



The Bone Densitometry Examination

The purpose of The American Registry of Radiologic Technologist® (ARRT®) Bone Densitometry Examination is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of the technologists who perform bone densitometry. Using a nationwide survey, the ARRT periodically conducts a practice analysis to develop a task inventory which delineates or lists the job responsibilities typically required of staff bone densitometry technologists.¹ An advisory committee then determines the knowledge and cognitive skills needed to perform the tasks on the task inventory and these are organized into the content categories within this document. The document is used to develop the examination. The results of the most recent practice analysis have been applied to this document. Every content category can be linked to one or more activities on the task inventory. The complete [task inventory](#) is available at arrt.org.

The following table presents the major content categories covered on the examination, and indicates the number of test questions in each category. The remaining pages list the specific topics addressed within each category, with the approximate number of test questions allocated to each topic appearing in parentheses.

This document is not intended to serve as a curriculum guide. Although certification and registration programs and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address the subject matter that is included in these content specifications, but do not limit themselves to only this content.

Content Category	Number of Scored Questions ²
A. Patient Factors and Instrumentation	37
B. DXA Procedures	
1. DXA Scanning of Lumbar Spine	15
2. DXA Scanning of Proximal Femur	15
3. DXA Scanning of Forearm	8
Total	75

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. Each exam includes an additional 30 unscored (pilot) questions.



A. Patient Factors and Instrumentation (37)

I. Patient Bone Health, Care, and Radiation Principles (20)

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. evaluation and diagnosis
 - a. basic statistical concepts
 1. mean
 2. standard deviation
 3. coefficient of variation
 - b. standard scores
 1. Z-scores
 2. T-scores

- c. WHO Diagnostic Criteria
 - d. FRAX® (WHO Fracture Risk Assessment Tool)
 - e. Vertebral Fracture Assessment (VFA)
 - f. pediatric/adolescent scanning
 - g. laboratory tests (e.g., biochemical markers)
6. 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. patient instructions
 1. explanation of procedure
 2. number and duration of scans
 3. motion and breathing requirements
 - c. patient history relevant to scan
 1. medical history (e.g., bone disorder, prosthesis)
 2. recent contrast agents or radiopharmaceuticals
 3. possible pregnancy
 - d. scan preparation
 1. entry of patient data
 2. removal of artifact-producing clothing
 - e. documentation of unusual positioning, acquisition, or analysis
 1. anatomy, pathology, body habitus
 2. nonremovable artifacts

*e.g., This is used here and in the remainder of this document to indicate examples of the topics covered, but not a complete list.

(Section A continues on the following page.)



A. Patient Factors and Instrumentation (continued)

2. radiation safety
 - a. basic principles
 1. ALARA
 2. workstation – scanner distance
 - b. levels of radiation in DXA
 1. entrance dose (mrem)
 2. effective dose (mrem)
 3. relationship to other types of imaging studies
- ### 2. Equipment Operation and Quality Control (17)
- 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. Pencil Beam Versus Fan Beam
 1. mechanics of pencil beam
 - a. beam collimation
 - b. detector system
 - c. scan arm motion
 2. mechanics of fan beam
 - a. beam collimation
 - b. detector system
 - c. scan arm motion
 3. 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. 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. current
 - c. 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. update baseline biography (patient height, weight, operator identification)
 - b. reproduce baseline study (acquisition parameters, positioning, ROI placement)
 - c. changes affecting scan validity
 - F. 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

(Section A continues on the following page.)



A. Patient Factors and Instrumentation (continued)

4. analysis of QC results
 - a. pass/fail criteria
 - b. need for repeat QC tests
 - c. need for service
- G. 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
- H. File and Database Management
 1. storage and retrieval of data
 2. back-up and archiving

B. DXA Procedures (38)

I. DXA Scanning of Lumbar Spine (15)

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

2. DXA Scanning of Proximal Femur (15)

- A. Anatomy Related to Scanning
 1. femoral neck anatomy
 2. regions of interest in DXA
 3. bony landmarks
 4. radiographic appearance
 5. significant adjacent structures (e.g. pelvis)
- B. Scan Acquisition
 1. femur selection (right versus left, or dual)
 2. scan parameters
 - a. standard technique
 - b. compensation for variation in anatomy, body habitus, pathology, or low bone density
 3. patient positioning
 - a. femoral neck rotation
 - b. femoral shaft placement
 - c. positioning aids
 - d. common challenges (e.g., arthritis)
- C. Scan Analysis and Printout
 1. ROI placement
 2. reported values (e.g., BMC, T-score, percent of mean)
 3. graphical displays

(Section B continues on the following page.)



B. DXA Procedures (continued)

- D. Problems Related to Positioning, ROI Placement and Analysis
 - 1. types of problems
 - a. poor bone edge detection
 - b. nonremovable artifacts
 - c. ischium underlying neck
 - d. inaccurate BMC or BMD values
 - 2. potential causes
 - a. variant anatomy (e.g., short femoral neck, inadequate space between ischium and femur)
 - b. fractures
 - c. pathological processes (e.g., arthritis, joint disease)
 - d. surgery (e.g., biomechanical devices)
- 3. DXA Scanning of Forearm (8)**
 - A. Anatomy Related to Scanning
 - 1. forearm anatomy
 - 2. regions of interest in DXA
 - 3. bony landmarks
 - 4. radiographic appearance
 - 5. significant adjacent structures (e.g., carpal bones, soft tissue)
 - B. Scan Acquisition
 - 1. selection (right versus left)
 - 2. scan parameters
 - a. standard technique
 - b. compensation for variations in anatomy, body habitus, pathology, or low bone density
 - 3. patient positioning
 - a. radius – ulna orientation
 - b. positioning aids
 - c. common challenges (e.g., kyphosis)
 - C. Scan Analysis and Printout
 - 1. ROI placement
 - 2. reported values (e.g., BMC, T-score percent of mean)
 - 3. graphical displays
 - D. Problems Related to Positioning, ROI Placement and Analysis
 - 1. types of problems
 - a. poor bone edge detection
 - b. nonremovable artifacts
 - c. inaccurate BMC or BMD values
 - 2. potential causes
 - a. low bone density
 - b. pathological processes (e.g., arthritis, joint disease)