



Bone Densitometry Equipment Operator

The purpose of the ~~B~~bone ~~D~~densitometry ~~E~~equipment ~~O~~operator ~~E~~examination, which is developed and administered by The American Registry of Radiologic Technologists (ARRT) on behalf of ~~made available to~~ state licensing agencies, is to assess the knowledge and cognitive skills underlying the intelligent performance of the tasks typically required of operators of bone densitometry equipment ~~at entry into the profession~~. The ARRT administers the examination to state approved candidates under contractual arrangement with the state and provides the results directly to the state. This examination is not associated with any type of certification and registration by the ARRT.

The knowledge and skills covered by the examination were determined by administering a comprehensive practice analysis survey to a nationwide sample of bone ~~density equipment operators~~ densitometrists and adopting a list of tasks for bone densitometry equipment operators as the task inventory. The task inventory appears in Attachment A of this document.¹ ~~The results of the practice analysis are reflected in this document.¹ The Task Inventory for Bone Densitometry Equipment Operator appears in Attachment A of this document.~~ The content specifications identify the knowledge areas underlying performance of the tasks on the bone densitometry equipment operator task inventory. ~~Task Inventory for Bone Densitometry Equipment Operator~~. Every content category can be linked to one or more activities on the task inventory.

The table below presents the major categories covered on the examination, along with the number of test questions in each category. The remaining pages of this document list the ~~s~~Specific topics addressed within each category ~~are addressed in the remaining pages of the content specifications~~.

Section	Number of Scored Questions ²
Patient Care	12
Safety	8
Image Production	15
Procedures	<u>25</u>
Total	60

¹ A special debt of gratitude is due to the hundreds of professionals participating in the project as committee members, survey respondents, and reviewers.

² The exam includes an additional ~~25~~45 unscored (pilot) questions.



Patient Care

1. Osteoporosis

- A. World Health Organization (WHO)
Definition ~~and Diagnostic Criteria~~
- B. Primary
- C. Secondary

2. Bone Physiology

- A. Functions of Bone
 - 1. structural support and protection
 - 2. storage of essential minerals

B. Structural Anatomy

CB. Types of Bone

- 1. cortical bone
- 2. trabecular bone

DC. Bone Remodeling Cycle

- 1. resorption/formation
- 2. osteoblasts/osteoclasts
- 3. factors affecting remodeling (e.g., age, hormones, pathology)

3. Bone Health and Patient Education

A. Nutrition Prevention and Treatment

- ~~B-1. Exercise~~
- 2. nutrition
- 3. smoking cessation
- 4. fall prevention

BG. Risk Factors

- 1. controllable (*e.g., ~~smoking~~, alcohol, calcium, vitamin D, hormone therapy, medications)
- 2. uncontrollable (~~genetics heredity~~, race, gender, age, medical conditions)

4. Patient Preparation

- A. Patient Instructions and Explanation of Procedure
- B. Patient History
 - 1. medical history (e.g., bone disorder, hyperparathyroidism, prosthesis, peak height)
 - 2. medications use (e.g., long term steroid use, hormone therapy, osteoporosis treatment)
 - 3. current height and weight
 - 4. contraindications (e.g., recent contrast agents, calcium supplements, pregnancy)
 - 5. possible pregnancy
 - 36. clinical indications and guidelines (Bone Mass Measurement Act)
- C. Patient Factors
 - 1. limited mobility or mental impairment
 - 2. unusual anatomy, pathology, or body habitus
 - 3. removable artifacts
 - 4. pediatric patients
- D. Operator Ergonomics
 - 1. body mechanics (e.g., balance, alignment, movement)
 - 2. patient transfer techniques
- E. Infection Control (e.g., disinfect work area and equipment)

* 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.

Safety

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
- B. Radiosensitive Tissues/Organs

3. Units of Measurement

- A. Absorbed Dose (e.g., ~~Rad/Gm~~Gray)
- B. Dose Equivalent Exposure (e.g., ~~Rem/Sm~~Sievert)

4. Radiation Protection in BD

- A. General Protection Issues
 - 1. radiation signs posted

- 2. door closed
- 3. ~~only patient and operator in room~~ limit unnecessary people 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. axial DXA
 - c. natural background radiation
 - 2. strategies to minimize patient exposure
 - a. patient instructions
 - b. correct exam performance



Image Production

1. Fundamentals of X-ray Production

- A. Properties of X-ray Beam (e.g., scatter, mass, wavelength, frequency)
 - ~~1. quality (kVp)~~
 - ~~2. quantity (mA)~~
 - ~~3. duration/time (S)~~
- ~~B. Filters and Collimators~~
- ~~BC. X-ray Energy Production~~

~~D. 2. Fan Beam DXA Systems~~

- A. Dual Photon Energies
- 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
 - 2. geometry of fan beam

23. Quality Control

- A. Equipment Safety (electrical, pinch points, emergency stop)
- B. Use of Phantoms ~~and/or Calibration~~
 - 1. frequency
 - 2. types
- C. ~~DXA~~ Calibration
 - 1. ~~in vivo precision study~~recalibration (e.g., relocation)
 - 2. cross-calibration (e.g., new scanner, software upgrade)
- D. Troubleshooting ~~and Actions~~
 - 1. shift or drift
 - 2. pass/fail criteria
 - 3. need for service
- E. Record Maintenance

43. Measuring BMD

- A. Scan Analysis Algorithm
 - 1. bone edge detection
 - 2. definition and calculation of BMC, area, and BMD
- BA. Basic Statistical Concepts
 - 1. mean
 - 2. standard deviation
 - 3. coefficient of variation
- CB. Reporting Patient Results
 - ~~1. BMD formula~~
 - ~~2. Z-score~~
 - ~~3. T-score~~
 - 3. WHO diagnostic criteria
- DC. FRAX® (WHO Fracture Risk Assessment Tool)
- ED. Vertebral Fracture Assessment (VFA)
- FE. Pediatric/Adolescent Scanning (ages 5-19)

54. Determining Quality in BMD

- A. Precision
- B. Accuracy
- C. Factors ~~Related to Affecting~~ Accuracy and Precision
 - 1. scanner (e.g., speed/mode)
 - 2. operator
 - a. in vivo precision study
 - b. positioning
 - 3. patient variables (e.g., body habitus, variant anatomy)

65. File and Database Management

- A. Storage and Retrieval of Data
- B. Back-up and Archiving



Procedures

1. DXA Scanning of Lumbar Spine

- A. Anatomy
 - 1. regions of interest
 - 2. bony landmarks
 - 3. radiographic appearance
 - 4. **significant** adjacent structures (e.g., pelvis, ribs, T12)
- B. Scan Acquisition
 - 1. patient instructions
 - 2. patient positioning
 - 3. ~~evaluating pre-set scan parameters~~ compensation for variations in anatomy, body habitus, pathology, or low bone density
- C. Common Problems and Potential Causes
 - 1. poor bone edge detection
 - 2. nonremovable artifacts
 - 3. variant anatomy
 - 4. fractures or pathology
 - 5. **aortic and other calcifications**
- D. Scan Analysis
 - 1. accurate ROI placement
 - 2. BMC, area, and BMD
 - 3. T-score, Z-score
 - 4. **graphical display**
 - 5. **exclusion of vertebrae**
- E. Follow-Up Scans
 - 1. unit of comparison
 - a. BMD
 - b. T-score
 - 2. reproduce baseline study

2. DXA Scanning of Proximal Femur

- A. Anatomy
 - 1. regions of interest
 - 2. bony landmarks
 - 3. radiographic appearance
 - 4. **significant** adjacent structures (e.g., pelvis)
- B. Scan Acquisition
 - 1. patient instructions
 - 2. **femur selection (right versus left or dual)**
 - 2. patient positioning
 - a. **femoral neck rotation**
 - b. **femoral shaft placement**
 - 3. ~~evaluating pre-set scan parameters~~ compensation for variations in anatomy, body habitus, pathology, or low bone density

- C. Common Problems and Potential Causes
 - 1. poor bone edge detection
 - 2. nonremovable artifacts
 - 3. variant anatomy (e.g., **short femoral neck, inadequate space between ischium and femur**)
 - 4. fractures or pathology
- D. Scan Analysis
 - 1. accurate ROI placement
 - 2. BMC, area, and BMD
 - 3. T-score, Z-score
 - 4. **graphical display**
- E. Follow-Up Scans
 - 1. unit of comparison
 - a. BMD
 - b. T-score
 - 2. reproduce baseline study

3. DXA Scanning of Forearm

- A. Anatomy
 - 1. regions of interest
 - 2. bony landmarks
 - 3. radiographic appearance
 - 4. **significant** adjacent structures (e.g., **carpal bones, soft tissue**)
- B. Scan Acquisition
 - 1. patient instructions
 - 2. **selection (right versus left)**
 - 3. **forearm length**
 - 4. patient positioning
 - 5. ~~evaluating pre-set scan parameters~~ compensation for variations in anatomy, body habitus, pathology, or low bone density
- C. Common Problems and Potential Causes
 - 1. poor bone edge detection
 - 2. nonremovable artifacts
 - 3. variant anatomy
 - 4. fractures or pathology
- D. Scan Analysis
 - 1. accurate ROI placement
 - 2. BMC, area, and BMD
 - 3. T-score, Z-score
 - 4. **graphical display**
- ~~E. Follow-Up Scans~~
 - ~~1. unit of comparison~~
 - ~~a. BMD~~
 - ~~b. T-score~~
 - ~~2. reproduce baseline~~