



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 Questions ² |
|---|---|
| Patient Care | 1214 |
| Education and Assessment <i>Patient Interactions and Management</i> (1214) | |
| Image Production | 4333 |
| Equipment Operation <i>Image Acquisition and Quality Assurance</i> (4333) | |
| Procedures | 6068 |
| <i>Anatomy, Physiology, and Pathology</i> (263) | |
| <i>Mammographic Positioning, Special Needs, and Imaging Procedures</i> (4237) | |
| 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~~ 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. patient education
 - a. guidelines for mammography screening (ACS, ACR)
 - b. breast self-examination (BSE)
 - c. clinical breast examination (CBE)
 - d. typical patient dose
- ~~6. digital breast tomosynthesis (DBT/3D)~~

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. importance of having prior images available
 - b. verify for interpreting physician review prior to exam

C. Breast Cancer Treatment Options¹

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. hormoneal therapy (anti-estrogen therapy)
 1. hormone receptor status (ER+/-)
 2. hormone receptor status (PR+/-)
 3. anti-HER2/neu therapy (e.g., tamoxifen)
3. reconstruction
 - ~~a. tissue expander~~
 - a. implant
 - b. TRAM flap
 - c. 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~~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 ~~devices~~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
 - a. ~~direct~~ FFDM
 - b. ~~indirect~~ FFDM
 - 3. monitors
 - a. acquisition workstation
 - b. ~~radiologist~~ interpretation workstation
 - 4. ~~hard copy devices (e.g., laser printer)~~
 - 5. digital image display and informatics
 - a. ~~HIS/RIS~~
 - b. ~~networking (e.g., HL7, DICOM)~~
 - c. a. workflow (e.g., ~~inappropriate~~ documentation, ~~lost images~~, ~~mismatching~~ed images, ~~corrupt~~ merging patient data)
 - d. b. PACS
 - 1. ~~lossy compression~~storage and retrieval of data
 - 2. 1. ~~lossless compression~~back-up and archive
 - 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)
 - 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 Control²

1. mammographer tests
 - ~~a. general 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 ~~QC~~ and test pattern (e.g., SMPTE, ~~AAPM task group-TG-18 templates~~)
 - e. repeat analysis
 - f. viewing conditions (~~e.g., lighting and viewboxes~~)
 - g. compression force
 - ~~b. digital QC tests~~
 - ~~2. laser imaQC test~~
 - h. manufacturer detector calibration artifact evaluation (e.g., flat field, detector calibration)
 - 4system resolution test (e.g., modulation transfer function [MTF], signal-to-noise ratio [SNR], contrast-to-noise ratio [CNR])

FOCUS OF QUESTIONS

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

²The **Quality Control (QC) tests for the** mammographer ~~general tests~~ and **the** medical physicist tests listed are referenced in the **2018 ACR Digital 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~~
 - a. mammographic ~~unit~~ **assembly** **equipment** evaluation
 - b. collimation assessment
 - c. ~~evaluation of~~ 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 **assessment**
 - f. artifact evaluation
 - g. **phantom** image quality evaluation
 - h. kVp accuracy and reproducibility
 - i. beam quality (half-value layer) assessment
 - j. average glandular dose
 - k. ~~viewbox luminance and~~ room illuminance
 - l. ~~assessing~~ **evaluation of technologist's the mammography site** quality control program
 - m. **application of** compression
 - n. compression paddle alignment
 - ~~b. QC tests specific to digital~~ **acquisition and** ~~printer check~~ **radiologist** interpretation workstation ~~tests~~ **QC**

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
 - j. labeling

2. Evaluation of Image Quality
 - a. positioning
 - b. compression
 - c. exposure
 - d. contrast
 - e. sharpness
 - f. noise
 - g. artifacts
 - h. collimation
 - ~~i. labeling~~
 - ij.** 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. Morgagni tubercles~~
 - 65. skin
 - a. sebaceous glands
 - b. sweat glands
 - c. hair follicles
 - 76. axillary tail
 - 87. 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
 - ~~10. Montgomery glands~~
- D. ~~Histology and~~ Cytology
 - ~~1. terminal ductal lobular unit (TDLU)~~
 - ~~2. cellular components~~
 - 1.a epithelial cells
 - 2.b myoepithelial cells
 - 3.e basement membrane
- E. Pathology
 - 1. mammographic appearance and reporting terminology (~~e.g.,~~ BI-RADS®)
 - a. architectural distortion (~~e.g.,~~ asymmetry, focal asymmetry (~~one-view finding~~))
 - b. characteristics of masses
 - 1. shape (e.g., round, irregular)
 - 2. margin (e.g., circumscribed, indistinct, spiculated)
 - 3. density
 - c. characteristics of calcifications
 - 1. ~~round or punctate~~ 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® assessment categories
 - 1. mammographic assessment
 - 2. breast composition (e.g., entirely fatty, heterogeneously dense)
 - e. recommendations
 - 2. benign ~~conditions~~ pathology 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~~ pathology and ~~their~~ mammographic appearances
 - a. lobular carcinoma in situ (LCIS)
 - b. atypical ductal hyperplasia (ADH)
 - c. atypical lobular hyperplasia (ALH)
 - d. radial scar
 - e. papilloma with atypia
 - ~~f. calcifications~~
4. malignant ~~conditions~~ pathology and ~~their~~ mammographic appearances
 - 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. 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)~~
10. implant displaced (ID)
11. nipple in profile
12. anterior compression
13. spot compression
14. magnification

B. Special Patient Situations

1. chest wall ~~deformities~~ variations (e.g., pectus excavatum, pectus carinatum)
2. irradiated breast
3. reduction mammoplasty
4. post-surgical breast
5. male patients
6. kyphotic/lordotic patients
7. protruding abdomen
8. ~~infusa-port (port a cath)~~ implanted devices (e.g., pacemaker, port)
- ~~109.~~ breast implants augmentation
- ~~110.~~ lactating breast
- ~~1211.~~ extremely large/small breast

C. Imaging Modalities Examinations

1. mammography
 - a. screening
 1. 2D
 2. digital breast tomosynthesis (DBT/3D)
 - b. diagnostic
2. breast ultrasound
3. breast MRI
4. sentinel node mapping

D. Interventional Procedures⁴

1. informed consent
2. procedures and associated imaging
 - a. biopsy with clip placement
 1. ultrasound core biopsy
 2. stereotactic core biopsy
 - b. cyst aspiration
 - ~~e. ductography/galactography~~
 - c. fine needle aspiration biopsy
 - d. needle/wire localization
 - e. interventional imaging
 1. stereotactic specimen
 2. surgical specimen
 3. localization wire imaging
 4. clip imaging
3. handling and disposing of bio-hazardous 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 procedures.