

Bone Densitometry Curriculum

Sponsored by the American Society of Radiologic Technologists, 15000 Central Ave. SE, Albuquerque, NM 87123-3909.

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Core Content

The professional practice of bone densitometry requires specific knowledge and skills generally not obtained in standard radiography programs. The core content section presents curriculum elements that are considered essential for technologists in the post primary practice of bone densitometry.

Objectives

- Describe the physiology of osteoporosis and the process of bone remodeling.
- Recognize the dangers of fragility fractures in patients with osteoporosis, as well as prevention and treatment strategies.
- Explain the diagnosis of osteoporosis using dual-energy x-ray absorptiometry (DXA).
- Discuss the applications and advantages of bone densitometry scanning, as well as alternative imaging modalities for bone density evaluation.
- List the components and possible scanning geometries of DXA systems.
- Explain the scan analysis software for DXA systems, as well as sources of accuracy and precision errors.
- Describe basic quality control (QC) statistical concepts, and the purpose and importance of QC.
- Discuss the use of phantoms, QC procedures, and manufacturer-specific QC requirements.
- Recognize scanner maintenance, repair, and upgrade SOPs, as well as documentation and record keeping requirements.
- List the steps in acquiring a patient medical history, preparing a patient for DXA scanning, and the requirements for follow-up and serial scanning.
- Describe the indications, contraindications, and positioning challenges associated with:
 - scanning the PA lumbar spine, proximal femur, and forearm.
 - FRAX and pediatric scans.
 - whole-body DXA, body composition, and vertebral fracture recognition scans.
- Explain the scan acquisition and notable findings for:
 - scans of the PA lumbar spine, proximal femur, and forearm.
 - FRAX and pediatric scans.
 - whole-body DXA, body composition, and vertebral fracture recognition scans.
- Recognize the steps and challenges associated with scan analysis of:
 - scans of the PA lumbar spine, proximal femur, and forearm.
 - FRAX and pediatric scans.
 - whole-body DXA, body composition, and vertebral fracture recognition scans.

Osteoporosis and Bone Remodeling

Content

- I. Bone remodeling (e.g., osteoclasts, osteoblasts)
- II. Fragility fractures (e.g., incidence, complications)
- III. Osteoporosis prevention and treatment
 - A. Lifestyle
 - B. Drug therapies
 - C. Fall prevention

Bone Densitometry Overview

Content

- I. Osteoporosis Diagnosis via DXA
 - A. Reference populations
 - B. National Health and Nutrition Examination Survey (NHANES)
 - C. Diagnostic scoring by WHO criteria
- II. Applications
- III. Advantages
- IV. Alternative Imaging Modalities (e.g., quantitative CT [QCT], quantitative ultrasound [QUS])

Physical Principles and Instrumentation of DXA

Content

- I. Fundamental Principles
- II. DXA Components
- III. Fan Beam Systems
- IV. Scan Analysis Software
- V. Accuracy and Precision Errors
 - A. Scanner calibration
 - B. Positioning significance
 - C. Reproducibility (i.e., serial scanning, least significant change [LSC])
 - D. Scan mode

Quality Control and Improvement

Content

- I. Purpose and Importance
- II. Phantoms, Phantom Methods, and Procedures
- III. Manufacturer-Specific QC
- IV. Statistics Concepts
 - A. Average (mean)
 - B. Standard deviation (SD)
 - C. Coefficient of variation (CV)
 - D. Percent coefficient of variation (%CV)
 - E. Longitudinal QC plots
- V. Scanner Maintenance, Repair, and Upgrade
- VI. Service Documentation and Record Keeping
- VII. Standard Operating Procedures (SOPs) According to Facility Protocol (e.g., Bone Health and Osteoporosis Foundation [BHOF], International Society for Clinical Densitometry [ISCD])
- VIII. DXA Networks and Data Transfer

Scan Preparation

Content

- I. Patient History
- II. Scanning Preparation
 - A. Clothing
 - B. Non-removable artifacts
- III. Follow-up/Serial Scanning

PA Lumbar Spine

Content

- I. Indications and Contraindications
- II. Positioning Challenges
- III. Scan Acquisition

IV. Notable Findings

V. Scan Analysis (e.g., steps, challenges)

Proximal Femur

Content

I. Indications and Contraindications

II. Positioning Challenges

III. Scan Acquisition

IV. Notable Findings

V. Scan Analysis (e.g., steps, challenges)

Forearm

Content

I. Indications and Contraindications

II. Positioning Challenges

III. Scan Acquisition

IV. Notable Findings

V. Scan Analysis (e.g., steps, challenges)

Fracture Risk Assessment (FRAX)

Content

I. Indications and Contraindications

II. Calculation

III. Risk Factors for FRAX Calculation

Pediatrics

Content

- I. Indications and Contraindications
- II. Positioning Challenges
- III. Scan Acquisition
- IV. Notable Findings
- V. Scan Analysis (e.g., steps, challenges)

Whole-body DXA Scanning

Content

- I. Indications and Contraindications
- II. Positioning Challenges
- III. Scan Acquisition
- IV. Notable Findings
- V. Scan Analysis (e.g., steps, challenges)

Body Composition

Content

- I. Indications and Contraindications
- II. Positioning Challenges
- III. Scan Acquisition
- IV. Notable Findings
- V. Scan Analysis (e.g., steps, challenges)

Vertebral Fracture Recognition (VFR)

Content

- I. Advantages
- II. Indications and Contraindications

III. Positioning Challenges

IV. Scan Acquisition

V. Notable Findings

VI. Scan Analysis (i.e., semi-quantitative visual method [Genant], steps, challenges)

Resources

This list of resources is designed to help educators sample the pool of available references and study materials that pertain to medical imaging. The resources list should be viewed as a snapshot of available materials. Omission of any one title is not intentional. Because the body of literature and media related to the field is dynamic, educators are encouraged to find additional sources for recent updates, revisions, and additions to this collection.

ACR-SPR-SSR Practice Parameter for the Performance of Dual-Energy X-ray Absorptiometry. Reston, VA: American College of Radiology; 2018.

Bilezikian JP, ed. *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism.* 9th ed. Oxford: Wiley Blackwell; 2018.

Bone Densitometry Basics. American Society of Radiologic Technologists.
<https://www.asrt.org/main/continuing-education/earn-ce/featured-ce/bone-densitometry-ce>

Bonnick SL, Lewis LA. *Bone Densitometry for Technologists.* 3rd ed. Springer; 2013.

Bonnick SL. *Bone Densitometry in Clinical Practice: Application and Interpretation.* 3rd ed. Humana; 2009.

FRAX[®] WHO Fracture Risk Assessment Tool. www.shef.ac.uk/FRAX.

ISCD Official Positions. <https://www.iscd.org/official-positions/>

Postprimary Eligibility Pathway Handbook. St. Paul, MN: American Registry of Radiologic Technologists; 2018.

Technical White Paper: Bone Densitometry. *J Am Coll Radiol*, Volume 4; Issue 5. May 2007; pages 320-327.

Wartenbee SR. *Bone Densitometry.* In: Long BW, Rollins, JH, Smith BJ. *Merrill's Atlas of Radiographic Positioning & Procedures.* 13th ed. Volume 3. St. Louis, MO: Elsevier/Mosby; 2016.

Journals

Bone. 12 issues/year. New York, NY: Elsevier Science, Inc.

J Bone and Miner Res. 12 issues/year. Malden, MA: Blackwell Science, Inc.

J Clinical Densitometry. 4 issues/year. Totowa, NJ: Humana Press.

Osteoporosis Int. 6 issues/year. Godalming, Surrey, England: Springer-Verlag London Ltd.

Radiol Technol. 6 issues/year. Albuquerque, NM: American Society of Radiologic Technologists.

Organizations

The International Society for Clinical Densitometry (ISCD) provides certification courses for technologists and physicians, site accreditation, and continuing education. The society newsletter (*SCAN*) and website provide listings of domestic and international meetings and courses with relevant content for technologists. Contact: ISCD at www.iscd.org

The Bone Health & Osteoporosis Foundation (BHOFF) is dedicated to preventing osteoporosis and broken bones. The organization's Podcast (*BoneTalk*) and website offer information about awareness and promoting strong bones for life through public and clinician awareness, education, advocacy, and research. Contact: BHOFF at bonehealthandosteoporosis.org.

Appendix

Curriculum Revision Workgroup

We would like to extend special recognition to the outstanding professionals who volunteered their time as members of the curriculum revision project:

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We also wish to express our sincere appreciation for the many contributions and suggestions from the professional community over the course of this project.