Breast 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 Breast Sonography* is provided to assist candidates with these requirements.

Candidates for breast sonography certification and registration must document at least 16 hours of structured education[1]. 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 ARRT[2], CE opportunities approved by a CE approver, 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. 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	1
Patient Interactions and Management	
Image Production	1
Basic Principles of Ultrasound	
Image Formation	
Evaluation and Selection of Representative Images	
Procedures	1
Anatomical Layers and Breast Tissues	
Pathology and Sonographic Features	
Breast Interventions and Other Imaging	
Total	**16**

Acceptable Examples:

Example 1	Example 2	Example 3
Patient Care – 3 hours Image Production – 6 hours Procedures – 7 hours	Patient Care – 1 hour Image Production – 1 hour Procedures – 14 hours	Patient Care – 1 hour Image Production – 10 hours Procedures – 5 hours
TOTAL – 16 hours	TOTAL – 16 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 log into your ARRT account and access *Earn Additional Credentials: Postprimary Pathway*, 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 Education Requirements for Obtaining and Maintaining Certification and Registration* for additional information.

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Patient Care

1. Patient Interactions and Management

A. Patient Communication
   1. explanation of procedure
      a. diagnostic ultrasound
      b. screening ultrasound
   2. patient assessment
      a. external appearance
         1. normal findings (e.g.,* hemangioma, skin tags/moles, tattoos, scarring)
         2. abnormal findings (e.g., nipple retraction, skin changes)
      b. patient symptoms/clinical indications
         1. nipple discharge/changes
         2. palpable lump
         3. focal pain
      c. medical history
         1. previous surgery
         2. previous imaging
         3. family history
         4. breast trauma
   3. review and respond to inquiries regarding benefits and limitations of breast imaging studies
      a. breast sonography
      b. automated whole-breast ultrasound
      c. mammography (2D, DBT)
      d. breast MRI
   4. patient positioning
   5. explanation of findings and follow-up recommendations (ACR guidelines)
      a. ACR BI-RADS®
      b. breast density (tissue composition)

B. Facility Requirements
   1. breast imaging center accreditation
   2. ultrasound personnel qualifications (e.g., training, education)

C. Verification of Requested Examination
   1. determination of appropriate sequence of imaging studies
   2. correlation of imaging request to clinical indications for appropriateness
   3. correlation of other imaging with breast ultrasound
      a. mammography
         1. quadrant (triangulation)
         2. depth
         3. size
         4. margin
      b. breast MRI
         1. quadrant
         2. depth
         3. size
         4. margin
      c. CT
      d. positron emission tomography (PET/CT)
      e. automated whole-breast ultrasound

D. Breast Cancer
   1. epidemiology
      a. incidence
      b. inherent risk factors
         1. female sex assigned at birth (e.g., menarche, menopause, nulliparity, primiparity)
         2. age
         3. personal history of cancer (e.g., breast, ovarian, lung)
         4. genetic risk (e.g., family history, gene mutations)
         5. previous chest radiation
         6. breast tissue density (tissue composition)
      c. social risk factors
         1. lifestyle (e.g., tobacco use, body weight, excessive alcohol use)
         2. access to care / health disparity
         3. hormone use (e.g., HRT, birth control, gender transition)

E. Communication of Imaging to Supervising Physician (radiologist, surgeon)
   1. description of findings using appropriate terminology (e.g., echo patterns, size/shape, vascularity, location)
   2. review of findings (e.g., in person, remote, teleradiology)

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

Image Production

1. Basic Principles of Ultrasound

A. Generation of Signal
   1. console
   2. monitors
   3. transducers
      a. piezoelectric effect
      b. components
      c. resonance frequency
      d. beam characteristics (e.g., near zone/field, far zone)
      e. focusing (e.g., electronic, beam)
      f. types (e.g., curved, linear)

B. Ultrasound Wave Characteristics
   1. speed of sound (propagation speed)
   2. frequency
   3. reflection and refraction
   4. intensity of signal
   5. acoustic impedance
   6. attenuation coefficient
   7. pulsed
   8. Doppler
   9. scatter (specular/nonspecular reflection)
   10. amplitude

C. Fundamentals
   1. relationship between speed of sound, frequency, and wavelength
   2. image resolution
      a. axial
      b. lateral
      c. elevational
      d. temporal
      e. contrast (soft tissue)
   3. range equation
   4. dynamic range
   5. acoustic transmission media (e.g., gel)

[1] Operator ergonomics is referenced in the "Industry Standards for the Prevention of Work Related Musculoskeletal Disorders in Sonography."

2. Image Formation

A. Selection and Adjustment of Technical Factors
   1. power
   2. focal zone
   3. field of view (depth)
   4. time-gain compensation (TGC)
   5. overall gain
   6. dynamic range
   7. harmonic imaging
   8. spatial compounding

B. Safety
   1. sonographer ergonomics[1]
      a. equipment (e.g., monitor level, table height)
      b. work environment (e.g., lighting, placement of accessories)
      c. body mechanics (e.g., transducer contact pressure, posture)
   2. patient bioeffects

C. Image Orientation and Transducer Manipulation
   1. superior and inferior
   2. lateral and medial

D. Image Documentation (ACR Practice Parameters)
   1. manual or automated annotation
      a. patient identification
      b. laterality
      c. transducer orientation (e.g., radial or antiradial, transverse or longitudinal)
      d. clock position
      e. distance from the nipple
   2. lesion measurement

E. Image Optimization
   1. manual image optimization
      a. Doppler
         1. color
         2. power
      b. fremitus
      c. panoramic imaging (extended field of view)
      d. stand-off pad
      e. cine loop
      f. beam steering
      g. static elastography (mechanical compression)
   2. automated imaging optimization (e.g., automated technical factor selection)

Image Production (continued)

3. Evaluation and Selection of Representative Images

A. Criteria for Diagnostic Quality
   1. demonstration of anatomic structure
   2. demonstration of pathologic conditions
   3. use of calipers
   4. improvement of suboptimal images

B. Artifact Recognition (diagnostic versus nondiagnostic value)
   1. posterior shadowing
   2. edge shadowing
   3. posterior enhancement
   4. reverberation
   5. color Doppler flash
   6. speed propagation
   7. mirror artifact
   8. implant rupture artifacts (e.g., snowstorm, stepladder)

C. Image Display and Storage
   1. postprocessing
      a. cine loop
      b. overall gain
   2. PACS (MIMPS)

D. Maintenance of Sonographic Equipment and Accessories
   1. sonographer quality assurance tasks
      a. clean filters
      b. visual check (e.g., cords, transducer)
      c. infection control (e.g., exam table, transducer disinfection[2])
      d. console cleanliness (e.g., gel buildup, dust)
   2. recognition of equipment malfunctions (e.g., transducer dropout, trackball)

[2] Transducer infection control is referenced in the "Guidelines for Infection Prevention and Control in Sonography: Reprocessing the Ultrasound Transducer."

Procedures

1. Anatomical Layers and Breast Tissues

A. Breast Anatomy
   1. skin
   2. fat
   3. fibroglandular tissue
   4. pectoralis muscle
   5. ribs

B. Fascia
   1. superficial fascia
   2. deep fascia

C. Nipple
   1. areola
      a. Montgomery glands
      b. Morgagni tubercles
      c. lactiferous sinus

D. Blood Flow
   1. normal blood flow
   2. artery versus vein

E. Lymph Nodes
   1. axillary
   2. internal mammary
   3. intramammary
   4. supraclavicular

F. Other Breast Components
   1. ducts
   2. lobules
   3. Cooper ligaments

2. Pathology and Sonographic Features[3]

A. Benign Conditions
   1. cyst (e.g., simple, complex, complicated)
   2. sebaceous cyst
   3. fibroadenoma
   4. papilloma
   5. lipoma
   6. hamartoma
   7. abscess and inflammation
   8. hematoma
   9. oil cyst
   10. fat necrosis
   11. duct ectasia
   12. edema
   13. diabetic mastopathy
   14. pseudoangiomatous stromal hyperplasia (PASH)
   15. gynecomastia
   16. lymph nodes
   17. pregnancy-induced changes (e.g., galactocele, prominent ducts, lactating adenoma)
   18. pseudoaneurysm

B. Benign with Upgrade Potential
   1. lobular carcinoma in situ (LCIS)
   2. atypical ductal hyperplasia (ADH)
   3. atypical lobular hyperplasia (ALH)
   4. papilloma with atypia
   5. radial scar
   6. phyllodes tumor

C. Malignant Conditions
   1. ductal carcinoma in situ (DCIS)
   2. invasive ductal carcinoma
      a. medullary carcinoma
      b. mucinous (colloid) carcinoma
      c. papillary carcinoma
      d. tubular carcinoma
   3. invasive lobular carcinoma
   4. inflammatory carcinoma
   5. Paget disease
   6. lymphoma
   7. metastasis
   8. metastatic lymph nodes

[3] The breast sonographer is expected to describe sonographic and pathologic features according to the ACR BI-RADS® lexicon manual including shape, orientation, margin, echo pattern, and posterior features.

Procedures (continued)

3. Breast Interventions and Other Imaging

A. Surgical Procedures*
   1. lumpectomy (e.g., benign surgical excision, breast conservation surgery)
   2. axillary dissection
   3. mastectomy (with/without reconstruction)
   4. augmentation
   5. reduction

B. Postoperative Breast Changes
   1. hematoma
   2. seroma
   3. surgical changes (e.g., fat necrosis, oil cysts, lumpectomy scarring)

C. Therapeutic Treatment Changes*
   1. chemotherapy (neoadjuvant and adjuvant)
   2. hormonal therapy (e.g., antiestrogen therapy)
   3. postradiation changes

D. Other Breast Ultrasound Imaging
   1. whole-breast ultrasound (implant integrity)
   2. supplemental screening for dense tissue
   3. identification of multifocal/multicentric disease (post breast cancer diagnosis)
   4. second look following MRI

*The breast sonographer is expected to have basic knowledge of these procedures and treatment changes.

Procedures (continued)

E. Image-Guided Breast Procedures

1. fluid aspiration (e.g., abscess, seroma, cyst)
2. fine needle aspiration
3. needle core biopsy (e.g., spring-loaded)
4. vacuum-assisted core biopsy
5. clip placement
6. needle localization
   a. wire
   b. non-wire (radar/radiofrequency, magnetic, radioactive seed)

FOCUS OF QUESTIONS

Questions about a specific study or procedure may address any of the following factors:

- Explain Procedure, Risks, and Benefits
- Consent (e.g., informed, oral, implied)
- Select and Prepare Equipment
- Perform Time-Out Procedure
- Position Patient
- Practice Infection Control and Prevention
  - aseptic technique
  - sharps disposal
  - biohazard disposal (OSHA Guidelines)
- Assist with Procedure
- Communicate with Performing Physician
- Provide Postprocedural Care and Instructions
- Hemostasis