Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for osteoporosis and bone mineral density.

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Musculoskeletal Imaging. Osteoporosis and bone mineral density. Reston (VA): American College of Radiology (ACR); 2001. 17 p. (ACR appropriateness criteria). [49 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Osteoporosis

GUIDELINE CATEGORY

Diagnosis
Risk Assessment

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations

Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of bone mineral density (BMD) measurement procedures for osteoporosis

TARGET POPULATION

Patients at risk of developing osteoporosis

INTERVENTIONS AND PRACTICES CONSIDERED

Central Quantitative Imaging Examinations

1. Dual x-ray absorptiometry (DXA)
    - Lumbar spine (frontal projection)
    - Proximal femur
    - Lumbar spine (lateral projection)
    - Total body calcium
2. Quantitative computed tomography (QCT)
    - Thoracolumbar spine
    - Proximal femur

Peripheral Quantitative Imaging Examinations

1. Peripheral quantitative computed tomography (pQCT)
    - Distal radius/ulna
2. Single x-ray absorptiometry (SXA)/dual x-ray absorptiometry
    - Distal radius/ulna
    - Calcaneus
    - Radiographic absorptiometry-phalanges
3. Quantitative ultrasound (QUS)
    - Calcaneus
    - Distal radius
    - Phalanges

Other Imaging Examinations

1. X-ray
    - Lateral thoracolumbar spine radiographs (fracture screen)

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)
Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The

survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Task Force on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Clinical Condition: Osteoporosis

Variant 1: Premenopausal woman with significant clinical risk factor.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral	4	May be helpful.

Radiologic Exam Procedure	Appropriateness Rating	Comments
projection)		
Total body calcium	4	May be helpful.
QCT		
Thoracolumbar spine	8	Greater sensitivity to bone loss but higher radiation exposure.
Proximal femur	8	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	3	
SXA/DXA		
Distal radius/ulna	3	
Calcaneus	3	
Radiographic absorptiometry–phalanges	3	
QUS		
Calcaneus	3	
Distal radius	2	
Phalanges	2	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: DXA, dual x-ray absorptiometry; QCT, quantitative computed tomography; pQCT, peripheral quantitative computed tomography; SXA, single x-ray absorptiometry; QUS, quantitative ultrasound

Variant 2: Perimenopausal black woman without other risk factors.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	2	
Proximal femur	2	
Lumbar spine (lateral projection)	1	
Total body calcium	1	
QCT		
Thoracolumbar spine	1	
Proximal femur	1	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	1	
SXA/DXA		
Distal radius/ulna	1	
Calcaneus	1	
Radiographic absorptiometry–phalanges	1	
QUS		
Calcaneus	1	
Distal radius	1	
Phalanges	1	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	1	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9		

Radiologic Exam Procedure	Appropriateness Rating	Comments
1=Least appropriate 9=Most appropriate		

Variant 3: Perimenopausal Caucasian or Asian woman.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	7	
Proximal femur	7	
Lumbar spine (lateral projection)	6	Sensitive to early bone loss.
Total body calcium	2	
QCT		
Thoracolumbar spine	6	
Proximal femur	6	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	2	
SXA/DXA		
Distal radius/ulna	2	
Calcaneus	2	
Radiographic absorptiometry–phalanges	2	
QUS		
Calcaneus	2	
Distal radius	2	
Phalanges	2	

Radiologic Exam Procedure	Appropriateness Rating	Comments
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 4: Woman of any age with history of fragility fracture.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	7	
Total body calcium	4	
QCT		
Thoracolumbar spine	8	
Proximal femur	8	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	4	
SXA/DXA		
Distal radius/ulna	4	
Calcaneus	4	
Radiographic absorptiometry–phalanges	4	

Radiologic Exam Procedure	Appropriateness Rating	Comments
QUS		
Calcaneus	4	
Distal radius	3	
Phalanges	3	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	7	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: DXA, dual x-ray absorptiometry; QCT, quantitative computed tomography; pQCT, peripheral quantitative computed tomography; SXA, single x-ray absorptiometry; QUS, quantitative ultrasound

Variant 5: Postmenopausal woman not on prescription drug therapy.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	7	
Total body calcium	5	
QCT		
Thoracolumbar spine	8	
Proximal femur	8	
Peripheral Quantitative Imaging Exams		

Radiologic Exam Procedure	Appropriateness Rating	Comments
pQCT		
Distal radius/ulna	5	
SXA/DXA		
Distal radius/ulna	5	
Calcaneus	5	
Radiographic absorptiometry–phalanges	5	
QUS		
Calcaneus	5	
Distal radius	4	
Phalanges	4	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	4	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 6: Perimenopausal woman unable or reluctant to commence hormone replacement therapy and seeking advice.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	7	
Total body calcium	5	

Radiologic Exam Procedure	Appropriateness Rating	Comments
QCT		
Thoracolumbar spine	8	
Proximal femur	8	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	5	
SXA/DXA		
Distal radius/ulna	5	
Calcaneus	5	
Radiographic absorptiometry–phalanges	5	
QUS		
Calcaneus	5	
Distal radius	4	
Phalanges	4	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	4	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Osteoporosis

Variant 7: Man of any age with significant clinical risk factor.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		

Radiologic Exam Procedure	Appropriateness Rating	Comments
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	4	
Total body calcium	4	
QCT		
Thoracolumbar spine	9	
Proximal femur	8	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	3	
SXA/DXA		
Distal radius/ulna	3	
Calcaneus	3	
Radiographic absorptiometry–phalanges	3	
QUS		
Calcaneus	3	
Distal radius	2	
Phalanges	2	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: DXA, dual x-ray absorptiometry; QCT, quantitative computed tomography; pQCT, peripheral quantitative computed tomography; SXA, single x-ray absorptiometry; QUS, quantitative ultrasound

Variant 8: Man of any age with history of fragility (atraumatic) fracture.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	7	
Total body calcium	4	
QCT		
Thoracolumbar spine	8	
Proximal femur	8	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	4	
SXA/DXA		
Distal radius/ulna	4	
Calcaneus	4	
Radiographic absorptiometry–phalanges	4	
QUS		
Calcaneus	4	
Distal radius	3	
Phalanges	3	
Other Imaging Exams		

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	7	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 9: Advanced lumbar degenerative changes with or without scoliosis and with significant risk factors.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Proximal femur	9	
Total body calcium	4	
Lumbar spine (frontal projection)	1	
Lumbar spine (lateral projection)	1	
QCT		
Proximal femur	8	
Thoracolumbar spine	6	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	5	
SXA/DXA		
Distal radius/ulna	5	
Calcaneus	5	
Radiographic absorptiometry–phalanges	5	

Radiologic Exam Procedure	Appropriateness Rating	Comments
QUS		
Calcaneus	5	
Distal radius	4	
Phalanges	4	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	If performed previously for diagnosis, no need to repeat.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 10: Atraumatic compression fractures involving L1 through L4 vertebral bodies.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Proximal femur	9	
Total body calcium	4	
Lumbar spine (frontal projection)	1	
Lumbar spine (lateral projection)	1	
QCT		
Proximal femur	9	
Thoracolumbar spine	1	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	5	

Radiologic Exam Procedure	Appropriateness Rating	Comments
SXA/DXA		
Distal radius/ulna	5	
Calcaneus	5	
Radiographic absorptiometry–phalanges	5	
QUS		
Calcaneus	5	
Distal radius	4	
Phalanges	4	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	If performed previously for diagnosis, no need to repeat.
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Variant 11: Pediatric patient with significant clinical risk factor.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Central Quantitative Imaging Exams		
DXA		
Lumbar spine (frontal projection)	9	
Proximal femur	9	
Lumbar spine (lateral projection)	5	
Total body calcium	5	
QCT		
Thoracolumbar spine	9	Adjust for all body sizes but radiation exposure is higher.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Proximal femur	1	
Peripheral Quantitative Imaging Exams		
pQCT		
Distal radius/ulna	5	
SXA/DXA		
Distal radius/ulna	5	
Calcaneus	5	
Radiographic absorptiometry–phalanges	5	
QUS		
Calcaneus	5	
Distal radius	4	
Phalanges	4	
Other Imaging Exams		
X-ray		
Lateral thoracolumbar spine radiographs (fracture screen)	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Abbreviations: DXA, dual x-ray absorptiometry; QCT, quantitative computed tomography; pQCT, peripheral quantitative computed tomography; SXA, single x-ray absorptiometry; QUS, quantitative ultrasound

Guidelines for the Clinical Utilization of BMD in the Adult Population

An international panel of authorities on bone mineral density (BMD) from the International Society for Clinical Densitometry (ISCD) (see appendix in the original guideline document for panel members) reached a consensus on the important issues that face physicians who will be ordering, performing, or interpreting BMD for the diagnosis of low bone mass in the adult population. Consensus guidelines were developed to help physicians use BMD in clinical decision-making.

World Health Organization guidelines formed the basis for defining osteoporosis based on levels of low bone mass in patients who have not yet suffered fracture. These guidelines on BMD measurement are best defined for nonblack postmenopausal women in whom the risk of osteoporosis is greatest. In addition, the International Society for Clinical Densitometry provided practical guidelines for clinicians to use in assessing which patients should be tested, what changes in bone mass are relevant to define response, what skeletal site(s) should be measured, what techniques should be used, and how clinical reports can enhance the value of BMD. These diagnostic and utilization guidelines will be followed soon by treatment and intervention guidelines. This complete compendium of information will form the basis of clinical decision-making in caring for patients with low bone mass.

Bone mineral density predicts a patient's future risk of fracture. The ability of bone mass to predict future fracture risk is as valuable as cholesterol testing or blood pressure measurements are for the prediction of heart attack or stroke and should be used more widely to identify at-risk patients. Osteoporosis can be diagnosed on the basis of BMD even in the absence of prevalent fractures. Diagnosing osteoporosis before a fracture occurs is an important concept advancement. It is justified on the recognized inverse and exponential relationship between low bone mass and future fracture risk and the exceedingly high risk observed for a second fracture once the first fracture has occurred.

Bone mineral density provides information that can affect the management of patients. It should be performed in any patient of any age or sex when the result will influence clinical decisions. The clinical decisions that may follow BMD results are diverse but include whether to initiate hormonal replacement therapy (HRT), to diagnose osteoporosis in a young fracturing amenorrheic athlete, or to monitor longitudinal changes in a patient receiving pharmacological therapy to prevent or treat osteoporosis. There are, therefore, a wide variety of clinical decisions that can be made more objectively with knowledge of bone-mass measurement results.

Choice of the appropriate site(s) for assessing bone mass or fracture risk may vary depending on the specific circumstances of the patient. Different skeletal sites can be measured to diagnose osteoporosis and predict fracture risk. Because bone mass is discordant in the younger perimenopausal population, if the first skeletal site measured is normal, it may be necessary to measure a second skeletal site to make an accurate diagnosis. Measuring more than one skeletal site may also be necessary if artifacts invalidate a particular site. Decisions about which site to measure and how many sites to measure should be the clinician's choice. In general, because cancellous bone changes more rapidly than cortical bone over time or with therapeutic intervention, cancellous bone sites (axial skeleton, calcaneus, or distal radius) may be the preferred sites to measure, though cortical bone sites (midradius, femoral neck) may also prove valuable and independent data. Also, when performing serial measurements in patients to monitor the natural course of bone loss (or gain) or the response to pharmacological intervention, clinicians must know if the changes are real or within the precision error of a particular measurement and a particular technique. Total body calcium measurement by dual x-ray absorptiometry (DXA) has the best precision of any site measured by this technology. This is a workable alternative if the proximal femur, spine, or both cannot be evaluated owing to

degenerative disease, orthopedic hardware, or both, providing the best estimate of global fracture risk. Body composition data can also be derived from these scans.

Choice of the appropriate technique for BMD in any given clinical circumstance should be based on an understanding of the strengths and limitations of the different techniques. All BMD techniques are valuable for diagnosing osteoporosis and predicting fracture risk. The choice of which treatment(s) to use for any patient should also be at the discretion of the physician. In most countries, DXA is the most widely used technique because of its low precision error, its low radiation exposure, and its capacity to measure multiple skeletal sites. However, other techniques such as quantitative computed tomography (QCT), ultrasound, single x-ray absorptiometry (SXA) of the wrist or calcaneus, peripheral quantitative computed tomography (pQCT), or hand radiogrametry are valuable and may offer information not assessed by DXA. Some of these lower-cost techniques may be used as screening techniques to detect a larger percentage of the high-risk population at potentially lower health care costs. Whatever technique is used, quality control and quality assurance are paramount for providing competent patient assessment. In situations where DXA is not readily accessible to the target population, such as small rural practices, QCT is the best alternative test because body computed tomography (CT) scanners are widely available. Although QCT (unlike DXA) can selectively evaluate high-turnover cancellous bone and is the best predictor of vertebral fracture risk, its relative disadvantages include higher radiation dose, lower precision, accuracy, and speed, and lower patient throughput because it is not performed on dedicated densitometric equipment. It should be noted that DXA scanners can be successfully mobilized to facilitate patient access.

Quantitative Computed Tomography

Quantitative computed tomography (QCT) was developed in the late 1970s by comparing bone to a series of standard liquids in a phantom for which bone density equivalence had been established. Most systems today use liquid or solid phantoms, although there is a phantomless system using muscle and fat in the patient as a comparative standard. In comparison to dual x-ray absorptiometry (DXA), QCT is a true volumetric measurement of bone and is measured in milligrams per cubic centimeter (mg/cm^3). It measures trabecular bone density separately from cortical bone. In a two-dimensional QCT scan, the calibration phantom is placed under the patient's back while the body is scanned. A computed radiographic localizer view is obtained to determine the levels of L1 to L3, and each vertebral body is imaged with 1.0-cm section thickness. Bone mineral density is then calculated by comparing the spine scan results to the calibrated standards. While this technique is accurate, the reproducibility (precision) can be diminished by variability of slice sampling. The advent of spiral CT scanners and three-dimensional software that acquire true volumetric images has improved reproducibility. There is also software for measuring the hip that can evaluate cortical, trabecular, and total bone density. The addition of hip measurement by CT greatly expands the diagnostic utility of QCT.

Trabecular bone is metabolically more active than cortical bone, and is the most sensitive indicator of early bone loss and vertebral fracture risk. There is a strong association between vertebral fracture and spinal trabecular BMD as measured by

QCT. Quantitative computed tomography has been shown to have the strongest ability to discriminate between healthy postmenopausal women and those with vertebral fractures. Spinal trabecular BMD also correlates with trochanteric fracture risk. Quantitative computed tomography may be useful in patients with severe scoliosis, facet disease, or hypertropic arthropathy, in whom DXA scans of the spine will yield spuriously elevated density. It may also be more accurate for obese or exceedingly small individuals for whom the assumptions made in DXA calculations regarding soft tissue may be inaccurate. Areal measurement of BMD versus true volumetric measurement may also affect the accuracy of areal BMD calculations due to their dependence on body size. Increased bone marrow fat content in the very elderly may exaggerate diminished bone density on QCT, as a single energy measurement (SEQCT). This uncertainty related to fat is far lower than the expected biological variation in the normal population. Also the normal database of single energy measurement accounts for most variability of marrow fat with age. Radiation dosage from QCT, although higher than the dosage from pencil-beam DXA, is still quite modest when performed correctly (See Table 1 in the original guideline document).

Peripheral BMD Measurements

Peripheral bone mineral density (pBMD) measurements, including radiographic absorptiometry (RA) and peripheral dual x-ray absorptiometry (pDXA) and peripheral quantitative computed tomography (pQCT), are becoming more readily available as screening techniques. Peripheral quantitative ultrasound (QUS), in particular, has been adopted in primary care due to its low cost, portability, ease of use, and lack of ionizing radiation. An international consensus group has reviewed the technology, and standards have been established to define patients at risk based on standard or modified T-scores obtained with this technology.

Peripheral QUS can assess fracture risk in a manner similar to other peripheral BMD measures. Its capacity for assessing rates of change or for monitoring response to therapy has not yet been firmly established. Because it does not measure BMD but speed of sound, which may be a parameter of a different quality of bone strength, it may yield additional information regarding fracture risk. However, without specific guidelines to determine whether central testing is necessary, some patients with low bone mass may be missed because their peripheral scans are "normal".

Peripheral QCT measures cortical and/or trabecular bone in the ultradistal radius and tibia. It may provide information regarding bone strength and may be particularly beneficial in the pediatric population because it measures BMD independently of bone size and with low radiation exposure. Patients at high risk with intermediate levels of peripheral BMD should probably have axial measurements in addition. However, more research is necessary to define the optimal algorithms for selecting peripheral versus central BMD measures as well as selecting appropriate diagnostic and treatment thresholds for all types of densitometry methods and for all manner of patients. Bone mineral density testing should be accompanied by a clinical interpretation. The computer printout data provided by BMD equipment manufacturers do not fully provide the type of clinical information that the primary care physician needs in order to direct patient care. Bone mineral density results have wide implications for clinical decisions in the care of patients with low bone mass and may lead to broader diagnostic and

therapeutic interventions than can be provided by blood pressure measurements or blood chemistry results. A brief narrative report that correlates the bone-mass measurement to a technician-obtained patient questionnaire database can allow the clinician interpreting the BMD results to suggest to the primary care physician wider diagnostic and intervention possibilities. In pediatric patients with risk factors for low bone mass, it is mandatory that DXA scans be performed using specialized pediatric software provided by the equipment manufacturer.

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Appropriate selection of bone mineral density (BMD) measurement procedures to evaluate patients at risk for osteoporosis or to diagnose osteoporosis
- Increased ability to predict fracture risk
- Decrease in morbidity, mortality, and cost of osteoporosis

Subgroups Most Likely to Benefit:

- Quantitative computed tomography (QCT) may be useful in patients with severe scoliosis, facet disease, or hypertropic arthropathy
- Quantitative computed tomography may also be more accurate in obese or exceedingly small individuals

POTENTIAL HARMS

None stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment.

Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

American College of Radiology (ACR), Expert Panel on Musculoskeletal Imaging. Osteoporosis and bone mineral density. Reston (VA): American College of Radiology (ACR); 2001. 17 p. (ACR appropriateness criteria). [49 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 (revised 2001)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Musculoskeletal Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Harry K. Genant, MD; Murray K. Dalinka, MD; Naomi Alazraki, MD; Richard H. Daffner, MD; John B. Kneeland, MD; B.J. Manaster, MD, PhD; Helene Pavlov, MD; David A. Rubin, MD; Murali Sundaram, MD; Barbara N. Weissman, MD; Robert H. Haralson III, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It updates a previous version: ACR Appropriateness Criteria™ for osteoporosis and bone mineral density. Radiology 2000 Jun;215(Suppl):397-414.

The ACR Appropriateness Criteria™ are reviewed every five years, if not sooner, depending on the introduction of new and highly significant scientific evidence. The next review date for this topic is 2006.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- American College of Radiology ACR Appropriateness Criteria™ introduction. Reston (VA): American College of Radiology; 6 p. Available in Portable Document Format (PDF) from the ACR Web site.

NGC STATUS

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001. This summary was updated by ECRI on July 31, 2002. The updated information was verified by the guideline developer on October 1, 2002.

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