluation and documentation of visualized anatomy
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2. Anatomy and Physiology
   • normal
   • normal variant
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3. Abnormalities
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4. Doppler Applications/Blood Flow Characteristics