# Breast Sonography

The purpose of the breast sonography examination is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of breast sonographers at entry into the profession. The tasks typically performed were determined by administering a comprehensive practice analysis survey to a nationwide sample of breast sonographers.[1] The *Task Inventory for Breast Sonography* may be found on the ARRT's website (www.arrt.org).

The *Examination Content Specifications for Breast Sonography* and attached content outline identify the knowledge areas underlying performance of the tasks on the *Task Inventory for Breast Sonography*. Every content category can be linked to one or more tasks on the task inventory.

The table below presents the major content categories covered on the examination. The number of test questions in each category are listed in bold and number of test questions in each subcategory in parentheses. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

| **Content Category** | **Number of Scored Questions[2]** |
|---|---|
| Patient Care | **18** |
| *Patient Interactions and Management (18)* | |
| Image Production | **102** |
| *Basic Principles of Ultrasound (37*) | |
| *Image Formation (32)* | |
| *Evaluation and Selection of Representative Images (33)* | |
| Procedures | **65** |
| *Anatomy and Physiology (15)* | |
| *Pathology (35)* | |
| Breast Interventions (15) | |
| **Total** | **185** |

[1] A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.

[2] **The exam includes an additional 40 unscored (pilot) questions.**

# Patient Care

## 1. Patient Interactions and Management

A. Patient Communication
   1. explanation of procedure
      a. diagnostic ultrasound
      b. screening ultrasound
   2. patient assessment
      a. physical observations and symptoms (*e.g., breast changes, palpation findings, scarring)
      b. medical history and clinical indications
         1. previous surgery
         2. previous imaging
         3. family history
   3. review and respond to inquiries regarding benefits and limitations of breast imaging studies
      a. breast sonography
      b. automated whole breast ultrasound
      c. mammography
      d. breast MRI
      e. nuclear medicine (e.g., BSGI, PET/CT)
      f. CT
   4. patient positioning
   5. explanation of findings and follow-up recommendations (ACR guidelines)
      a. ACR BI-RADS®
      b. tissue composition (breast density)

B. Accreditation of Ultrasound Facilities and Personnel Certification Requirements

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 MR
         1. quadrant
         2. depth
         3. size
         4. margin
      c. CT
      d. PET/CT

D. Breast Cancer
   1. epidemiology
      a. incidence
      b. risk factors
   2. signs and symptoms

E. Communication of Imaging to Supervising Physician (radiologist, surgeon)
   1. evaluation of echo patterns (e.g., anechoic, hypoechoic, hyperechoic, isoechoic)
   2. review of findings

*e.g., 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. monitor
   3. transducers
      a. piezoelectric effect
      b. components
      c. resonance frequency
      d. beam characteristics (e.g., near zone/field, far zone)
      e. focusing
      f. types

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. specular reflectors
   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)

## 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
      b. work environment
      c. sonographer body mechanics
   2. patient bioeffects

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

D. Image Documentation (ACR Guidelines)
   1. patient identification
   2. laterality
   3. transducer orientation (e.g., radial or antiradial, transverse or longitudinal)
   4. clock position
   5. distance from the nipple
   6. lesion measurements

E. Other Imaging Tools
   1. Doppler
      a. color
      b. power
   2. fremitus
   3. panoramic imaging
   4. stand-off pad
   5. cine loop

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

(Image Production continues on the following page.)

# 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
   1. posterior shadowing
   2. edge shadowing
   3. posterior enhancement
   4. reverberation
   5. color Doppler flash
   6. speed propagation
   7. ring-down

C. Image Display and Storage
   1. post-processing
      a. dynamic range
      b. cine loop
      c. gain
      d. annotations and measurements
   2. PACS

D. Evaluation of Sonographic Equipment and Accessories
   1. equipment quality control
      a. sensitivity (e.g., contrast resolution, detection of lesion, dead zone)
      b. vertical and horizontal distance accuracy
      c. focal zone
      d. resolution (e.g., lateral, axial)
      e. TGC characteristics
      f. overall gain
      g. dynamic range
   2. recognition of equipment malfunctions
   3. clean, disinfect, and maintain equipment (e.g., transducers[2], keyboard, monitor, filters)

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

# Procedures

## 1. Anatomy and Physiology

A. Ducts
B. Lobules
C. Fibroglandular Tissue
D Fat
E. Skin
F. Cooper Ligament
G. Fascia
H. Pectoralis Muscle
I. Ribs
J. Pregnancy Induced Changes
K. Nipple
   1. areola
   2. Montgomery glands
L. Vascular System
M. Lymphatic System
   1. axilla
   2. regional lymph nodes

## 2. Pathology

A. Benign Conditions and Sonographic Features (e.g., echogenicity, posterior acoustic features)
   1. cyst
   2. galactocele
   3. sebaceous cyst
   4. fibroadenoma
   5. papilloma
   6. lipoma
   7. hamartoma
   8. abscess and inflammation
   9. traumatic changes
   10. fat necrosis
   11. ductal ectasia
   12. edema
   13. diabetic mastopathy
   14. pseudoangiomatous stromal hyperplasia (PASH)
   15. phyllodes tumor
   16. gynecomastia
   17. lymph nodes

B. High Risk Conditions and Sonographic Features (e.g., echogenicity, posterior acoustic features)
   1. lobular carcinoma in situ (LCIS)
   2. atypical ductal hyperplasia (ADH)
   3. atypical lobular hyperplasia (ALH)
   4. papilloma with atypia
   5. radial scar

C. Malignant Conditions and Sonographic Features (e.g., echogenicity, posterior acoustic features)
   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. phyllodes
   7. lymphoma
   8. metastasis
   9. metastatic lymph nodes

## 3. Breast Interventions

A. Surgical Procedures*
   1. lumpectomy
   2. axillary dissection
   3. mastectomy
   4. augmentation
   5. reduction
   6. reconstruction

B. Postoperative Breast Changes
   1. hematoma
   2. seroma
   3. surgical scarring

C. Therapeutic Treatment Changes*
   1. chemotherapy
   2. hormonal therapy (e.g., antiestrogen therapy)
   3. post-radiation changes

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

(Procedures continues on the following page.)

# Procedures (continued)

D. Image-Guided Breast Procedures

1. Fluid Aspiration (e.g., abscess, seroma, cyst)
2. Fine Needle Aspiration Biopsy
3. Needle Core Biopsy (e.g., spring-loaded)
4. Vacuum-Assisted Core Biopsy
5. Clip Placement
6. Needle/Wire Localization

## FOCUS OF QUESTIONS

*Questions about each of the procedures listed on the left may focus on any of the following factors:*

A. Explain Procedure, Risks, and Benefits

B. Consent (e.g., informed, oral, implied)

C. Select and Prepare Equipment

D. Perform Time Out Procedure

E. Position Patient

F. Practice Infection Control and Prevention

1. aseptic technique
2. sharps disposal
3. biohazard disposal (OSHA Guidelines)

G. Assist with Procedure

H. Communicate with Performing Physician

I. Provide Post-Procedural Care and Instructions

J. Hemostasis