Mammography

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.

Candidates for Mammography Certification and Registration must document at least 16 hours of structured education. Structured education activities may be academic courses from an institution accredited by a mechanism recognized by the ARRT\(^1\), 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 area listed below (i.e., Patient Care, Image Production, and Procedures). The remaining hours may be earned from any one or more of the content areas.

<table>
<thead>
<tr>
<th>Content Areas</th>
<th>Minimum Credits</th>
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<tbody>
<tr>
<td><strong>Patient Care</strong></td>
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<tr>
<td>1. Patient Interactions and Management</td>
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<tr>
<td><strong>Image Production</strong></td>
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<td>1. Equipment Operation and Quality Assurance</td>
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<tr>
<td><strong>Procedures</strong></td>
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<tr>
<td>1. Anatomy, Physiology, and Pathology</td>
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<td>2. Positioning and Procedures</td>
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<td><strong>Total</strong></td>
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<td>16</td>
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Acceptable Examples:

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
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<tbody>
<tr>
<td>Patient Care – 3 hours</td>
<td>Patient Care – 1 hour</td>
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<tr>
<td>Image Production – 6 hours</td>
<td>Image Production – 1 hour</td>
<td>Image Production – 10 hours</td>
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<tr>
<td>Procedures – 7 hours</td>
<td>Procedures – 14 hours</td>
<td>Procedures – 5 hours</td>
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<tr>
<td>TOTAL – 16 hours</td>
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*The number of questions and organization of content for the Mammography Examination are located in the Mammography Examination Content Specifications document.*

\(^1\) 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. Patient Communication
   1. pre-exam instructions (e.g., removal of deodorant, clothing)
   2. explanation of mammographic procedure
      a. establish patient rapport
      b. psychological and emotional support
      c. address physical and mental limitations
      d. typical patient dose
      e. importance of having prior images available
   3. ACS guidelines for mammography screening
   4. breast self-examination (BSE)
   5. clinical breast examination (CBE)
   6. informed consent

B. Patient Assessment (risks for breast cancer; implication for imaging)
   1. epidemiology of breast cancer
      a. incidence
      b. risk factors
         1. female gender
         2. advancing age
         3. personal history of breast cancer
         4. personal history of other cancers
         5. family history of breast cancer
         6. genetic predisposition
         7. race
         8. abnormal breast biopsy
         9. early menarche
         10. late menopause
         11. nulliparity
         12. late age at primiparity
         13. previous breast radiation
         14. obesity
         15. hormone replacement therapy (HRT)
         16. breast tissue density (tissue composition)
   2. signs and symptoms
      a. pain
      b. lump
      c. thickening
      d. nipple discharge
      e. skin changes
      f. nipple and areolar changes
      g. edema
      h. erythema
      i. dimpling
   3. documentation of medical history and clinical findings
   4. previous mammograms
      a. review prior to exam
      b. treatment options

C. Treatment Options
   1. surgical options
      a. lumpectomy
      b. lumpectomy and radiation therapy
      c. lumpectomy with axillary dissection and radiation therapy
      d. simple mastectomy
      e. modified radical mastectomy
      f. prophylactic mastectomy
   2. nonsurgical options
      a. radiation therapy
      b. chemotherapy
      c. hormonal therapy (e.g., tamoxifen)
   3. reconstruction
      a. tissue expander
      b. implant
      c. TRAM flap
      d. latissimus dorsi flap

1 The mammographer is expected to understand the definitions and basic descriptions of these terms.
Image Production

1. Equipment Operation and Quality Assurance
   A. Design Characteristics of Mammography Units
      1. kVp range
      2. mammography tube
         (e.g., anode, filtration, window, focal spot)
      3. compression devices
      4. grids
      5. system geometry (e.g., SID, OID, magnification)
   B. Digital Acquisition, Display and Informatics
      1. image receptors
         a. full field digital mammography-computed radiography (FFDM-CR)
         b. full field digital mammography-direct radiography (FFDM-DR)
      2. workstations
         a. acquisition
         b. interpretation
      3. hard copy devices (e.g., laser printer)
      4. digital image display and informatics
         a. HIS/RIS
         b. networking (e.g., HL7, DICOM)
         c. workflow (e.g., inappropriate documentation, lost images, mismatched images, corrupt data)
         d. PACS
            1. lossy compression
            2. lossless compression
      5. computer aided detection (CAD)

   C. Quality Assurance and Evaluation
      1. accreditation and certification
         a. agencies (i.e., ACR, FDA)
         b. purpose
         c. process
         d. frequency
      2. MQSA regulations
         a. personnel requirements
         b. record keeping
            (e.g., assessment categories, image ID and labeling, maintenance of images and reports, communication of results to providers and patient)
         c. medical outcomes audit
         d. required policies
            (e.g., infection control, consumer complaint)

   (Image Production continues on the following page.)
D. Medical Physicist Tests
   1. general QC tests
      a. mammographic unit assembly evaluation
      b. collimation assessment
      c. evaluation of system resolution
      d. automatic exposure system performance assessment
      e. artifact evaluation
      f. image quality evaluation
      g. kVp accuracy and reproducibility
      h. beam quality assessment (half-value layer measurement)
      i. breast entrance exposure, automatic exposure reproducibility, average glandular dose and radiation output rate
      j. viewbox luminance and room illuminance
      k. assessing the mammography site quality control program
      l. compression paddle alignment
   2. QC tests specific to digital
      a. system/spatial resolution (e.g., CNR, SNR, MTF)
      b. printer check
      c. interpretation workstation tests

FOCUS OF QUESTIONS:

1. Purpose
2. Frequency

(Image Production continues on the following page.)
E. Quality Control

1. technologist tests
   a. general tests
      1. phantom images
      2. visual checklist
      3. repeat analysis
      4. viewing conditions
         (e.g., lighting and viewboxes)
      5. compression force
   b. digital QC tests
      1. monitor cleanliness
      2. laser imager QC test
      3. artifact evaluation
         (e.g., flat field, detector calibration)
      4. system resolution test
         (e.g., modulation transfer function [MTF], signal-to-noise ratio [SNR], contrast-to-noise ratio [CNR])
      5. monitor calibration QC and test pattern (e.g., SMPTE, AAPM task group 18 templates)

FOCUS OF QUESTIONS:

1. Purpose
2. Frequency
3. Equipment and Procedure
4. Performance Criteria
5. Corrective Action

(Image Production continues on the following page.)

2 The technologist general tests and medical physicist tests listed are referenced in the ACR Mammography Quality Control Manual (1999). Digital QC tests for the technologist and the medical physicist tests will also be covered. The technologist is expected to have a detailed understanding of all the technologist QC tests and a basic understanding of the medical physicist QC tests.
Image Production (continued)

F. Mammographic Technique and Image Evaluation
1. Technical Factors
   a. kVp
   b. mAs
   c. automatic exposure
   d. manual exposure
   e. compression thickness
   f. target/filter
   g. focal spot
   h. grids
   i. magnification

2. Evaluation of Image Quality
   a. positioning
   b. compression
   c. exposure
   d. contrast
   e. sharpness
   f. noise
   g. artifacts
   h. collimation
   i. labeling
   j. motion
Procedures

1. Anatomy, Physiology and Pathology

A. Localization Terminology
   1. clock position
   2. quadrants
   3. triangulation

B. External Anatomy
   1. breast margins
   2. nipple
   3. areola
   4. angle of pectoral muscle
   5. Morgagni tubercles
   6. skin
      a. sebaceous glands
      b. sweat glands
      c. hair follicles
   7. axillary tail
   8. inframammary fold

C. Internal Anatomy
   1. fascial layers
   2. retromammary space
   3. fibrous tissues
   4. glandular tissues
      a. lobules
      b. terminal ductal lobular unit (TDLU)
   5. adipose tissues
   6. Cooper ligaments
   7. pectoral muscle
   8. vascular system
   9. lymphatic system
   10. Montgomery glands

D. Histology and Cytology
   1. terminal ductal lobular unit (TDLU)
      a. extralobular terminal duct
      b. intralobular terminal duct
      c. acinus (ductal sinus)
   2. cellular components
      a. epithelial cells
      b. myoepithelial cells
      c. basement membrane

E. Pathology
   1. mammographic appearance and reporting terminology (e.g., BI-RADS®)
      a. asymmetry (one view finding)
      b. focal asymmetry (two view finding)
      c. mass and margins
         1. circumscribed
         2. indistinct
         3. spiculated
      d. characteristics of calcifications
         1. round or punctate
         2. amorphous or indistinct
         3. coarse heterogeneous
         4. fine heterogeneous
      e. architectural distortion
      f. assessment categories
      g. recommendations
   2. benign conditions and their mammographic appearances
      a. cyst
      b. galactoceles
      c. fibroadenoma
      d. lipoma
      e. hamartoma
      f. papillomas
      g. ductal ectasia
      h. hematoma
      i. abscess and inflammation
      j. fat necrosis
      k. calcifications
      l. lymph nodes
      m. gynecomastia
   3. high risk conditions and their mammographic appearances
      a. lobular carcinoma in situ (LCIS)
      b. atypical ductal hyperplasia
      c. atypical lobular hyperplasia
      d. radial scar
      e. papilloma with atypia
      f. calcifications

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

4. malignant conditions and their mammographic appearances
   a. ductal carcinoma in situ (DCIS)
   b. invasive/infiltrating ductal carcinoma
   c. invasive lobular carcinoma
   d. inflammatory carcinoma
   e. Paget disease of the breast
   f. sarcoma
   g. lymphoma
   h. calcifications

2. Positioning\(^3\) and Procedures

A. Standard Views
   1. craniocaudal (CC)
   2. mediolateral oblique (MLO)

B. Additional Views
   1. mediolateral (ML)
   2. lateromedial (LM)
   3. exaggerated craniocaudal (XCCL, XCCM)
   4. cleavage (CV)
   5. axillary tail (AT)
   6. tangential (TAN)
   7. rolled (RL, RM, RS, RI)
   8. caudocranial (FB)
   9. lateromedial oblique (LMO)
   10. superolateral-to-inferomedial oblique (SIO)
   11. implant displaced (ID)
   12. nipple in profile
   13. anterior compression
   14. spot compression
   15. magnification

C. Special Patient Situations
   1. chest wall deformities
   2. irradiated breast
   3. reduction mammoplasty
   4. post-surgical breast
   5. males
   6. kyphotic patients
   7. protruding abdomens
   8. pacemaker
   9. infusa-port (port-a-cath)
   10. implants
   11. lactating breast
   12. large breast

D. Imaging Modalities
   1. mammography
      a. screening
      b. diagnostic
      c. digital breast tomosynthesis (DBT/3D)
   2. breast ultrasound
   3. breast MRI
   4. sentinel node mapping
   5. interventional procedures\(^4\)
      a. breast specimen imaging
      b. core biopsy (i.e., stereotactic, ultrasound)
      c. cyst aspiration
      d. ductography/galactography
      e. fine needle aspiration
      f. needle localization
      g. clip placement

\(^3\) The mammographer is expected to know positioning as presented in the ACR Mammography Quality Control Manual (1999).

\(^4\) The mammographer is expected to have the basic knowledge of these procedures.