



Mammography

The purpose of the examination requirement is to assess whether individuals have obtained the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required in mammography for practice at entry level.

ARRT determined the tasks that entry level mammographers typically perform by administering a comprehensive practice analysis survey to a nationwide sample of mammographers¹. The *Task Inventory for Mammography* is on ARRT's website (www.arrt.org).

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

The table below presents the major content categories and subcategories that the examination covers. The table lists the number of test questions in each category in bold, and the number of test questions in each subcategory in parentheses. The content outline, which makes up the remaining pages of this document, addresses specific topics within each category.

Content Category	Number of Scored Questions²
Patient Care	20
<i>Patient Interactions and Management (20)</i>	
Image Production	30
<i>Image Acquisition and Quality Assurance (30)</i>	
Procedures	65
<i>Anatomy, Physiology, and Pathology (26)</i>	
<i>Mammographic Positioning and Procedures (39)</i>	
Total	115

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 30 unscored (pilot) questions.



Patient Care

1. Patient Interactions and Management

- A. Patient Communication
 - 1. pre-exam instructions (*e.g., removal of deodorant, clothing)
 - 2. explanation of mammographic imaging
 - a. establish patient rapport
 - b. provide psychological and emotional support (e.g., anxiety, modesty)
 - c. address physical and mental needs
 - d. explain need for repeat imaging (e.g., motion, artifact)
 - 3. patient education
 - a. American Cancer Society (ACS) and American College of Radiology (ACR) guidelines for mammography screening
 - b. ACS recommendations for breast self-examination (BSE)
 - c. ACS recommendations for clinical breast examination (CBE)
 - d. typical patient dose
 - e. breast imaging modalities (e.g., DBT/3D, 2D, ultrasound)
 - 4. patient results
 - a. process for receiving results (e.g., telephone, mail, electronic chart access)
 - b. reason(s) for additional imaging
 - c. clinician's role in explaining results and findings (e.g., breast density reporting, diagnostic mammogram)
- B. Patient Assessment (risks for breast cancer; implication for imaging)
 - 1. epidemiology of breast cancer
 - 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)
- 2. signs and symptoms
 - a. pain
 - b. lump
 - c. nipple discharge
 - d. skin changes
 - 1. thickening
 - 2. erythema
 - 3. dimpling
 - e. nipple and areolar changes
 - f. edema
- 3. review and documentation of medical history and physical findings
 - a. imaging request (e.g., physician orders)
 - b. previous breast surgery (e.g., lumpectomy, augmentation)
 - c. clinical findings (e.g., lumps, scars, moles, tattoos, abnormalities)
 - d. gender affirmation (e.g., surgery, hormonal therapy)
- 4. previous mammograms
 - a. importance of having prior images available
 - b. review prior to exam

*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)

C. Breast Cancer Treatment Options¹

1. surgical options
 - a. lumpectomy / breast-conserving surgery
 - b. sentinel axillary node biopsy
 - 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. implant reconstruction

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 (e.g., fixed, flexed, curved, spot, implant)
 - 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)
 - c. synthesized imaging
 - 2. image receptors
 - 3. monitors
 - a. acquisition workstation
 - b. radiologist interpretation workstation
 - 4. digital image display and informatics
 - a. medical record
 - 1. HIS/RIS
 - 2. EMR
 - b. PACS
 - 1. storage and retrieval of data
 - 2. backup and archive
 - 3. troubleshooting
 - 5. computer-aided detection (CAD)
- C. Quality Assurance and Evaluation
 - 1. accreditation bodies and certifying agencies (e.g., ACR, FDA)
 - a. purpose
 - b. process
 - c. frequency
 - 2. MQSA regulations
 - a. personnel requirements
 - b. recordkeeping (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
 - f. breast density reporting requirements

(Image Production continues on the following page.)



Image Production (continued)

D. Quality Control²

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

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 technologists' quality control program
 - m. application of compression
 - n. compression paddle alignment
 - o. acquisition and radiologist interpretation workstation QC

FOCUS OF QUESTIONS

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

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 continues on the following page.)



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. EQUIP
 - 1. positioning
 - 2. compression
 - 3. exposure
 - 4. contrast
 - 5. sharpness
 - 6. noise artifacts
 - 7. exam ID
 - b. patient-related artifacts
(e.g. motion, clothing, anatomy, implanted devices)



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. retroglandular 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
 - b. asymmetry and focal asymmetry
 - c. characteristics of masses
 - 1. shape (e.g., round, irregular)
 - 2. margin (e.g., circumscribed, indistinct, spiculated)
 - 3. density
 - d. characteristics of calcifications
 - 1. typically benign (e.g., skin, vascular, coarse, milk of calcium, dystrophic)
 - 2. suspicious morphology (e.g., amorphous, heterogeneous, fine pleomorphic)
 - 3. distribution (e.g., diffuse, grouped, linear)
 - 2. BI-RADS® categories
 - 1. mammographic assessment
 - 2. breast density (e.g., entirely fatty, heterogeneously dense)
 - f. recommendations
 - 3. benign pathology and mammographic appearance
 - a. cyst
 - b. galactocele
 - c. fibroadenoma
 - d. lipoma
 - e. hamartoma
 - f. papilloma
 - g. duct ectasia
 - h. hematoma
 - i. abscess and inflammation
 - j. fat necrosis
 - k. lymph nodes
 - l. gynecomastia
 - m. edema
 - n. seroma
 - 4. benign with upgrade potential pathology and mammographic appearance
 - a. lobular carcinoma in situ (LCIS)
 - b. atypical ductal hyperplasia (ADH)
 - c. atypical lobular hyperplasia (ALH)
 - d. papilloma with atypia
 - e. flat epithelial atypia
 - f. radial scar
 - g. phyllodes tumor
 - 5. 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
 - h. metastatic lesions



Procedures (continued)

2. Mammographic Positioning³ and 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. Patient Variance

1. chest wall variations (e.g., pectus excavatum, pectus carinatum)
2. irradiated breast
3. reduction mammoplasty
4. postsurgical breast
5. male sex assigned at birth
6. kyphotic/lordotic patients
7. protruding abdomen
8. implanted devices (e.g., pacemaker, port)
9. breast augmentation (e.g., implants, injections)
10. lactating breast
11. extremely large/small breast (e.g., mosaic, tiling, paddle selection)

C. Imaging Examinations

1. mammography
 - a. screening
 - b. diagnostic
2. breast ultrasound⁴
3. breast MRI⁴

D. Interventional Procedures⁴

1. patient preparation
 - a. pertinent history (e.g., anticoagulation, allergies)
 - b. informed consent
 - c. time-out procedure
 - d. procedure setup
 - e. postprocedure instructions
2. procedures
 - a. biopsy
 1. stereotactic (upright or prone)
 2. ultrasound
 - b. needle localization (wire)
3. procedure-associated imaging
 - a. surgical specimen
 - b. stereotactic specimen
 1. intraprocedural (real-time)
 2. post core needle biopsy
 - c. localization
 - d. clip placement
4. handling and disposing of biohazardous materials
 - a. biopsy specimens
 - b. body fluids
 - c. sharps and biopsy supplies

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.