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. The *Structured Education Requirements for Mammography* is provided to assist candidates with these requirements.

Candidates for mammography 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 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)	1
Patient Interaction and Management	
Image Production (includes)	1
Image Acquisition and Quality Assurance	
Procedures (includes)	1
Anatomy, Physiology, and Pathology	
Mammographic Positioning, Special Needs, and Imaging Procedures	
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 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. 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
3. patient education
   a. guidelines for mammography screening (ACS, ACR)
   b. breast self-examination (BSE)
   c. clinical breast examination (CBE)
   d. typical patient dose

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. importance of having prior images available

C. Breast Cancer Treatment Options[1]
1. surgical options
   a. lumpectomy/breast-conserving surgery
   b. sentinel/axillary node dissection
   c. simple (total) mastectomy
   d. modified radical mastectomy
   e. prophylactic mastectomy
2. nonsurgical options
   a. radiation therapy
   b. chemotherapy
   c. hormone therapy (antiestrogen therapy)
      1. hormone receptor status (ER+/-)
      2. hormone receptor status (PR+/-)
      3. anti-HER2/neu therapy
3. reconstruction
   a. implant
   b. TRAM flap
   c. latissimus dorsi flap

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[*] 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.

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

Image Production

1. Image Acquisition and Quality Assurance

A. Design Characteristics of Mammography Units
1. kVp range
2. mammography tube (e.g., anode, filtration, window, focal spot)
3. compression paddles
4. grids
5. system geometry (e.g., SID, OID, magnification)

B. Digital Acquisition, Display and Informatics
1. acquisition type
   a. full field digital mammography-direct radiography (FFDM-DR/2D)
   b. digital breast tomosynthesis (DBT/3D)
2. image receptors
3. monitors
   a. acquisition workstation
   b. radiologist interpretation workstation
4. digital image display and informatics
   a. workflow (e.g., appropriate documentation, matching images, merging patient data)
   b. PACS
      1. storage and retrieval of data
      2. backup and archive
5. computer-aided detection (CAD)

C. Quality Assurance and Evaluation
1. accreditation and certification
   a. agencies (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)
   e. Enhancing Quality Using the Inspection Program (EQUIP)
      1. quality assurance (clinical image corrective action)
      2. clinical image quality
      3. quality control oversight

(Image Production continues on the following page.)

Image Production (continued)

D. Quality Control[2]
   1. mammographer tests
      a. phantom image
         1. quality
         2. artifact
      b. compression thickness
      c. visual checklist
      d. acquisition and radiologist
         workstation monitors
         1. monitor cleanliness
         2. monitor calibration and test pattern
            (e.g., SMPTE, TG18)
      e. repeat analysis
      f. viewing conditions
      g. compression force
      h. manufacturer detector calibration

FOCUS OF QUESTIONS

- Purpose
- Frequency
- Equipment and Procedure
- Performance Criteria
- Corrective Action

   2. medical physicist tests
      a. mammographic equipment evaluation
      b. collimation assessment
      c. system resolution tests
         1. spatial resolution
         2. modulation transfer function (MTF)
      d. low contrast performance tests
         1. signal-to-noise (SNR)
         2. contrast-to-noise (CNR)
      e. automatic exposure control
         system performance
      f. artifact evaluation
      g. phantom image quality evaluation
      h. kVp accuracy and reproducibility
      i. beam quality assessment
         (half-value layer)
      j. average glandular dose
      k. room illuminance
      l. evaluation of technologist's quality
         control program
      m. application of compression
      n. compression paddle alignment
      o. acquisition and radiologist
         interpretation workstation QC

FOCUS OF QUESTIONS

- Purpose
- Frequency

[2] The Quality Control (QC) tests for the mammographer and the medical physicist tests listed are referenced in the 2018 ACR Digital Mammography Quality Control Manual. The mammographer is expected to have a detailed understanding of all the mammographer QC tests and a basic understanding of the medical physicist QC tests.

Image Production (continued)

E. 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
   j. labeling

2. evaluation of image quality
   a. positioning
   b. compression
   c. exposure
   d. contrast
   e. sharpness
   f. noise
   g. artifacts
   h. collimation
   i. 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
    a. Morgagni tubercles
    b. Montgomery glands
4. angle of pectoral muscle
5. skin
    a. sebaceous glands
    b. sweat glands
    c. hair follicles
6. axillary tail
7. 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)
        1. extralobular terminal duct
        2. intralobular terminal duct
        3. acinus (ductal sinus)
5. adipose tissues
6. Cooper ligaments
7. pectoral muscle
8. vascular system
9. lymphatic system

D. Cytology
1. epithelial cells
2. myoepithelial cells
3. basement membrane

E. Pathology
1. mammographic appearance and reporting terminology (BI-RADS®)
    a. architectural distortion (e.g., asymmetry, focal asymmetry)
    b. characteristics of masses
        1. shape (e.g., round, irregular)
        2. margin (e.g., circumscribed, indistinct, spiculated)
        3. density

    c. characteristics of calcifications
       1. typically benign (e.g., skin, vascular, coarse, milk of calcium, dystrophic)
       2. suspicious morphology (e.g., amorphous, heterogenous, fine pleomorphic)
       3. distribution (e.g., diffuse, grouped, linear)
    d. BI-RADS® categories
       1. mammographic assessment
       2. breast composition (e.g., entirely fatty, heterogenously dense)
    e. recommendations

2. benign pathology and mammographic appearance
    a. cyst
    b. galactocele
    c. fibroadenoma
    d. lipoma
    e. hamartoma
    f. papilloma
    g. ductal ectasia
    h. hematoma
    i. abscess and inflammation
    j. fat necrosis
    k. lymph nodes
    l. gynecomastia
    m. radial scar

3. high risk pathology and mammographic appearance
    a. lobular carcinoma in situ (LCIS)
    b. atypical ductal hyperplasia (ADH)
    c. atypical lobular hyperplasia (ALH)
    d. papilloma with atypia

4. malignant pathology and mammographic appearance
    a. ductal carcinoma in situ (DCIS)
    b. invasive/infiltrating ductal carcinoma (IDC)
    c. invasive lobular carcinoma
    d. inflammatory carcinoma
    e. Paget disease of the breast
    f. sarcoma
    g. lymphoma

Procedures (continued)

2. Mammographic Positioning[3], Special Needs, and Imaging Procedures

A. Views
1. craniocaudal (CC)
2. mediolateral oblique (MLO)
3. mediolateral (ML)
4. lateromedial (LM)
5. exaggerated craniocaudal (XCCL, XCCM)
6. cleavage (CV)
7. axillary tail (AT)
8. tangential (TAN)
9. rolled (RL, RM, RS, RI)
10. implant displaced (ID)
11. nipple in profile
12. anterior compression
13. spot compression
14. magnification

B. Special Patient Situations
1. chest wall variations (e.g., pectus excavatum, pectus carinatum)
2. irradiated breast
3. reduction mammoplasty
4. postsurgical breast
5. male patients
6. kyphotic/lordotic patients
7. protruding abdomen
8. implanted devices (e.g., pacemaker, port)
9. breast augmentation
10. lactating breast
11. extremely large/small breast

C. Imaging Examinations
1. mammography
   a. screening
      1. 2D
      2. digital breast tomosynthesis (DBT/3D)
   b. diagnostic
2. breast ultrasound
3. breast MRI[4]
4. sentinel node mapping [4]

D. Interventional Procedures[4]
1. informed consent
2. procedures and associated imaging
   a. biopsy with clip placement
      1. ultrasound core biopsy
      2. stereotactic core biopsy
   b. cyst aspiration
   c. fine needle aspiration biopsy
   d. needle localization
   e. interventional imaging
      1. specimen (e.g., stereotactic, surgical)
      2. localization
      3. clip
3. handling and disposing of biohazardous materials
   a. biopsy specimens
   b. cyst aspirate

[3] The mammographer is expected to know positioning as presented in the ACR *Mammography Quality Control Manual-Clinical Image Quality* (1999). Approximately six items in this section will cover the standard views (CC and MLO).

[4] The mammographer is expected to have the basic knowledge of these examinations and procedures.