Mammography
Professional Curriculum

Sponsored by the American Society of Radiologic Technologists, 15000 Central Ave. SE, Albuquerque, NM 87123-3917.

Contents

Introduction ii

Course Content
- Department Organization 1
- Indicators and Treatment of Breast Disease 4
- Breast Anatomy and Physiology 7
- Positioning 9
- Equipment 13
- Technical Applications 17
- Breast Viability and Pathology 20
- Quality Assurance and Quality Control 27
- Interventional Procedures 30

Clinical Practicum 32

Practice Standards 33
- Glossary 48

Reference Resources 50

Introduction

The mammography curriculum is intended to assist the educational community with a course outline in mammography. The curriculum includes measurable tasks that the mammography student is expected to perform.

The inference is made that students receiving education in mammography have completed radiologic technology instruction or its equivalent. For this reason, specific areas have been purposely omitted from the mammography curriculum. For example, radiation protection is not included, the assumption made that properties of radiation do not differ from general radiography to mammography.

Legal and professional liability are not included in this curriculum. Laws governing medical malpractice, libel, slander, patient confidentiality and invasion of privacy do not differ between general radiography and mammography. Mammography is considered a part of radiography; therefore, the curriculum does not distinguish nor make particular rules regarding specific areas.

Due to the diversity of the health insurance field, health care plans, providers and insurance information are not included in the mammography curriculum.

This mammography curriculum provides a basis for education in mammography; it is not an exclusive summary of all mammography information and knowledge. References are included as a resource.

Sandra W. Wilson, B.S., R.T.(R)(M)

Department Organization

Course Description
Content provides students with an overview of the mammography facility and its personnel. It provides a foundation for the types of patient services offered and the regulations that affect the operation of the facility or service.

Objectives
The student will:

1. Identify key personnel and discuss regulations of the MQSA of 1992.
2. Define a mammography facility.
3. Explain patient services in the mammography department.
4. Discuss MQSA, ACR and FDA guidelines and accreditations.

Content
I. The Mammography Facility Defined

A. Hospitals

B. Outpatient departments

C. Clinics

D. Radiology practices

E. Mobile units

F. Department of Veterans Affairs

G. Other

II. Ancillary Personnel

A. Interpreting physicians
   1. Training requirements
      a. Medical licensing
   2. Experience
      a. Interpretation of mammograms according to MQSA guidelines
   3. Certification
      a. FDA-approved bodies
   4. Continuing education
      a. Regulations
      b. Requirements

B. Mammographers
   1. Training requirements

a. Licensing
b. Certification

2. Experience
3. Continuing education
   a. Regulations
   b. Requirements

C. Medical physicist
1. Training
   a. License or approval by state
2. Experience
3. Certification
4. Continuing education
   a. Regulations
   b. Requirements

III. Patient Services

A. Screening mammography
1. Asymptomatic patients

B. Diagnostic mammography (consultative mammography)
1. Clinical signs, symptoms or physical findings
2. Abnormal or questionable screening mammogram
3. History of breast cancer
4. Augmented breasts

C. Other
1. Experimental mammography
2. Localization procedures
3. Biopsy procedures

IV. National Quality Standards

A. FDA
1. Approved accrediting bodies
   a. Private, nonprofit organizations
   b. State agencies
2. Responsibilities of accrediting bodies
   a. Facility standards
      1) Physician standards
      2) Mammographer standards
      3) Medical physicist standards
      4) X-ray equipment characteristics
      5) Quality assurance and quality control programs
      6) Phantom image quality testing
      7) Radiation dose limits

8) Information update provisions
9) Medical records
10) Patient notification requirements
11) Clinical image review

B. MQSA requirements
1. Accreditation of mammography facilities by approved accrediting bodies
2. Annual mammography facility physics survey, consultation and evaluation performed by a certified or state-licensed medical physicist
3. Annual inspection of mammography facilities, performed by federally certified or state-certified inspectors
4. Qualification standards for interpreting physicians, mammographers, medical physicists and mammography facility inspectors
5. Specification of boards or organizations eligible to certify the training and experience of mammography personnel
6. Establishment of quality standards for mammography equipment and practices, including quality assurance and quality control programs
7. Establishment of a National Mammography Quality Assurance Advisory Committee
8. Establishment of standards governing record keeping for patient files and requirements concerning mammography reporting and patient notification by physicians

Indicators and Treatment of Breast Disease

Course Description

Content focuses on changes that occur in breast tissue and procedures for breast examination. Risk factors, detection and treatment of breast cancer will be discussed and evaluated.

Objectives

The student will:

1. Recognize clinical breast changes.
2. Identify risk factors linked to breast cancer.
3. State the recommendations for asymptomatic women regarding mammography.
4. Provide information on the importance of manual and visual breast self-examination.
5. Define treatment options for breast cancer.

Content

I. Clinical Breast Changes

A. Lumps
   1. Location
   2. Size
   3. Pain
   4. Mobility

B. Thickening
   1. Location

C. Swelling
   1. Location

D. Dimpling
   1. Location

E. Skin irritation
   1. Location

F. Retraction
   1. Location
   2. Duration of time

G. Pain
   1. Location
   2. Duration of time

H. Discharge
   1. Duration of time

2. Color of discharge
3. Ipsilateral or bilateral

II. Risk Factors Associated With Breast Cancer

A. Male vs. female

B. Age

C. Family history of breast cancer

D. Menses
   1. Early age at menarche
   2. Late age at menopause

E. Exposure to cyclical estrogen

F. Parity
   1. Nulliparity
   2. Primiparity
   3. Multiparity
   4. Age at primiparity

G. Educational level and socioeconomic status

H. Diet

III. Early Detection of Breast Cancer

A. Screening mammograms
   1. Baseline between the ages of 35 and 40
   2. Women 40 to 49, every 1 to 2 years
   3. Women 50 and older, annual mammograms

B. Clinical examinations
   1. Women 20 to 40, every 3 years
   2. Women older than 40, every year

IV. Manual Breast Examination

A. Age
   1. Puberty through old age

B. Time
   1. Monthly
      a. Seven to 10 days after last menstrual period
      b. First day of each month after menopause or hysterectomy

C. Technique
    1. Fingerpads
    2. Superficial pressure
    3. Deep pressure
    4. Axillae and clavicular areas

D. Methods
    1. Spiral method
    2. Grid method
    3. Pie wedge method
    4. Visual inspection

V. Treatment Options for Breast Cancer

A. Surgery
    1. Lumpectomy
    2. Partial mastectomy
    3. Simple mastectomy
    4. Modified radical mastectomy
    5. Radical mastectomy
    6. Reconstructive surgery

B. Radiation therapy

C. Chemotherapy

D. Hormone therapy

Breast Anatomy and Physiology

Course Description

Content establishes a base of knowledge in breast anatomy and physiology. Correlation between breast anatomical structures and mammographic anatomic structure will be described and discussed.

Objectives

The student will:

1. Identify and label anatomical structures of the breast.
2. Identify and label the breakdown of the single lobe.
3. Identify the three arterial branches supplying the breast and the three venous drainage channels.
4. Describe the lymphatic system and lymphatic drainage.
5. Correlate breast anatomical structures to mammographic anatomical structures.
6. Identify and label mammographic anatomical structures, given a mammographic image.

Content

I. Gross Anatomy of the Normal Breast

A. Definition of the breast
   1. Male vs. female
   2. Developmental stages

B. External anatomy
   1. Breast margins
   2. Nipple
   3. Areola
   4. Montgomery's glands
   5. Morgagni's tubercles
   6. Skin
      a. Sebaceous glands
      b. Sweat (sudiferous) glands
      c. Hair follicles
   7. Axillary tail
   8. Inframammary fold
   9. Margin of pectoralis major

C. Internal anatomy
   1. Fascial layers
   2. Retromammary (fat) space
   3. Fibrous tissues
   4. Glandular (secretory) tissues
      a. Glandular lobes
         1) Lobules

2) Terminal ductal lobular unit (TDLU)

5. Adipose (fatty) tissues
6. Cooper's ligaments
7. Pectoral muscle
8. Circulatory (blood supply) system
9. Lymphatic channels

D. Histology
   1. Terminal ductal lobular unit
      a. Extralobular terminal duct
      b. Intralobular terminal duct
      c. Ductal sinus (acinus)
   2. Cellular components
      a. Epithelial cells
      b. Myoepithelial cells
      c. Basement membrane

Positioning

Course Description

Content provides a knowledge base of the various positions used in mammography. Content includes discussions on clinical data needed to perform the exam and positioning techniques for screening and diagnostic mammography.

Objectives

The student will:

1. Identify patient's name from the request form or doctor's order to confirm the information on the request form by questioning the patient or by checking the patient's wristband.
2. Ask appropriate questions, listen to patient responses and accurately document the information.
3. Observe any outstanding physical characteristics and document the findings.
4. Explain procedure to the patient before proceding with the mammogram.
5. Manipulate breast into proper placement to achieve the best demonstration of breast tissue by adjusting the patient, mammography equipment and cassettes.
6. Process and evaluate the completed image.
7. Identify the qualities necessary for an acceptable mammogram.
8. Identify anatomical structures or pathological findings.
9. Repeat films or additional views if necessary.
10. Be professional, competent, confident and nonjudgmental.

Content

I. Clinical Data of Patient

- A. History
  1. Gender
  2. Age
  3. Age at onset of menses
  4. Parity
     - a. Nulliparity
     - b. Multiparity
     - c. Age at primiparity
  5. Menstrual status
     - a. Last menstrual cycle
     - b. Age at menopause
     - c. Hysterectomy
     - d. Oophorectomy
  6. Medications
     - a. Estrogen
     - b. Progesterone
     - c. Prolactin
     - d. Thyroid
     - e. Diabetes

f. Steroids
g. Estrogen inhibitors

7. Previous breast biopsies
   a. Surgical biopsy and pathologic results
   b. Core biopsy and pathologic results
   c. Cyst aspirations
8. Previous breast surgery
   a. Augmentation
   b. Reduction
   c. Other
9. Family history of breast cancer
10. Other
    a. Previous chest surgery (open heart, etc.)
    b. Port-A-Caths
    c. Moles
    d. Accessory nipple
    e. Unusual landmarks

II. Screening Mammography

A. Craniocaudal (CC) projection
   1. Purpose
   2. Anatomical structures demonstrated
   3. Part position (x-ray tube assembly and image receptor)
   4. Patient position
   5. Other (wheelchair patient, male patient, patient with Port-A-Caths, etc.)

B. Mediolateral oblique (MLO) projection
   1. Purpose
   2. Anatomical structures demonstrated
   3. Part position (x-ray tube assembly and image receptor)
   4. Patient position
   5. Other (pectus excavatum patients, pectus carinatum patients, patients with protruding abdomens, etc.)

C. Ninety degree or true lateral projection
   1. Mediolateral (ML) projection
      a. Purpose
      b. Anatomical structures demonstrated
      c. Part position (x-ray tube assembly and image receptor)
      d. Patient position
      e. Other
   2. Lateromedial (LM) projection
      a. Purpose
      b. Anatomical structures demonstrated
      c. Part position (x-ray tube assembly and image receptor)

d. Patient position
e. Other

III. Diagnostic and Additional Projections

A. Exaggerated craniocaudal (XCCL) projection
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

B. Spot compression projection and view
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

C. Cleavage (CV) projection
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

D. Tangential (TAN) projection
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

E. Axillary tail (AT) projection
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

F. Rolled (RL and RM) projections
1. Purpose
2. Anatomical structures demonstrated
3. Part position (x-ray tube assembly and image receptor)
4. Patient position
5. Other

G. Superolateral to inferomedial oblique (SIO) projection
    1. Purpose
    2. Anatomical structures demonstrated
    3. Part position (x-ray tube assembly and image receptor)
    4. Patient position
    5. Other

H. Caudocranial (FB) projection
    1. Purpose
    2. Anatomical structures demonstrated
    3. Part position (x-ray tube assembly and image receptor)
    4. Patient position
    5. Other

I. Implant displaced (ID) projection
    1. Purpose
    2. Anatomical structures demonstrated
    3. Part position (x-ray tube assembly and image receptor)
    4. Patient position
    5. Other

J. Magnification (M) projection
    1. Purpose
    2. Anatomical structures demonstrated
    3. Part position (x-ray tube assembly and image receptor)
    4. Patient position
    5. Other

K. Patients requiring modification of positioning techniques
    1. Males
    2. Kyphotic patients
    3. Large breasts
    4. Small breasts
    5. Encapsulated implants
    6. Pectus excavatum
    7. Pectus carinatum
    8. Protruding abdomens
    9. Pacemaker
    10. Stretcher
    11. Wheelchair
    12. Port-A-Cath
    13. Physically handicapped
    14. Mentally handicapped

Equipment

Course Description

Content gives the student a foundation of the concepts of mammography equipment. The types and function of mammographic and quality control equipment, along with the mandated requirements governing their use, will be described and discussed.

Objectives

The student will:

1. Label the components of the mammographic unit.
2. Demonstrate and properly operate mammography equipment and the correct use of compression devices, filtration devices, magnification setup, use of grids and automatic exposure controls.
3. State the specifications of the various components in a mammography unit (half-value layer, focal spot size, source-to-image distance and the minimum requirements according to MQSA guidelines).
4. Define heel effect.
5. Define reciprocity law failure.
6. Differentiate between the various types of x-ray generators used in mammography.
7. Discuss and define digital mammography.
8. Explain the additional functions available with digital imaging – measurement of area of interest, filtration of image, magnification, contrast, density, subtraction of image.
9. Define compression, its usefulness and minimum and maximum requirements, according to MQSA guidelines.
10. State the purpose of magnification.
11. State the procedure used when magnifying breast tissue.
12. Accessorize equipment according to the procedure being performed.
13. Set appropriate kVp, mA and time or automatic exposure control (AEC) and the correct position of the photosensor.
14. Process film and reload cassettes with mammography film.
15. Produce hard copy images of digital images.

Content

I. Dedicated Mammography Equipment

A. C-arm x-ray tube stand

B. Mammography tube
   1. Rotating vs. stationary anodes
   2. Target materials
      a. Molybdenum
      b. Specialized tungsten
      c. Rhodium
   3. Focal spot
      a. Standard

b. Magnification
c. Actual focal spot
d. Effective focal spot

4. Source-to-image distance (SID)
5. Object to film distance
6. Filtration
    a. Tube filtration
        1) Molybdenum
        2) Rhodium
        3) Yttrium
        4) Aluminum
    b. Exit window filtration
        1) Glass
        2) Beryllium
    c. Heel effect
    d. Effects on dose
    e. Effects on contrast
7. Generator
    a. Types
        1) Single-phase
        2) Three-phase
        3) High-frequency
        4) Constant potential
    b. Homogenous x-ray beam
    c. Ripple factor
    d. Tube capacity (mA output)
8. Automatic exposure control (AEC)
    a. Purpose
    b. Types
        1) Photomultiplier
        2) Ionization chamber
        3) Solid state
9. Grids
    a. Types
        1) Reciprocating
        2) Stationary
    b. Ratio
10. Beam limiting devices
    a. Purpose
    b. Collimation
        1) Three-sided
11. Compression devices
    a. Purpose
    b. Compression testing
    c. Types

1) Manual
2) Motorized

d. Paddle shapes, sizes and purposes

12. Magnification
    a. Purpose
    b. Focal spot size
    c. Air gap technique
    d. Effect of dose
    e. Magnification factor

II. Digital Mammography

A. Theory
1. Phosphor screens
2. CCD (charged coupled device)
3. Matrix/pixels
4. Optical density vs. noise ratio

B. Approaches of digital mammography
1. Slot scanning approach
2. Single-exposure approach
3. Multiple-exposure approach

C. Benefits
1. Radiation dose reductions
2. Image enhancement
3. Time
4. Possible computer-aided diagnosis
5. Telemammography

III. FDA/MQSA Requirements

A. Mammography equipment
1. Dedicated
2. Gantry assembly motion
    a. Rigidly fixed
    b. Rotation requirements
    c. Visual indication of gantry angle
3. Image receptors
    a. Classification of sizes
    b. Film-screen receptors (moving grids)
    c. Magnification devices (removable grids)
    d. Grid motion impedance
4. Compression
5. Beam limitation and light fields
    a. Alignment of light field to x-ray field
    b. Illumination requirements

c. Exposure interlock systems

6. Source-to-image receptor distance
   a. Minimum requirements
   b. Visual indication of selected SID
7. Dose limitations
8. Infection control

IV. Quality Assurance of Equipment

A. Facility quality assurance program

B. Maintenance of log books

C. Phantom images

D. Clinical image monitoring

E. Clinical image interpretation

F. Physicist surveys

G. Medical records

Technical Applications

Course Description
Content establishes a knowledge base in factors that govern and influence the production and recording of mammographic images.

Objectives
The student will:

1. Perceive the purpose for automatic exposure control (AEC) and relate it with an automatic kVp system.
2. Describe how kVp, mA, time and compression affect the mammographic image.
3. Identify the maximum permissible dose per mammography exam, according to MQSA standards.
4. Identify the average dose per mammographic exposure.
5. Describe how kVp, mA, time and compression affect the radiation dose to the patient.
6. Select the correct technical variable based on variations in breast anatomy.
7. Identify imaging artifacts on the mammography film.
8. Understand different film-screen combinations, their functions within the imaging system and their effect on the mammographic image.
9. Describe different types of processing and their importance in the mammographic imaging chain.
10. Identify processing artifacts on the mammography film.

Course Content
I. Technical Variables

A. Density

B. Contrast

C. kVp
   1. Range
   2. Rationale
   3. Effect on image quality
   4. Relationship to exposure time/reciprocity law failure and optimum optical density
   5. Effect on contrast

D. mAs
   1. Range
   2. Relationship to mR
   3. Relationship to exposure time/reciprocity law failure
   4. Effect on density

E. Compression
   1. Density

2. Contrast
3. Detail
4. Radiation dose

F. Automatic exposure control (AEC)
1. Definition
2. Effect of kVp
3. Effect of consistent image quality
4. Backup timing
5. Photocell placement
6. Tracking
7. Reproducibility
8. MQSA requirements

G. Half-value layer (HVL)
1. Heterogeneous and homogeneous radiation
2. MQSA requirements

H. Reciprocity law failure
1. Definition
2. Correlation to generator type and mR/mAs
3. Correlation to exposure time
4. Correlation to film-screen combination

I. Collimation
1. Purpose and importance
2. Film size
3. MQSA requirements

II. Screen and Film Variables

A. Screens
1. Intensifying differences
a. Slow
b. Medium
c. Fast
d. Rare earth
2. Single screens
a. Advantages
b. Disadvantages
3. Double screens
a. Advantages
b. Disadvantages
4. Cassettes
5. Care and maintenance of screens
6. MQSA requirements and tests

7. Artifacts

B. Image receptors (film systems)
   1. Single emulsion
   2. Double emulsion
   3. Speed
   4. Contrast
   5. H&D curves
   6. Artifacts

III. Processing

A. Darkroom
   1. Safelight standard
   2. Airflow (ventilation)
   3. Humidity
   4. Design
   5. MQSA requirements

B. Dedicated and nondedicated processing

C. Standard and extended processing
   1. Chemistry
   2. Temperature
   3. Replenishment rates
   4. Roller transport
   5. Guideshoes
   6. Airflow

D. Artifacts

E. MQSA requirements
   1. Cleaning
   2. Preventive maintenance
   3. Quality control and quality assurance

Breast Viability and Pathology

Course Description
Content introduces concepts of breast viability and pathology. Benign and cancerous pathology, including their mammographic appearance, will be presented.

Objectives
The student will:

1. Discuss and understand the changes the breast undergoes due to hormonal influences during puberty, menses, pregnancy and the postmenopausal life cycles.
2. Describe the physiologic changes caused by estrogen, progesterone and prolactin.
3. Describe breast augmentation and identify the types of implants, the common implant locations and the anatomical changes to the augmented breast.
4. Describe the anomalies of development that can occur in the breast.
5. List the physical changes of the breast related to pathology.
6. List the mammographic changes of the breast related to pathology and, given mammographic images, identify the common mammographic appearance of breast pathology.
7. Describe the generally accepted (postulated) progression of breast cancers from the ductal epithelium and nonepithelial tissues.

Content
I. Developmental Stages of Breast Tissue

A. Fetal

B. Puberty

C. Menstruation

D. Pregnancy

E. Lactation

F. Menopause

G. Postmenopause

II. Hormonal Influences

A. Birth control pills

B. Estrogen

C. Progesterone

D. Prolactin

E. Testosterone

F. Other

III. Breast Augmentation or Reconstruction

A. Implants

1. Types

a. Silicone

b. Saline

c. Other

IV. Breast Anomalies

A. Asymmetry

B. Inverted nipples

C. Accessory nipples

D. Other

V. Physical Changes Due to Pathology

A. Pain

B. Lumps

C. Thickening

D. Discharge

E. Skin changes

F. Nipple and areola changes

G. Edema

H. Erythema

I. Dimpling

J. Other

VI. Mammographic Appearance Pathology

A. Masses

1. Shape
    a. Round
    b. Oval
    c. Lobulated
    d. Irregular
    e. Architectural distortion
2. Margins
    a. Circumscribed
    b. Obscured
    c. Ill-defined (indistinct)
    d. Spiculated
    e. Microlobulated
3. Benign characteristics
    a. Encapsulated
    b. Low density
        1) Fat containing
    c. Mixed density
    d. Well circumscribed
4. Malignant characteristics
    a. Spiculated
    b. High density
    c. Low density
    d. Indistinct

B. Calcifications
1. Characteristics
    a. Number (quantity)
    b. Size
    c. Shape
    d. Distribution
        1) Clustered or grouped
        2) Segmental
        3) Regional
        4) Diffuse (scattered)
        5) Multiple groups
2. Benign characteristics (typical)
    a. Coarse
    b. Rim or eggshell
    c. Milk of calcium (teacup-like)
    d. Dystrophic
    e. Vascular
    f. Skin (superficial)
    g. Secretory
    h. Fat necrosis
    i. Punctate

3. Malignant (nondeterminate characteristics)
    a. Indistinct (amorphous)
    b. Granular (clustered)
    c. Irregular
    d. Casting

C. Nodules
    1. Characteristics
        a. Shape
        b. Fluid or cystic
        c. Solid or indistinct

D. Other indicators of pathology
    1. Asymmetry
    2. Contour changes
    3. Prominent ductal pattern
    4. Prominent venous or arterial pattern
    5. Skin changes
    6. Other

VII. Breast Carcinomas

A. Postulated development of breast cancer
    1. Epithelial hyperplasia
    2. Atypical epithelial hyperplasia
    3. Carcinoma in situ
    4. Invasive carcinoma

B. Pathological types
    1. Ductal carcinomas
        a. Medullary
        b. Mucinous
        c. Tubular
        d. Inflammatory
        e. Comedo
    2. Lobular
    3. Paget disease

C. Carcinoma categories
    1. In situ
    2. Intraductal
    3. Invasive

D. Stromal cancer
    1. Sarcoma

E. Other
   1. Lymphoid malignancy
   2. Metastatic to the breast from other primary

F. Diagnosis of breast carcinoma
   1. Fine-needle aspiration
   2. Core biopsy
   3. Surgical biopsy
   4. Other

G. TNM classification of breast cancer
   1. Primary tumor
      a. Clinical
      b. Diagnostic
      c. Surgery
      d. Postsurgical treatment
      e. Re-treatment
      f. Autopsy
   2. N subclasses
      a. Regional lymph node involvement
      b. Regional lymph node metastasis
      c. Increasing degree of demonstrable lymph node abnormalities
   3. Metastasis
      a. No evidence
      b. Evidence of distant metastasis
      c. Assessment of distant metastasis cannot be met

VIII. Benign Breast Pathology

A. Cyst
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

B. Galactocele
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

C. Fibroadenoma
   1. Etiology
   2. Mammographic appearance

3. Diagnosis
4. Treatment

D. Lipoma
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

E. Hamartoma (fibroadenolipoma)
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

F. Papilloma
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

G. Ductal ectasia
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

H. Breast infection
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

I. Abscess
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

J. Hematoma
   1. Etiology
   2. Mammographic appearance
   3. Diagnosis
   4. Treatment

K. Fat necrosis
    1. Etiology
    2. Mammographic appearance
    3. Diagnosis
    4. Treatment

L. Inflammation vs. inflammatory cancer
    1. Etiology
    2. Mammographic appearance
    3. Diagnosis
    4. Treatment

M. Radial scarring
    1. Etiology
    2. Mammographic appearance
    3. Diagnosis
    4. Treatment

Quality Assurance and Quality Control

Course Description

Content establishes a protocol for quality assurance and quality control that incorporates all operations and functions of a mammography facility or service. The interrelatedness of accreditation and service delivery standards will be demonstrated and discussed.

Objectives

The student will:

1. Perform quality control test procedures according to ACR and MQSA guidelines.
2. Document control test results.
3. Determine and implement appropriate corrective measures when established quality control standards are out of tolerance.
4. Perform safety checks on radiographic equipment and accessories.

Content

I. Daily Quality Assurance Procedures

A. Darkroom
   1. Purpose of quality assurance
   2. Regulations and recommendations

B. Processor
   1. Purpose of quality assurance
   2. Control film
   3. Data plotted
      a. Film speed
      b. Film contrast
      c. Film fog
   4. Corrective measures
      a. Chemistry
         1) Developer
         2) Fixer
         3) Water (rinse)
      b. Temperature
         1) Developer
         2) Fixer
         3) Water (rinse)
         4) Dryer
      c. Time
      d. Film

II. Weekly Quality Assurance Procedures

A. Screen cleanliness
   1. Purpose

2. Procedure
3. Documentation

B. Viewbox maintenance
1. Purpose
2. Procedure
3. Magnifying glasses
4. Documentation

C. Phantom images
1. Purpose
2. Congruity of image
a. Cassette
b. Phototimer
c. Viewbox
3. Documentation
a. Exposure time
b. Optical density
c. Density difference
d. Simulated fibers
e. Speck groups
f. Masses
4. Problem-solving steps

III. Monthly Quality Assurance Procedures

A. Visual checklist
1. Purpose
2. Documentation

IV. Quarterly Quality Assurance Procedures

A. Repeat analysis
1. Purpose
2. Analysis of data
3. Documentation of data

B. Fixer retention test
1. Purpose
2. Procedure
3. Documentation

V. Semiannual Quality Assurance Procedures

A. Darkroom fog test
1. Purpose
2. Procedure
3. Documentation

B. Film-screen contact test
    1. Purpose
    2. Procedure
    3. Documentation

C. Compression test
    1. Purpose
    2. Procedure
    3. Documentation

VI. Annual Quality Assurance Procedures

A. Physicist's survey

B. Inspection by federally certified or state-certified inspectors

C. Qualification standards
    1. Physicians
    2. Mammographers
    3. Medical physicists

Interventional Procedures

Course Description
Content establishes a knowledge base in the type and application of interventional procedures involving mammography.

Objectives
The student will describe, assist or perform:

1. Sterile technique.
2. A standard needle lesion localization.
3. A stereotactic lesion localization.
4. A fine-needle aspiration biopsy.
5. Galactography.
6. Pneumocystography.
7. A stereotactic or core biopsy.

Content
I. Interventional Procedures

A. Sterile technique
   1. Spread of infection
      a. Exogenous
      b. Endogenous
      c. Iatrogenic
      d. Nosocomial
   2. Preparation of local anesthetics, contrast media, etc.
   3. Proper glove usage
   4. Skin preparation
   5. Sterile tray preparation
   6. Disposal of items

B. Standard lesion localization
   1. Definition
   2. Application
   3. Technique

C. Stereotactic lesion localization
   1. Definition
   2. Application
   3. Technique

D. Ultrasound
   1. Definition
   2. Application
   3. Technique

E. Cyst aspirations and fine-needle aspiration biopsies
    1. Definition
    2. Application
    3. Technique
    4. Lab analysis (pathology)

F. Pneumocystography
    1. Definition
    2. Application
    3. Technique

G. Galactography
    1. Definition
    2. Application
    3. Technique

H. Core biopsy
    1. Definition
    2. Application
    3. Technique
    4. Specimen radiographs
    5. Pathologic analysis

Clinical Practicum

Suggested Credit

The number of hours varies; three hours of clinical practice for every hour of didactic lecture is suggested.

Course Format

1. Cooperative clinical experience, preferably with clinical competencies
2. Lab or simulations
3. Film review sessions

Course Description

1. Clinical experience in mammography and related activities
2. Individual research project

Syllabus Course Content

1. Clinical time (attendance)
2. Clinical examination record
3. Competency evaluation
4. Personal and professional evaluation
5. Clinical objectives
6. Miscellaneous

Because there are no essentials that govern the educational activities in mammography education, there are no mandatory clinical requirements. However, the clinical education experience should be conducted on sound educational principles based on a competency evaluation system and should reflect both personal and professional growth of the student.

Suggestions include: 1) observation in the areas related to patient screening; 2) imaging; 3) film processing; 4) quality control and 5) assisting the mammographer in the areas listed. The final section should be in the area of standardized clinical competencies with a mammographer present. The student completes the entire exam from request and chart review to patient screening, explaining the procedure to the patient, positioning the patient, using required accessories, setting the equipment, completing the image, releasing the patient, finalizing paperwork, storing the data and maintaining quality controls.

Introduction to Mammography
Practice Standards

The complex nature of breast disease involves multiple imaging modalities. Although an interdisciplinary team of radiologists, mammographers and support staff plays a critical role in the delivery of health services, it is the mammographer who performs the mammography examination that creates the images needed for diagnosis. Mammography integrates scientific knowledge and technical skills with effective patient interaction to provide quality patient care and useful diagnostic information.

Mammographer

Mammographers must demonstrate an understanding of human anatomy, physiology, pathology and medical terminology.

Mammographers must maintain a high degree of accuracy in mammography positioning and exposure technique. He or she must maintain knowledge about radiation protection and safety. Mammographers prepare for and assist the radiologist in the completion of intricate mammography examinations, including breast biopsies.

Mammographers are the primary liaison among patients, radiologists and other members of the support team. They must remain sensitive to the physical and emotional needs of the patient through good communication, patient assessment, patient monitoring and patient care skills. Mammography often is an uncomfortable examination; therefore, the mammographer is challenged to make each examination a positive experience.

Mammographers use professional and ethical judgment and critical thinking when performing their duties. Quality improvement allows the mammographer to be a responsible member of the health care team by continually assessing professional performance as mandated by the Mammography Quality Standards Act of 1992 (MQSA) and regulated by the U.S. Food and Drug Administration. Mammographers embrace continuing education for optimal patient care, public education, enhanced knowledge and technical competence.

Education and Certification

Mammographers prepare for their role on the interdisciplinary team by satisfactorily completing an accredited educational program in radiologic technology. Two-year certificate, associate degree and four-year baccalaureate degree programs are available.

Accredited programs must meet specific curricular and educational standards. The Joint Review Committee on Education in Radiologic Technology (JRCERT) is the accrediting agency for radiologic technology programs recognized by the U.S. Department of Education.

Upon completion of a course of study in radiologic technology, individuals may apply for the national certification examination. The American Registry of Radiologic Technologists (ARRT) is the recognized certifying agency for radiographers and offers examinations three times each

year. Those who successfully complete the certification examination in radiography may use the credential R.T.(R) following their name; the R.T. signifies registered technologist and the (R) indicates radiography.

Eligibility to take the advanced-level examination in mammography requires certification as a registered technologist in radiography for a minimum of one year. After successfully completing the mammography advanced-level examination, the credentials R.T.(R)(M) may be used.

To maintain ARRT certification, a level of expertise and awareness of changes and advances in practice, mammographers must complete 24 hours of appropriate continuing education every two years. In addition, continuing education mandated by the Mammography Quality Standards Act of 1992 (MQSA) must be met to lawfully practice in the specialty of mammography.

Practice Standards

The practice standards define the practice and establish general criteria to determine compliance. Practice standards are authoritative statements enunciated and promulgated by the profession for judging the quality of practice, service and education. They include desired and achievable levels of performance by which actual performance can be measured.

Professional practice constantly changes and actual practice varies from state to state as determined by local law and community custom. Recognizing this, the profession has adopted standards that are general in nature. The format was favored over a "cookbook" style or a "step-by-step" approach that would be difficult to maintain in a changing environment and confining for those practitioners with an expanded practice.

The standards focus on the dynamic nature of the health care delivery system. The standards are adaptable not only to the area of practice but also the locality of practice and institutional needs. While a minimum standard of acceptable performance is appropriate and should be followed by all practitioners in a specific area, it is unrealistic and highly inappropriate to assume that professional practice is the same in all regions of the United States.[1] State statute or regulation may dictate practice parameters. To conduct an appropriate review of the standards, one must look to the professional standard as well as local or state law that may impact the nature and scope of practice.

Format

The cohesive nature and inherent differences of medical imaging and radiation therapy are recognized in the general format of the standards. The standards are divided into three sections: clinical performance, quality performance and professional performance.

> *Clinical Performance Standards.* The clinical performance standards define the activities of the practitioner in the care of patients and delivery of diagnostic or therapeutic

[1] The term "practitioner" is used in all areas of the standards in place of the various names used in medical imaging and radiation therapy, such as radiologic technologist, sonographer or radiation therapist. Practitioner is defined as any individual practicing in a specific area or discipline. The profession believes that any individual practicing in one of the defined disciplines or specialties should be held to a minimum standard of performance to protect the patients who receive professional services.

procedures and treatments. The section incorporates patient assessment and management with procedural analysis, performance and evaluation.

Quality Performance Standards. The quality performance standards define the activities of the practitioner in the technical areas of performance including equipment and material assessment, safety standards and total quality management.

Professional Performance Standards. The professional performance standards define the activities of the practitioner in the areas of education, interpersonal relationships, personal and professional self-assessment and ethical behavior.

Each section of the standards is subdivided into individual standards. The standards are numbered and followed by a term or set of terms that identify the standards, such as "assessment" or "analysis/determination." The next statement is the expected performance of the practitioner when performing the procedure or treatment. A rationale statement follows and explains why a practitioner should adhere to the particular standard of performance.

Criteria. Criteria are used in evaluating a practitioner's performance. Each set of criteria is divided into two parts, the general criteria and the specific criteria. Both the measurement and specific criteria should be used when evaluating performance.

General Criteria. General criteria are written in a general style that applies to either medical imaging or radiation therapy practitioners. These criteria are the same in all sections of the standards and should be used for the appropriate area of practice. For example, a radiographer should use good professional judgment to make decisions concerning the adaptation of equipment and technical variables for a diagnostic procedure. Under these circumstances, the evaluation of the decision-making process concerning radiation therapy procedures would not be appropriate and should not be applied unless the procedure is diagnostic in nature, such as simulation.

Specific Criteria. While many areas of performance within medical imaging and radiation therapy are similar, others are not. The specific criteria are drafted with these differences in mind. For example, a criterion that calls for daily review of patient treatment records and doses to ensure that treatment does not exceed prescribed dose or normal tissue tolerance is imperative for those who practice in radiation therapy, yet is not applicable to those who practice in the imaging professions.

A profession's practice standards serve as a guide for appropriate practice. Standards provide role definition for practitioners that can be used by individual facilities to develop job descriptions and practice parameters. Those outside the medical imaging and radiation therapy community can use the standards as an overview of the role and responsibilities of the practitioner as defined by the profession.

Mammography Clinical Performance Standards

Standard One – Assessment
The practitioner collects pertinent data about the patient and the procedure.

Rationale
Information about the patient's health status is essential for providing appropriate imaging and therapeutic services.

General Criteria
The practitioner:

1. Uses consistent and appropriate techniques to gather relevant information from the medical record, significant others and health care providers. The collection of information is determined by the patient's needs or condition.
2. Reconfirms patient's identification and verifies the procedure requested or prescribed.
3. Verifies the patient's pregnancy status when appropriate.
4. Determines whether the patient has been appropriately prepared for the procedure.
5. Assesses factors that may contraindicate the procedures, such as medications, insufficient patient preparation or artifacts.

Specific Criteria
The practitioner:

1. Gathers relevant patient history, including information about:
   a. History of any breast surgery.
   b. Personal history of breast cancer.
   c. Personal history of other cancers.
   d. Family history of breast cancer.
   e. Estrogen replacement therapy.
   f. History of previous radiation therapy.
2. Documents the location of previous mammograms, if applicable, and asks the patient to sign release forms.
3. Documents the location of breast lumps, scars or moles by placing radiopaque markers on the breast and/or diagramming them on the patient's clinical history sheet.

Standard Two – Analysis/Determination
The practitioner analyzes the information obtained during the assessment phase and develops an action plan for completing the procedure.

Rationale
Determining the most appropriate action plan enhances patient safety and comfort, optimizes diagnostic and therapeutic quality and improves cost effectiveness.

General Criteria
The practitioner:

1. Selects the most appropriate and cost-effective action plan after reviewing all pertinent data and assessing the patient's abilities and condition.
2. Uses his or her professional judgment to adapt imaging and therapeutic procedure to improve diagnostic quality and therapeutic outcome.
3. Consults appropriate medical personnel to determine a modified action plan when necessary.
4. Determines the need for accessory equipment.

Specific Criteria
The practitioner:
1. Verifies that deodorants, powders, jewelry or other radiopaque materials that could interfere with the mammogram have been removed from the area of interest.
2. Assesses the need for alternative procedures based on the patient's hormonal status and the presence of surgical implants.

Standard Three – Patient Education
The practitioner provides information about the procedure to the patient, significant others and health care providers.

Rationale
Communication and education are necessary to establish a positive relationship with the patient, significant others and health care providers.

General Criteria
The practitioner:
1. Verifies that the patient has consented to the procedure and fully understands its risks, benefits, alternatives and follow-up. The practitioner verifies that written consent has been obtained when appropriate.
2. Provides accurate explanations and instructions at an appropriate time and at a level the patient can understand. Addresses and documents patient questions and concerns regarding the procedure when appropriate.
3. Refers questions about diagnosis, treatment or prognosis to the patient's physician.
4. Provides appropriate information to any individual involved in the patient's care.

Specific Criteria
The practitioner:
1. Emphasizes the need for mammographic examination according to established guidelines, as well as the importance of monthly breast self-examination and regular clinical examination.
2. Provides information on breast self-examination via demonstration, videotape, visual aids or brochures.
3. Responds to questions about radiation dosage, other modalities, the possible need for additional projections, the mammography procedure or other breast imaging concerns.
4. Explains the need for adequate compression in achieving a quality mammogram and instructs the patient to indicate whether the compression is too strong.

Standard Four – Implementation
The practitioner implements the action plan.

Rationale
Quality patient services are provided through the safe and accurate implementation of a deliberate plan of action.

General Criteria
The practitioner:
1. Implements an action plan that falls within established protocols and guidelines.
2. Elicits the cooperation of the patient to carry out the action plan.
3. Uses an integrated team approach as needed.
4. Modifies the action plan according to changes in clinical situation.
5. Administers first aid or provides life support in emergency situations.
6. Uses accessory equipment when appropriate.
7. Assesses and monitors the patient's physical and mental status.

Specific Criteria
The practitioner:
1. Performs both the craniocaudal and mediolateral oblique projections during a screening mammogram.
2. Attaches radiopaque markers to the mammography image receptor to document which breast is imaged and in which projection.
3. Applies the maximum tolerable amount of compression to the patient's breast to assist in achieving a quality mammogram.
4. Informs the patient how and when to receive a radiologist's report of the examination.

Standard Five – Education
The practitioner determines whether the goals of the action plan have been achieved.

Rationale
Careful examination of the procedure is necessary to determine that all goals have been met.

General Criteria
The practitioner:
1. Evaluates the patient and the procedure to identify variances that may affect patient outcome. The evaluation process should be timely, accurate and comprehensive.
2. Measures the procedure against established protocols and guidelines.
3. Identifies any exceptions to the expected outcome.
4. Documents any exceptions clearly and completely.
5. Develops a revised action plan to achieve the intended outcome, if necessary.
6. Disseminates reasons for revisions to all team members.

Specific Criteria
The practitioner:
1. Evaluates the mammographic image for positioning, technique, artifacts and compression.
2. Determines the need for repeat or additional images.

Standard Six – Implementation
The practitioner implements the revised action plan.

Rationale
It may be necessary to make changes to the action plan to achieve the intended outcome.

General Criteria
The practitioner:
1. Bases the revised plan on the patient's condition and the most appropriate means of achieving the intended outcome.
2. Takes action based on patient and procedural variances.
3. Measures and evaluates the results of the revised action plan.
4. Notifies appropriate health provider when immediate clinical response is necessary based on procedural findings and patient condition.

Specific Criteria
The practitioner:
1. Obtains additional views as needed.

Standard Seven – Outcomes Measurement
The practitioner reviews and evaluates the outcome of the procedure.

Rationale
To evaluate the quality of care, the practitioner compares the actual outcome with the intended outcome.

General Criteria
The practitioner:
1. Reviews all diagnostic or therapeutic data for completeness and accuracy.
2. Determines whether the actual outcome is within established criteria.
3. Evaluates the process and recognizes opportunities for future changes.
4. Assesses the patient's physical and mental status prior to discharge from the practitioner's care.

Specific Criteria
None added.

Standard Eight – Documentation
The practitioner documents information about patient care, the procedure and the final outcome.

Rationale
Clear and precise documentation is essential for continuity of care, accuracy of care and quality assurance.

General Criteria
The practitioner:

1. Documents diagnostic, treatment and patient data in the appropriate record.
2. Documentation must be timely, accurate, concise and complete.
3. Documents any exceptions from the established criteria or procedures.
4. Records diagnostic or treatment data.

Specific Criteria
None added.

Quality Performance Standards

Standard One – Assessment
The practitioner collects pertinent information regarding equipment, procedures and the work environment.

Rationale
The planning and provision of safe and effective medical services relies on the collection of pertinent information about equipment, procedures and the work environment.

General Criteria
The practitioner:
1. Ensures that services are performed in a safe environment in accordance with established guidelines.
2. Ensures that equipment maintenance and operation comply with established guidelines.
3. Assesses equipment to determine acceptable performance based on established guidelines.
4. Ensures that protocol and procedure manuals include recommended criteria and are reviewed and revised on a regular basis.

Specific Criteria
The practitioner:
1. Uses a densitometer and sensitometer to establish a baseline and to measure daily processor performance.
2. Establishes a baseline phantom image chart and routinely monitors the mammography machine, according to state and federal regulation and guidelines.
3. Ensures that the mammography department adheres to state and federal regulations and guidelines.

Standard Two – Analysis/Determination
The practitioner analyzes information collected during the assessment phase and determines whether changes need to be made to equipment, procedures or the work environment.

Rationale
Determination of acceptable performance is necessary for the provision of safe and effective services.

General Criteria
The practitioner:
1. Assesses whether services, procedures and the work environment meet or exceed established guidelines. If not, the practitioner develops an action plan.
2. Evaluates equipment to determine if it meets or exceeds established standards. If not, the practitioner develops an action plan.
3. Analyzes information collected during the assessment phase to determine whether optimal services are being provided. If not, the practitioner develops an action plan.

Specific Criteria

None added.

Standard Three – Education
The practitioner informs the patient, public and other health care providers about procedures, equipment and facilities.

Rationale
Open communication promotes safe practices.

General Criteria
The practitioner:
1. Elicits confidence and cooperation from the patient, the public and health care providers by providing timely communication and effective instruction.
2. Presents explanations and instructions at the learner's level of understanding and learning style.

Specific Criteria
The practitioner:
1. Provides information on certification or accreditation of mammography facilities to the patient, other health care providers and the general public. A certificate of compliance must be displayed in each facility.

Standard Four – Performance
The practitioner performs quality assurance activities or acquires information on equipment and materials.

Rationale
Quality assurance activities provide valid and reliable information regarding the performance of materials and equipment.

General Criteria
The practitioner:
1. Performs quality assurance activities on established protocols.
2. Provides evidence of ongoing quality assurance activities.

Specific Criteria
The practitioner:
1. Performs and documents any quality assurance tests required by state and federal regulations or guidelines.
2. Calls upon the medical physicist to serve as a consultant and to assist, as needed, in performing and documenting the assigned quality assurance tests.
3. Performs regular, preventive maintenance on mammography equipment.

Standard Five – Evaluation
The practitioner evaluates quality assurance results and establishes appropriate action plan.

Rationale
Materials, equipment and procedure safety depend on ongoing quality assurance activities that evaluate performance based on established guidelines.

General Criteria
The practitioner:
1. Compares quality assurance results to established acceptable values.
2. Verifies quality assurance testing conditions and results.
3. Formulates an action plan following verification of testing.

Specific Criteria
The practitioner:
1. Collaborates with the radiologist and medical physicist on a regular basis to devise a plan to bring equipment or procedures into compliance with state and federal requirements.
2. Evaluates the daily processor testing before mammograms are performed. Develops an appropriate action plan when the results are not in compliance with established guidelines.

Standard Six – Implementation
The practitioner implements the quality assurance action plan.

Rationale
Implementation of a quality assurance action plan is imperative for quality diagnostic and therapeutic procedures and patient care.

General Criteria
The practitioner:
1. Obtains assistance from appropriate personnel to implement the quality assurance action plan.
2. Implements the quality assurance action plan.

Specific Criteria
The practitioner:
1. Proceeds with the mammographic examination only when results from the processor and phantom images are in compliance with state and federal regulations.

Standard Seven – Outcomes Measurement
The practitioner assesses the outcome of the quality assurance action plan in accordance with established guidelines.

Rationale
Outcome assessment is an integral part of the ongoing quality assurance plan to enhance diagnosis and therapeutic services.

General Criteria
The practitioner:

1. Reviews the implementation process for accuracy and validity.
2. Determines whether the performance of equipment and materials is safe for practice based on the outcome assessment.
3. Develops and implements a modified action plan when testing results are not in compliance with guidelines.

Specific Criteria
The practitioner:

1. Performs the repeat analysis test at least once per quarter and reviews the results to evaluate quality and to identify variance from accepted standards.
2. Reviews the medical physicist's report and inspection reports to assess the quality of the mammography service.
3. Reviews the quality of films from each exam to measure against established guidelines in conjunction with the radiologist.

Standard Eight – Documentation
The practitioner documents quality assurance activities and results.

Rationale
Documentation provides evidence of quality assurance activities designed to enhance the safety of patients, the public and health care providers during diagnostic and therapeutic services.

General Criteria
The practitioner:

1. Maintains documentation of quality assurance activities, procedures and results in accordance with established guidelines.
2. Provides timely, concise, accurate and complete documentation.
3. Provides documentation that adheres to current protocol, policy and procedures.

Specific Criteria
The practitioner:

1. Ensures that documentation of quality control tests is readily available for the medical physicist and state and federal inspectors, according to stated guidelines and requirements.

Professional Performance Standards

Standard One – Quality
The practitioner strives to provide optimal care to all patients.

Rationale
All patients expect and deserve optimal care during diagnosis and treatment.

General Criteria
The practitioner:
1. Works with others to elevate the quality of care.
2. Participates in quality assurance programs.
3. Adheres to the accepted standards, policies and procedures adopted by the profession and regulated by law.
4. Provides the best possible diagnostic study for each patient by applying professional judgment and discretion.
5. Anticipates and responds to the needs of the patient.

Specific Criteria
None added.

Standard Two – Self-Assessment
The practitioner evaluates personal performance, knowledge and skills.

Rationale
Self-assessment is an important tool in professional growth and development.

General Criteria
The practitioner:
1. Monitors personal work ethics, behaviors and attitudes.
2. Monitors and evaluates orientation guidelines and recommends improvements or changes as needed.
3. Evaluates performance and recognizes opportunities for improvement.
4. Recognizes his or her strengths and uses them to benefit patients, coworkers and the profession.
5. Performs procedures only after receiving appropriate education and training.
6. Recognizes and takes advantage of opportunities for educational growth and improvement in technical and problem-solving skills.
7. Participates actively in professional societies and organizations.

Specific Criteria
The practitioner:
1. Recognizes the importance of understanding breast health and the need for monthly breast self-examination, mammography and clinical examination.

Standard Three – Education
The practitioner acquires and maintains current knowledge in clinical practice.

Rationale
Advancements in medical science require enhancement of knowledge and skills through education.

General Criteria
The practitioner:
1. Demonstrates completion of the appropriate education related to clinical practice.
2. Maintains appropriate credentials and certification related to clinical practice.
3. Participates in educational activities to enhance knowledge, skills and performance.
4. Shares knowledge and expertise with others.

Specific Criteria
None added.

Standard Four – Collaboration and Collegiality
The practitioner promotes a positive, collaborative practice atmosphere with other members of the health care team.

Rationale
To provide quality patient care, all members of the health care team must communicate effectively and work together efficiently.

General Criteria
The practitioner:
1. Shares knowledge and expertise with colleagues, peers, students and all members of the health care team.
2. Develops collaborative partnerships with other health care providers in the interest of diagnostic and therapeutic quality, cost effectiveness and safety.

Specific Criteria
None added.

Standard Five – Ethics
The practitioner adheres to the profession's accepted Code of Ethics.

Rationale
All decisions and actions made on behalf of the patient are based on a sound ethical foundation.

General Criteria
The practitioner:
1. Provides health care services with respect for the patient's dignity and age-specific needs.

2. Acts as a patient advocate to support patients' rights.
3. Takes responsibility for professional decisions.
4. Delivers patient care and service without bias based on personal attributes, nature of the disease, sex, race, creed, religion or socioeconomic status.
5. Respects the patient's right to privacy and confidentiality.
6. Adheres to the established practice standards of the profession.

Specific Criteria
None added.

Standard Six – Exploration and Investigation
The practitioner participates in the acquisition, dissemination and advancement of the professional knowledge base.

Rationale
Scholarly activities such as research, scientific investigation, presentation and publication advance the profession and thereby improve the quality and efficiency of patient services.

General Criteria
The practitioner:
1. Reads and critically evaluates research in diagnostic and therapeutic services.
2. Investigates new, innovative methods and applies them in practice.
3. Shares information with colleagues through publication, presentation and collaboration.
4. Pursues lifelong learning.
5. Participates in data collection.

Specific Criteria
None added.

Glossary

Artifacts – False features in the image produced by patient instability or equipment deficiencies.

Competent – Trained, well-qualified; meeting requirements of mammography.

Compression – To uniformly reduce the thickness of the breast using rigid, plastic device so that the breast is more readily and uniformly penetrated by the x-ray beam.

Densitometer – An instrument that measures the degree of blackening or optical density of the film.

Dose measurements – The measure of the amount of energy deposited in tissue due to x-ray exposure.

Entrance exposure – That amount of radiation at the skin of the breast, quantitated by measuring the amount of ionization in air caused by the radiation.

Estrogen replacement therapy – A regular program of estrogen to replace the natural estrogen that wanes at menopause.

Exposure factor – Technical factors in the design of the mammography machine that affect production of the mammographic image. The goal is to produce consistent, high-contrast diagnostic images.

FDA inspector – A person certified by the U.S. Food and Drug Administration to inspect assigned mammography facilities to assure that the mammography services provided to the community are safe and effective.

Federal Register – United States government document containing requirements for mammography facilities, accrediting bodies, quality standards and certification requirements.

Focal spot size – A test performed to evaluate the focal spot performance on the mammographic machine by measuring the focal spot dimensions.

Half-value layer – The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the exposure rate by one-half. HVL is a measure of beam quality and usually is specified by millimeters of aluminum for diagnostic units. The higher the HVL, the more penetrating the x-ray beam.

Image receptor – The film-screen combination is the standard image receptor used in mammography.

KVp accuracy and reproducibility – Test used to ensure that the indicated peak x-ray beam energy is accurate and reproducible so that consistent x-ray output and contrast are maintained.

Low-dose mammography – The recording of breast tissue on a radiographic image with the least amount of radiation possible for the purpose of detecting any abnormalities.

Medical physicist – A trained specialist who conducts a number of mammography-related tests, at least annually, intended to assess the continuing performance of mammography equipment.

Phantom – A test object that simulates the average composition of various structures within the breast.

Positioning – The art and skill of the mammographer to adequately demonstrate the entire breast in at least two differing projections, known as the craniocaudal and mediolateral projections.

Processor – An automated device that transports film at a constant speed by a system of rollers through development fixing, washing and drying cycles.

Projection – Demonstration of breast tissue from a specific angle depending on what area of the breast needs to be seen.

Radiation therapy – A series of high-dose radiation treatments applied to a specific area of the body to destroy malignant cells.

Radiopaque marker – A permanent identification label to indicate right or left laterality and projection. This marker is placed on the top of the cassette holder near the axillary portion of the breast.

"Repeat analysis" test – A system for determining the causes of repeat radiographs.

Sensitometer – A device used to reproducibly expose film to a number of known different levels of light.

Technique – Technical factors in the design of the mammography machine that affect production of the mammographic image. The goal is to produce consistent, high-contrast diagnostic images.

Reference Resources

1996 Accreditation Manual for Hospitals. Oakbrook Terrace, Ill: Joint Commission on Accreditation of Healthcare Organizations*; 1996.*
ISBN 0-86688-444-0

Andolina VF, Lille SL, Willison K. *Mammographic Imaging: A Practical Guide*. Philadelphia, Pa: Lippincott-Raven Publishers; 1992.
ISBN 0-397-51096-9

Ballinger PA. *Merrill's Atlas of Radiographic Positions and Radiologic Procedures.* 8th ed. St. Louis, Mo: Mosby-Year Book Inc; 1995.
ISBN 0-8016-7935-4

Barnes F. *Screen Film Mammography*. Madison, Wis: Medical Physics Publishing; 1991.
ISBN 0-944838-12-X

Bassett LW, Jahanshahi R, Gold RH, Fu. *Film-Screen Mammography: An Atlas of Instructional Cases.* New York, NY: Raven Press; 1991.
ISBN 0-88167-756-5

Bontrager KL. *Textbook of Radiographic Positioning and Related Anatomy.* 4th ed. St. Louis, Mo: Mosby-Year Book Inc; 1997.
ISBN 0-8151-09474

Cardenosa G. *Breast Imaging Companion*. Philadelphia, Pa: Lippincott-Raven Publishers; 1997.
ISBN 0-397-51778-5

Carlton RR, Adler AM. *Principles of Radiographic Imaging*. 2nd ed. Albany, NY: Delmar Publishers; 1996.
ISBN 0-8273-6864-X

Cowdrey M, Drew M. *Basic Law for the Allied Health Professions.* 2nd ed. Boston, Mass: Jones and Bartlett Publishers; 1995.
ISBN 0-867207108

DeParedes ES. *Atlas of Film-Screen Mammography.* 2nd ed. Baltimore, Md: Williams & Wilkins; 1992.
ISBN 0-683-06758-3

Diagnostic X-ray Imaging Committee Task Group #7. *Equipment Requirements and Quality Control for Mammography*. College Park, Md: American Association of Physicists in Medicine; 1990. AAPM, Report #29

Friedrich M, Sickles EA. *Radiological Diagnosis of Breast Diseases*. New York, NY: Springer-Verlag; 1997.
ISBN 30-540-58863-9

Gamagami P. *Atlas of Mammography: New Early Signs in Breast Cancer*. Cambridge, Mass: Blackwell Science; 1996.
ISBN 0865424810

Gorezyca DP, Brenner RJ. *The Augmented Breast: Radiologic and Clinical Perspectives*. New York, NY: Thieme; 1997.
ISBN 0-865-77612-1

Gurley LT, Callaway WJ, eds. *Introduction to Radiologic Technology*. 3rd ed. St. Louis, Mo: CV Mosby; 1992.
ISBN 0-8151-3984-5

Heywang-Kobrunner SH, Schreer I, Dershaw DD. *Diagnostic Breast Imaging*. New York, NY: Thieme; 1997.
ISBN 0-86577-636-9

Hindle WH. *Breast Disease for Gynecologists*. Norwalk, Conn: Appleton and Lange; 1990.
ISBN 083850826X

Homer M. *Mammographic Interpretation: A Practical Approach.* 2nd ed. New York, NY: McGraw-Hill Inc; 1996.
ISBN 0-007-029720-7

Kimme-Smith C, Bassett LW, Gold RH. *Workbook for Quality Mammography*. Baltimore, Md: Williams & Wilkins; 1996.
ISBN 0-638-04612-8

Kopans DB. *Breast Imaging*. 2nd ed. Philadelphia, Pa: JB Lippincott Co; 1997.
ISBN 0-097-51302-X

LeFave L. *Mammography Pre-Test, Self-Assessment and Review*. New York, NY: McGraw-Hill Inc.
ISBN 0-07-0-52017-8

Mammography facilities: requirements for accrediting bodies and quality standards and certification requirements; interim rules no. 93N-0351. *The Breast Cancer Digest.* 2nd ed. Washington, DC: U.S. Department of Health and Human Services National Institute of Health. Publication #84-1691.

Mammography Quality Standards Act: Final rules (21 CFR Part 900). *Federal Register.* November 10, 1997.

McKinney WE. *Radiographic Processing and Quality Control*. Philadelphia, Pa: JB Lippincott Co; 1988.
ISBN 0-397-50902-2

Myers C. *Mammography Quality Control: The Why and How Book*. Madison, Wis: Medical Physics Publishing.

Obergfell A. *Law and Ethics in Diagnostic Imaging and Therapeutic Radiology*. Philadelphia, Pa: WB Saunders; 1995.
ISBN 0-7216-5062-7

Parker SH, William EJ. *Percutaneous Breast Biopsy*. Philadelphia, Pa: Raven Press; 1993.
ISBN 0-7817-0010-8

Peters ME, Voeseli D, Scanlan K. *Breast Imaging*. New York, NY: Churchill Livingstone; 1989.
ISBN 0-443-08620-6

Philpot-Scroggins, Carlton, McLaughlin, Miller. *Mammographic Exam Review*. Philadelphia, Pa: Lippincott-Raven Publishers; 1996.
ISBN 0-397-55019-7

Prue LK. *Atlas of Mammographic Positioning*. Philadelphia, Pa: WB Saunders; 1994.
ISBN 0-7216-3683-7

Richard, Farris, Wilson, Blackett. *Positioning and Quality Control: Mammography Today for Radiographers*. 1992.
ISBN 0-646-08728-2

Rubin F. *Mammography: The Requisites*. St. Louis, Mo: Mosby-Year Book Inc; 1997.
ISBN 0-8151-7481-0

Rubin E, Simpson J. *Breast Specimen Radiography: Needle Localization and Radiographic Pathologic Correlation*. Philadelphia, Pa: Lippincott-Raven Publishers; 1998.
ISBN 0-397-51667-3

Staging Cards. Atlanta, Ga: American Cancer Society; 1998. No. 3485.01

Wentz G, Parsons W. *Mammography for Radiologic Technologists*. 2nd ed. New York, NY: McGraw-Hill Inc; 1997.
ISBN 0-07-105845-1

Wilson B. *Ethics and Basic Law for Medical Imaging Professionals.* Philadelphia, Pa: FA Davis; 1997.
ISBN 0-8036-0152

Publishers

American Society of Radiologic Technologists
15000 Central Ave. SE
Albuquerque, NM 87123-3917
800-444-2778
www.asrt.org

Appleton and Lange
Box 120041
Stamford, CT 06912-0041
800-423-1359
www.appletonlang.com

Blackwell Science Inc.
Commerce Place
350 Main Street
Malden, MA 02148
617-388-8250
617-388-8255
www.blacksci.co.uk

Charles C Thomas Publishers
2600 South First Street
Springfield, IL 62794-9265
217-789-8980
www.ccthomas.com

CRC Press LLC
2000 Corporate Blvd NW
Boca Raton, FL 33131
800-374-3401
www.crcpress.com

Churchill Livingstone Inc.
650 Avenue of the Americas
New York, NY 10011
800-553-05426
www.churchillmed.com

Delmar Publishers
3 Columbia Circle
Albany, NY 12203
800-998-7498
www.delmar.com

Elsevier Science
Regional Sales Office
Customer Support Dept.
P. O. Box 945
New York, NY 10159-0945
888-437-4636
www.elsevier.nl

F. A. Davis
1915 Arch Street
Philadelphia, PA 19103
800-323-3555
www.fadavis.com

John Wiley & Sons, Inc.
605 Third Avenue
New York, NY 10158
800-225-5945
www.wiley.com

Jones and Bartlett Publishers
40 Tall Pine Drive
Sudbury, MA 01776
978-443-5000
978-443-8000 (fax)
www.jbpub.com

Lippincott Williams & Wilkins
227 East Washington Square
Philadelphia, PA 19106
800-638-3030
www.lww.com

Little, Brown and Company
1271 Avenue of the Americas
New York, NY 10020
littlebrown.com

McGraw-Hill Inc.
Health Professions Division
1221 Avenue of the Americas, 28th Floor
New York, NY 10020
800-221-2956
www.mcgraw-hill.com

Medical Physics Publishing
4513 Vernon Blvd.
Madison, WI 53705-4964
800-442-5778
www.medicalphysics.org

Mosby-Year Book Inc.
11830 Westline Industrial Drive
St. Louis, MO 63146
800-325-4177
www.mosby.com

Springer-Verlag New York Inc.
175 Fifth Avenue
New York, NY 10010
800-777-4643
www.springer-ny.com

Thieme
333 Seventh Avenue
New York, NY 10001
800-782-3488
www.thieme.com

W. B. Saunders Company
The Curtis Center
Independence Square West
Philadelphia, PA 19106-3399
800-782-4479
www.wbsaunders.com

Wiley-Liss, John Wiley & Sons, Inc.
605 Third Avenue
New York, NY 10158-0012
808-225-5945
www.wiley.com