



Mammography

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

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

The table below presents the major content categories and subcategories 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 Questions²
Patient Care	12
<i>Education and Assessment (12)</i>	
Image Production	43
<i>Equipment Operation and Quality Assurance (43)</i>	
Procedures	60
<i>Anatomy, Physiology, and Pathology (23)</i>	
<i>Mammographic Positioning, Special Needs, and Imaging Procedures (37)</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 25 unscored (pilot) questions.



Patient Care

1. Education and Assessment

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. guidelines for mammography screening (ACS, ACR)
4. breast self-examination (BSE)
5. clinical breast examination (CBE)
6. digital breast tomosynthesis (DBT/3D)
7. 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. verify for interpreting physician

C. Treatment Options¹

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

* 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. 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. acquisition type
 - a. full field digital mammography-direct radiography (FFDM-DR/2D)
 - b. digital breast tomosynthesis (DBT/3D)
 - 2. image receptors
 - a. direct FFDM
 - b. indirect FFDM
 - 3. workstations
 - a. acquisition
 - b. interpretation
 - 4. hard copy devices (e.g., laser printer)
 - 5. 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
 - 6. 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.)



Image Production (continued)

D. Quality Control²

1. mammographer 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

²The mammographer general tests and medical physicist tests listed are referenced in the ACR Mammography Quality Control Manual (1999). Digital QC tests for the mammographer and the medical physicist tests will also be covered. 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)

2. medical physicist tests
 - a. general QC tests
 1. mammographic unit assembly evaluation
 2. collimation assessment
 3. evaluation of system resolution
 4. automatic exposure system performance assessment
 5. artifact evaluation
 6. image quality evaluation
 7. kVp accuracy and reproducibility
 8. beam quality assessment (half-value layer measurement)
 9. breast entrance exposure, automatic exposure, reproducibility, average glandular dose, radiation output rate
 10. viewbox luminance and room illuminance
 11. assessing the mammography site quality control program
 12. compression paddle alignment
 - b. QC tests specific to digital
 1. system/spatial resolution (e.g., CNR, SNR, MTF)
 2. printer check
 3. interpretation workstation tests

FOCUS OF QUESTIONS

1. Purpose
2. Frequency

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

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. galactocele
 - c. fibroadenoma
 - d. lipoma
 - e. hamartoma
 - f. papilloma
 - 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
 - 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

(Procedures continue on the following page.)



Procedures (continued)

2. Mammographic Positioning³, 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. caudocranial (FB)
11. lateromedial oblique (LMO)
12. superolateral-to-inferomedial oblique (SIO)
13. implant displaced (ID)
14. nipple in profile
15. anterior compression
16. spot compression
17. magnification

B. Special Patient Situations

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

C. 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 procedures⁴
 - 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. tissue marker clip placement

³ The mammographer is expected to know positioning as presented in the *ACR Mammography Quality Control Manual* (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 procedures.