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# CONTENT SPECIFICATIONS FOR THE BONE DENSITOMETRY EQUIPMENT OPERATORS EXAMINATION



*Content Specifications Effective with the January 2003 Examination*

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The Bone Densitometry Equipment Operator Examination is made available to state licensing agencies to assess the knowledge and cognitive skills required to perform DXA scans of central and peripheral anatomical sites. These content specifications were derived from the ARRT Job Analysis Project for Bone Densitometry. The ARRT administers the examination to state approved candidates under contractual arrangement and provides the results directly to the state. This examination is not associated with any type of certification by the ARRT.

The major sections of the examination are outlined below. Subsequent pages describe in detail the topics covered within each major section.

<b>Section</b>	<b>Number of Questions</b>
A. Basic Concepts	12
B. Equipment Operation & QC	9
C. Radiation Safety	9
D. DXA Scanning of Finger	4
E. DXA Scanning of Heel (Os Calcis)	4
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G. DXA Scanning of Lumbar Spine	8
H. DXA Scanning of Proximal Femur	<u>8</u>
	60*

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\* An additional 20% of the test may be pilot questions.

## A. BASIC CONCEPTS (12)

### 1. Osteoporosis

- a. World Health Organization (WHO) Definition and Diagnostic Criteria
- b. Primary vs. Secondary
- c. Type I (postmenopausal) vs. Type II (senile)
- d. Risk Factors
  - 1) controllable (smoking, calcium intake, estrogen, medications)
  - 2) uncontrollable (heredity, race, gender, age, medical conditions)

### 2. Bone Physiology

- a. Functions of Bone
  - 1) structural support & protection
  - 2) storage of essential minerals
- b. Types of Bone
  - 1) cortical bone
  - 2) trabecular bone
- c. Bone Remodeling Cycle
  - 1) resorption/formation
  - 2) osteoblasts/osteoclasts
- d. Bone Health
  - 1) nutrition
  - 2) exercise

### 3. BMD Testing Methods (anatomical sites scanned; key advantages and disadvantages)

- a. Dual-Energy X-ray Absorptiometry (DXA)
- b. Single X-ray Absorptiometry (SXA)
- c. Quantitative Ultrasound (QUS)
- d. Radiographic Absorptiometry (RA)

### 4. Measuring BMD

- a. Basic Statistical Concepts
  - 1) mean
  - 2) standard deviation
  - 3) coefficient of variation
- b. Reporting Patient Results
  - 1) BMD formula
  - 2) Z-score
  - 3) T-score

## B. EQUIPMENT OPERATION & QC (9)

### 1. Computer Console

- a. Major Components
- b. File Management

### 2. Fundamentals of X-ray Production

- a. Properties of X-ray Beam
  - 1) quality (kVp)
  - 2) quantity (mA)
  - 3) duration/time (S)
- b. Filters and Collimators
- c. X-ray Energy Production
  - 1) single
  - 2) dual

### 3. Types of DXA Systems

- a. Pencil Beam Systems
- b. Fan Beam Systems
- c. Cone Beam Systems

### 4. Quality Control

- a. Equipment Safety (electrical, pinch points, emergency stop)
- b. Use of Phantoms and/or Calibration
- c. Troubleshooting
  - 1) shift or drift
  - 2) pass/fail
- d. Record Maintenance

### 5. Determining Quality in BMD

- a. Precision (definition)
- b. Accuracy (definition)
- c. Factors Affecting Accuracy and Precision
  - 1) scanner
  - 2) operator
  - 3) patient

## C. RADIATION SAFETY (9)

### 1. Fundamental Principles

- a. ALARA
- b. Basic Methods of Protection
  - 1) time
  - 2) distance
  - 3) shielding

### 2. Biological Effects of Radiation

- a. Long-Term Effects
  - 1) cancer
  - 2) cataracts
  - 3) life-shortening
- b. Radiosensitive Tissues/Organs

### 3. Units of Measurement

- a. Absorbed Dose
  - 1) Rad
  - 2) Gray (Gy, mGy,  $\mu$ Gy)
- b. Exposure (dose equivalent)
  - 1) rem, mrem
  - 2) Sievert (Sv, mSv,  $\mu$ Sv)

### 4. Radiation Protection in BD

- a. General Protection Issues
  - 1) radiation signs posted
  - 2) door closed
  - 3) only patient and operator in room
- b. Occupational Protection
  - 1) scanner-operator distance
  - 2) personnel monitoring
  - 3) exposure records
- c. Patient Protection
  - 1) comparison levels of radiation
    - a. peripheral DXA
    - b. central DXA
    - c. natural background radiation
    - d. airline flight
    - e. chest x-ray
  - 2) strategies to minimize patient exposure
    - a. patient instructions
    - b. correct exam performance

## D. DXA SCANNING OF FINGER (4)

### 1. Anatomy

- a. Regions of Interest
- b. Bony Landmarks
- c. Radiographic Appearance
- d. Adjacent Structures

### 2. Scan Acquisition

- a. Patient Instructions
- b. Patient Positioning
- c. Evaluating Pre-Set Scan Parameters

### 3. Scan Analysis

- a. BMD
- b. T-score, Z-score

### 4. Common Problems

- a. Nonremovable Artifacts
- b. Fractures or Pathology

## E. DXA SCANNING OF HEEL (OS CALCIS) (4)

### 1. Anatomy

- a. Regions of Interest
- b. Bony Landmarks
- c. Radiographic Appearance
- d. Adjacent Structures

### 2. Scan Acquisition

- a. Patient Instructions
- b. Patient Positioning
- c. Evaluating Pre-Set Scan Parameters

### 3. Scan Analysis

- a. BMD
- b. T-score, Z-score

### 4. Common Problems

- a. Nonremovable Artifacts
- b. Fractures or Pathology

## F. DXA SCANNING OF FOREARM (6)

### 1. Anatomy

- a. Regions of Interest
- b. Bony Landmarks
- c. Radiographic Appearance
- d. Adjacent Structures

### 2. Scan Acquisition

- a. Patient Instructions
- b. Patient Positioning
- c. Evaluating Pre-Set Scan Parameters

### 3. Scan Analysis

- a. Accurate ROI Placement
- b. BMC, Area, and BMD
- c. T-score, Z-score

### 4. Common Problems

- a. Poor Bone Edge Detection
- b. Nonremovable Artifacts
- c. Variant Anatomy
- d. Fractures or Pathology

### 5. Follow-Up Scans

- a. Unit of Comparison
  - 1) BMD
  - 2) T-score
- b. Reproduce Baseline Study

## G. DXA SCANNING OF LUMBAR SPINE (8)

### 1. Anatomy

- a. Regions of Interest
- b. Bony Landmarks
- c. Radiographic Appearance
- d. Adjacent Structures

### 2. Scan Acquisition

- a. Patient Instructions
- b. Patient Positioning
- c. Evaluating Pre-Set Scan Parameters

### 3. Scan Analysis and Printout

- a. Accurate ROI Placement
- b. BMC, Area, and BMD
- c. T-score, Z-score

### 4. Common Problems

- a. Poor Bone Edge Detection
- b. Nonremovable Artifacts
- c. Variant Anatomy
- d. Fractures or Pathology

### 5. Follow-Up Scans

- a. Unit of Comparison
  - 1) BMD
  - 2) T-score
- b. Reproduce Baseline Study

## H. DXA SCANNING OF PROXIMAL FEMUR (8)

### 1. Anatomy

- a. Regions of Interest
- b. Bony Landmarks
- c. Radiographic Appearance
- d. Adjacent Structures

### 2. Scan Acquisition

- a. Patient Instructions
- b. Patient Positioning
- c. Evaluating Pre-Set Scan Parameters

### 3. Scan Analysis and Printout

- a. Accurate ROI Placement
- b. BMC, Area, and BMD
- c. T-score, Z-score

### 4. Common Problems

- a. Poor Bone Edge Detection
- b. Nonremovable Artifacts
- c. Variant Anatomy
- d. Fractures or Pathology

### 5. Follow-Up Scans

- a. Unit of Comparison
  - 1) BMD
  - 2) T-score
- b. Reproduce Baseline Study