Minimum Requirements for Bone Densitometry Operators:

Part 2 of the Colorado Rules and Regulations Pertaining to Radiation Control, RH 2.6.1.8 states:

2.6.1.8 For bone densitometry equipment used in examination of living humans, “adequately trained” shall mean that the individual has met the requirements of Appendix 2F by:

1. Being an ARRT-registered radiologic technologist or equivalent for bone densitometry; or
2. Being certified in bone densitometry by a specialty board recognized by the Department, including or in combination with training accepted by the Department; or
3. Having been approved as a bone densitometry equipment operator by passing the Department-required examination.

PART 2, APPENDIX 2F: BONE DENSITOMETRY (BD)
ADEQUATE RADIATION SAFETY TRAINING AND EXPERIENCE

The registrant shall require each bone densitometry equipment operator (BDEO) to be an individual at least 18 years of age who:

2F1 Is certified or registered by:

- 2F1.1 ARRT(R), ARRT(M), ARRT(N), ARRT(T), or CNMT; or
- 2F1.2 The International Society for Clinical Densitometry (ISCD), combined with or including the didactic radiation safety training in 2F2A, 2F2B and 2F2C; or
- 2F1.3 A specialty board that has been recognized by the Department, in combination with documentation accepted by the Department for the training required by 2F2A through 2F2I; or

2F2 Is accepted by the Department as having satisfactorily completed:

- 2F2.1 At least 30 hours of didactic training recognized by the Department that provided the minimum hours of instruction (as part of, or in addition to, specialty certificate and equipment operation training) in the specific subjects listed in 2F2A through 2F2I;

RADIATION SAFETY:

2F2A Basic X-Ray Physics—2 hours

1. Structure of matter and the atom
2. General description of production of x rays
3. X-ray emission, quantity and quality
4. Function of filtration and effects it has on x-ray beam collimation
5. Types of function of beam limiting devices
6. Design, features and functions of x-ray tubes
7. Circuitry of the x-ray machine

2F2B Radiobiology—2 hours
1. Effects of ionizing radiation to the human body
2. Molecular and cellular radiobiology
3. Factors that cause somatic and genetic damage

2F2C Radiation Protection—5 hours
1. ALARA
2. Shielding materials
3. Radiation quantity and units of measurement
4. Basic interactions of x-ray with matter
5. Primary and secondary scatter
6. Importance of time, distance, shielding
7. Maximum permissible dose: occupational and public
8. Patient protection
   a. Patient instruction
   b. Comparison levels of radiation
      (1) Natural background radiation
      (2) Central DXA
      (3) Peripheral DXA

BONE DENSITOMETRY PROCEDURES
2F2D Basic Concepts—8 hours
1. Osteoporosis
   a. World Health Organization 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)
   e. Radiographic Absorptiometry (RA)
2. Bone physiology
   a. Functions of bone
      (1) Structural support and protection
      (2) Storage of essential minerals
   b. Types of bone
      (1) Cortical
      (2) Trabecular
   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)
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

**2F2E** Equipment Operation & Quality Control—6 hours
1. Computer console
   a. Major components
   b. File management
2. X-ray energy production
   a. Single
   b. 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

**2F2F** DXA Scanning of Finger and Heel (OS CALCIS)—1 hour
1. Anatomy
   a. Regions of interest
   b. Bony landmarks
   c. Radiographic appearance
2. Scan acquisition
2F2G DXA Scanning of Forearm—2 hours

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. Nonremovable artifacts
   b. Fractures or pathology

5. Follow-up scans
   a. Unit of comparison: BMD, T-score
   b. Reproduce baseline study

2F2H DXA Scanning of Lumbar Spine—2 hours

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: BMD, T score
   b. Reproduce baseline study

2F2I DXA Scanning of Proximal Femur—2 hours

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: BMD, T-score
   b. Reproduce baseline study; and

2F2.2 At least 480 hours of clinical training during which time DXA examinations are performed only under direct supervision of a Colorado qualified bone densitometry equipment operator or other qualified trainer:

2F2.2.1 “Direct supervision” means the supervisor must be present in the facility and immediately available to furnish assistance and direction throughout the performance of a procedure. The supervisor is not required to be present in the room when the procedure is performed.

2F2.2.2 A signed statement by the individual(s) who provided supervision and evaluation shall be kept on file to document dates and locations of clinical training; and

2F2.3 Performance of the following imaging procedures (at least 30 examinations in total, with record of each examination kept on file):

2F2.3.1 DXA scanning of the forearm—10 examinations
2F2.3.2 DXA scanning of the lumbar spine—10 examinations
2F2.3.3 DXA scanning of the proximal femur—10 examinations

2F3 Has maintained a minimum of eighteen (18) hours continuing education every three years, documented by certificate(s) or other attestation(s) of satisfactory completion.