Bone Densitometry

The purpose of continuing qualifications requirements (CQR) is to assist registered technologists in documenting their continued qualifications in the disciplines of certification and registration held. To accomplish this purpose the continuing qualifications requirements are presented in three parts: the professional profile, the structured self assessment (SSA) and continuing education (CE).

The purpose of the CQR SSA is to assist registered technologists identify gaps in the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required for practice within the disciplines of certification and registration held and help direct their professional development efforts.

The *Structured Self Assessment Content Specifications for Bone Densitometry* is provided to assist bone densitometrists during their CQR compliance period. Its purpose is to prepare bone densitometrists for the SSA and to help education providers develop coursework for the bone densitometrists who need to address specified areas with targeted continuing education. Targeted CE is assigned only if a standard is not met in a category on the SSA.

The SSA is composed of sets of questions that are designed to evaluate an individual's knowledge in topics related to current practice. Participants have a maximum of 30 minutes to complete the SSA. Please allow an additional 8 minutes for the tutorial, two minutes for the non-disclosure agreement (NDA), and 10 minutes for a follow-up survey.

The table below presents the major categories and subcategories covered on the SSA. The number of questions in each category are listed in bold and number of questions in each subcategory in parentheses. The potential number of targeted CE credits that would be prescribed if the standard is not met, are across from each subcategory, with the maximum amount listed at the bottom. Specific topics within each category are addressed in the content outline, which makes up the remaining pages of this document.

Content Category	Number of Questions	Potential CE Credits
Patient Care	**10**	
Patient Bone Health, Care, and Radiation Principles (10)		3
Image Production	**10**	
Equipment Operation and Quality Control (10)		4
Procedures	**10**	
DXA Scanning (10)		7
	Total 30	**Maximum CE 14**

Patient Care

1. Patient Bone Health, Care, and Radiation Principles

A. Osteoporosis
   1. definitions and types
      a. definition according to World Health Organization (WHO)
      b. primary
      c. secondary
   2. bone physiology
      a. functions of bone
      b. structural anatomy
      c. types of bone
         1. cortical bone
         2. trabecular bone
      d. cellular structure
         1. osteoclasts
         2. osteoblasts
      e. bone remodeling
         1. remodeling cycle
         2. factors affecting remodeling (*e.g., age, hormones, pathology)
   3. risk factors
      a. genetic
      b. endocrine
      c. nutritional
      d. lifestyle
      e. medications (e.g., steroids, thyroid, hormones, anticoagulants)
   4. Bone Mass Measurement Act (CMS billing and coding)
      a. clinical indications
      b. guidelines
   5. prevention and treatment
      a. lifestyle factors
         1. nutrition
         2. exercise
         3. smoking cessation
      b. fall prevention
      c. drug therapies
         1. antiresorptive
         2. formation
         3. hormonal and others

B. Patient Preparation and Safety
   1. patient preparation
      a. special needs
         1. fall prevention and mobility assistance
         2. mental impairment or disorientation
      b. technologist ergonomics
         1. alignment, movement
         2. patient transfer techniques
      c. patient instructions
         1. explanation of procedure
         2. number and duration of scans
         3. motion and breathing requirements
      d. patient history relevant to scan
         1. medical history (e.g., bone disorder, prosthesis, peak height)
         2. current height and weight
         3. laboratory tests (e.g., biochemical markers)
         4. contraindications (e.g., recent contrast agents, radiopharmaceuticals, calcium supplements)
         5. possible pregnancy
      e. scan preparation
         1. entry of patient data
         2. removal of artifact-producing clothing and jewelry
      f. infection control (e.g., disinfect work area and equipment)
   2. radiation safety
      a. basic principles
         1. ALARA
         2. workstation – scanner distance
      b. levels of radiation in DXA
         1. entrance dose (mSv)
         2. dose equivalent (mSv)
         3. relationship to other types of imaging studies

* The abbreviation "e.g.," is used to indicate that examples are listed in parenthesis, but that it is not a complete list of all possibilities.

Image Production

1. Equipment Operation and Quality Control

- A. Dual Photon Energies
  1. typical energy levels
  2. advantages and limitations
- B. DXA Components
  1. x-ray production
     - a. k-edge filtration
     - b. energy switching
  2. radiation detector system
- C. Fan Beam
  1. mechanics of fan beam
     - a. beam collimation
     - b. detector system
     - c. scan arm motion
  2. geometry of fan beam
     - a. source-object-detector distances
     - b. magnification and distortion
     - c. object centering
     - d. estimated BMC and area
- D. Scan Analysis Algorithm
  1. computation of soft tissue density
  2. bone edge detection
  3. definition and calculation of BMC, area, and BMD
- E. Measuring BMD
  1. basic statistical concepts
     - a. mean
     - b. standard deviation
     - c. coefficient of variation
  2. standard scores
     - a. Z-scores
     - b. T-scores
  3. WHO Diagnostic Criteria
  4. FRAX® (WHO Fracture Risk Assessment Tool)
  5. Vertebral Fracture Assessment (VFA)
  6. pediatric/adolescent scanning
- F. Factors Affecting Accuracy and Precision
  1. quality of bone density measurements
     - a. precision
     - b. sources of precision error
     - c. accuracy
  2. equipment characteristics
     - a. scanner speed/mode
     - b. scanner calibration/stability
  3. operator and patient characteristics
     - a. positioning
     - b. geometry (e.g., centering, ROI size)
     - c. body habitus, variant anatomy
     - d. pathology
     - e. in vivo precision studies
  4. follow-up scanning
     - a. reproduce baseline study (acquisition parameters, positioning, ROI placement)
     - b. changes affecting scan validity
- G. Equipment QC
  1. purposes of quality control
     - a. scanner function and calibration
     - b. timely repairs and recalibration
     - c. shift/drift
  2. types of QC
     - a. internal versus external calibration
     - b. baseline versus longitudinal phantom
  3. types of phantoms
     - a. aluminum
     - b. anthropomorphic
  4. analysis of QC results
     - a. pass/fail criteria
     - b. need for repeat QC tests
     - c. need for service
- H. Maintenance, Repair, and Upgrade
  1. relocation
     - a. recalibration
     - b. reestablish baseline data
  2. equipment safety
     - a. electrical
     - b. emergency stop button
  3. cross-calibration
     - a. equipment replacement
     - b. change in manufacturer
  4. software errors and upgrades
- I. File and Database Management
  1. storage and retrieval of data
  2. back-up and archiving

Procedures

1. DXA Scanning

A. Lumbar Spine
  1. anatomy related to scanning
     a. vertebral anatomy
     b. regions of interest in DXA
     c. bony landmarks
     d. radiographic appearance
     e. significant adjacent structures (e.g., pelvis, ribs, T12)
  2. scan acquisition
     a. scan parameters
        1. standard technique
        2. compensation for variation in anatomy, body habitus, pathology, or low bone density
     b. patient positioning
        1. positioning aids (e.g., leg block)
        2. common challenges (e.g., scoliosis)
  3. problems related to positioning, ROI placement, and analysis
     a. types of problems
        1. poor bone edge detection
        2. intervertebral spaces obscured
        3. nonremovable artifacts
        4. inaccurate BMC or BMD values
     b. potential causes
        1. variant anatomy
        2. fractures
        3. pathological processes (e.g., scoliosis, arthritis, osteophytes)
        4. aortic and other calcifications
        5. surgery (e.g., biomechanical devices, laminectomy, fusion)
  4. lumbar spine analysis
     a. ROI placement
     b. reported values (e.g., BMC, T-score, percent of mean)
     c. vertebral exclusions
     d. graphical displays

B. Proximal Femur
  1. anatomy related to scanning
     a. femoral neck anatomy
     b. regions of interest in DXA
     c. bony landmarks
     d. radiographic appearance
     e. significant adjacent structures (e.g., pelvis)
  2. scan acquisition
     a. femur selection (right versus left, or dual)
     b. scan parameters
        1. standard technique
        2. compensation for variation in anatomy, body habitus, pathology, or low bone density
     c. patient positioning
        1. femoral neck rotation
        2. femoral shaft placement
        3. positioning aids
        4. common challenges (e.g., arthritis)
  3. problems related to positioning, ROI placement, and analysis
     a. types of problems
        1. poor bone edge detection
        2. nonremovable artifacts
        3. ischium underlying neck
        4. inaccurate BMC or BMD values
     b. potential causes
        1. variant anatomy (e.g., short femoral neck, inadequate space between ischium and femur)
        2. fractures
        3. pathological processes (e.g., arthritis, joint disease)
        4. surgery (e.g., biomechanical devices)
  4. scan analysis
     a. ROI placement
     b. reported values (e.g., BMC, T-score, percent of mean)
     c. graphical displays

(Procedures continues on the following page.)

Procedures (continued)

C. Forearm
1. anatomy related to scanning
    a. forearm anatomy
    b. regions of interest in DXA
    c. bony landmarks
    d. radiographic appearance
    e. significant adjacent structures (e.g., carpal bones, soft tissue)
2. scan acquisition
    a. selection (right versus left)
    b. forearm length
    c. scan parameters
        1. standard technique
        2. compensation for variations in anatomy, body habitus, pathology, or low bone density
    d. patient positioning
        1. radius – ulna orientation
        2. positioning aids
        3. common challenges (e.g., kyphosis, contracture)
3. problems related to positioning, ROI placement, and analysis
    a. types of problems
        1. poor bone edge detection
        2. nonremovable artifacts
        3. inaccurate BMC or BMD values
    b. potential causes
        1. low bone density
        2. pathological processes (e.g., arthritis, joint disease)
4. scan analysis
    a. ROI placement
    b. reported values (e.g., BMC, T-score, percent of mean)
    c. graphical displays