American College of Radiology
American Medical Association (AMA)-convened Physician Consortium for Performance Improvement® (PCPI®)
National Committee for Quality Assurance

Non-Cardiac Diagnostic Imaging Performance Measurement Set

Status: Draft

For Public Comment
September 2014

Table of Contents

Physician Performance Measures (Measures) and related data specifications are developed by the American Medical Association (AMA)-convened Physician Consortium for Performance Improvement® (PCPI®)

These performance Measures are not clinical guidelines and do not establish a standard of medical care, and have not been tested for all potential applications.

The Measures, while copyrighted, can be reproduced and distributed, without modification, for noncommercial purposes, e.g., use by health care providers in connection with their practices. Commercial use is defined as the sale, license, or distribution of the Measures for commercial gain, or incorporation of the Measures into a product or service that is sold, licensed or distributed for commercial gain. Commercial uses of the Measures require a license agreement between the user and the AMA (on behalf of the PCPI). Neither the AMA, the PCPI nor its members shall be responsible for any use of the Measures.

THE MEASURES AND SPECIFICATIONS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND.

Limited proprietary coding is contained in the Measure specifications for convenience. Users of the proprietary code sets should obtain all necessary licenses from the owners of these code sets. The AMA, the PCPI and its members disclaim all liability for use or accuracy of any Current Procedural Terminology (CPT®) or other coding contained in the specifications. Use of CPT coding beyond fair use requires a license from the AMA.

Non-Cardiac Diagnostic Imaging Measure Development Work Group Members

Work Group Members

William Golden, MD (Co-Chair) (internal medicine)
David Seidenwurm (Co-chair) (diagnostic radiology)

Michael Bettmann, MD
Dorothy Bulas, MD (pediatric radiology)
Rubin I. Cohen, MD, FACP, FCCP, FCCM
Richard T. Griffey, MD, MPH (emergency medicine)
Eric J. Hohenwalter, MD (vascular interventional radiology)
Deborah Levine, MD, FACR (radiology/ultrasound)
Mark Morasch, MD (vascular surgery)
Paul Nagy, MD, PhD (radiology)
Mark R. Needham, MD, MBA (family medicine)
Hoang D. Nguyen (diagnostic radiology/payer representative)
Charles J. Prestigiacomo, MD, FACS (neurosurgery)
William G. Preston, MD, FAAN (neurology)
Robert Pyatt, Jr., MD (diagnostic radiology)
Robert Rosenberg, MD (diagnostic radiology)
David A. Rubin, MD (diagnostic radiology)
B Winfred (B.W.) Ruffner, MD, FACP (medical oncology)
Frank Rybicki, MD, PhD, FAHA (diagnostic radiology)
Cheryl A. Sadow, MD (radiology)
John Schneider, MD, PhD (internal medicine)
Gary Schultz, DC, DACR (chiropractic)
Paul R. Sierzenski, MD, RDMS (emergency medicine)
Michael Wasylik, MD (orthopedic surgery)

Work Group Staff

American College of Radiology
Judy Burleson, MHSA

American Medical Association-convened Physician Consortium for Performance Improvement
Mark Antman, DDS, MBA
Kathleen Blake, MD, MPH
Kendra Hanley, MS
Toni Kaye, MPH
Marjorie Rallins, DPM
Kimberly Smuk, RHIA
Samantha Tierney, MPH
Stavros Tsipas, MA

National Committee for Quality Assurance
Mary Barton, MD

Measure Attributes At-A-Glance

Measure Title	Measure Purpose	Type of Measure	Level of Measurement
Measure #1: Stenosis measurement in carotid imaging reports	Accountability	Process	Individual Practitioner
Measure #2: Inappropriate use of "probably benign" assessment category in screening mammograms	Accountability	Process	Individual Practitioner
Measure #3: Reminder system for screening mammograms	Accountability	Process	Individual Practitioner
Measure #4: Exposure reported for procedures using fluoroscopy	Accountability	Process	Individual Practitioner
Measure #5: Utilization of ultrasonography in children with clinically suspected appendicitis	Accountability	Process	Facility
Measure #6: Radiation consideration for adult computed tomography (CT): utilization of dose reduction techniques	Accountability	Process	Facility
Measure #7: Appropriate use of Imaging for non-traumatic shoulder pain	Accountability	Process	Facility
Measure #8: Appropriate use of imaging for non-traumatic knee pain	Accountability	Process	Facility
Measure #9: Use of premedication before contrast-enhanced imaging studies in patients with documented contrast reaction	Accountability	Process	Individual Practitioner
Measure #10: Extravasation of contrast following contrast-enhanced computed tomography (CT)	Accountability	Outcome	Facility
Measure #11: Appropriate follow-up imaging for incidental thyroid nodules	Accountability	Process	Individual Practitioner
Measure #12: Appropriate follow-up imaging for incidental abdominal lesions	Accountability	Process	Individual Practitioner
Measure #13: Appropriate follow-up imaging for incidental simple ovarian cysts	Accountability	Process	Individual Practitioner

Purpose of Measurement Set

The American Medical Association (AMA)-convened Physician Consortium for Performance Improvement® (PCPI®), the American College of Radiology (ACR), and the National Committee for Quality Assurance (NCQA) formed a Non-Cardiac Diagnostic Imaging Work Group to identify and define quality measures for improving outcomes for patients undergoing non-cardiac diagnostic imaging.

The Work Group was tasked with developing measures that reflect the most rigorous clinical evidence and address areas most in need of performance improvement. The Work Group considered opportunities for outcome, process and structural measures as well as composite, bundled, and group or system-level measures.

This work represents the formal periodic review and maintenance of an existing radiology measurement set as well as the creation of new measures pertaining to non-cardiac diagnostic imaging. The Radiology measure set was initially developed in 2007. This measure review and maintenance project aimed to review and update the existing measures to ensure they reflect the latest guideline recommendations, address gaps in care, and incorporate results from testing projects, when available. The first four measures represent the updated measures from the original radiology measure set. Additionally, the Work Group undertook the development of new measures specific to non-cardiac diagnostic imaging to complement the existing measures. The last nine measures of the set represent the newly developed measures.

Importance of Topic

As imaging technology continues to advance, the United States healthcare system has seen an increase in both the type and frequency of imaging studies being performed. This increase in utilization of imaging studies is accompanied by a corresponding increase in cost and exposure to radiation for both patients and healthcare professionals.

- From 1980-2006, the number of radiologic procedures performed in the United States showed a ten-fold increase while the annual per-capita effective dose from radiologic and nuclear medicine procedures increased by 600%[1].
- From 1996-2010, the number of CT examinations tripled, while the number of ultrasounds nearly doubled[2].
- Between 1996-2010, advanced diagnostic imaging (ie, CT, MRI, nuclear medicine, and ultrasound) accounted for approximately 35% of all imaging studies[2].
- From 1980-2006, the proportion of radiation exposure that is attributable to medical sources increased from 17% to 53%[1].
- In 2006, while CT scans only accounted for approximately 17% of all radiologic procedures performed in the United States, they accounted for over 65% of the total effective radiation dose from radiologic procedures[1].
- In 2006, the estimated annual per-capita effective radiation dose for radiologic procedures in the United States was nearly 20% higher than the average for other well-developed countries[1].

Non-cardiac diagnostic imaging was prioritized as a topic area for measure development due to a high level of utilization, rising costs, and the need for measures to help promote appropriate use of imaging and improve outcomes.

Clinical Evidence Base

Clinical practice guidelines serve as the foundation for the development of performance measures. A number of clinical practice guidelines have been developed to promote safe, effective, and efficient use of non-cardiac diagnostic imaging based on exam modality and body part, offering an evidence base to guide clinical decision-making and performance measure development. Guidelines from the below organizations were reviewed during the measure development process.

- American College of Radiology (ACR)
- United States Preventive Services Task Force (USPSTF)
- Community Preventive Services Task Force (CPSTF)
- National Cancer Institute (NCI)
- American College of Emergency Physicians (ACEP)
- American Family Physicians (AFP)
- Journal Manipulative and Physiological Therapeutics (JMPT)
- American Thyroid Association (ATA)
- Society of Radiologists in Ultrasound (SRU)
- American Congress of Gynecology (ACOG)
- Society of Interventional Radiology (SIR)

Performance measures, however, are not clinical practice guidelines and cannot capture the full spectrum of care for this patient population. The Non-Cardiac Diagnostic Imaging Work Group attempted to use guideline principles with the strongest recommendations and often the highest level of evidence as the basis for measures in this set; however, due to the paucity of well-designed randomized-controlled trials related to imaging, the Work Group relied on practice parameters, consensus documents, and guidelines that are most widely used in clinical practice.

Non-Cardiac Diagnostic Imaging Outcomes

Ideally, a set of performance measures would include both measures of outcomes as well as measures of processes that are known to positively influence clinical outcomes. The development of outcome measures for non-cardiac diagnostic imaging proved particularly challenging given the broad topic and the combination of collaborative approaches necessary to ensure optimal care for this patient population. The Work Group was able to develop one outcome measure around extravasation of contrast material. However, in light of the difficulties around outcomes measurement for non-cardiac diagnostic imaging, the Work Group set out to develop performance measures based on processes and structures that are strongly linked to desired outcomes and reflect high quality. Desired outcomes for non-cardiac diagnostic imaging include:

1. Increase appropriate selection of imaging studies based on evidence, including, but not limited to, guidelines and appropriate use criteria
2. Decrease patient/operator radiation exposure
3. Decrease patient contrast extravasation
4. Reduce inappropriate use of follow-up imaging
5. Improve accuracy of imaging interpretation
6. Increase recording of critical values
7. Improve timeliness of emergency imaging procedures

The Non-cardiac Diagnostic Imaging Work Group focused on current quality gaps in care in order to develop measures that will have an important role in optimizing patient outcomes.

Intended Audience and Use, Care Setting, and Patient Population

The PCPI encourages use of these measures by physicians, other health care professionals, and healthcare systems, where appropriate, to achieve improved performance and as steps towards optimized clinical outcomes for patients undergoing non-cardiac diagnostic imaging in a variety of settings. Performance measurement serves as an important component in a quality improvement strategy but performance measurement alone will not achieve the desired goal of improving patient care. Measures can have their greatest effect when they are used judiciously and linked directly to operational steps that clinicians, patients, and health plans can apply in practice to improve care.

These clinical performance measures are appropriate for accountability if the appropriate methodological, statistical, and implementation rules are achieved.

The PCPI encourages that performance measure data be stratified by race, ethnicity, and primary written and spoken language to assess disparities and initiate subsequent quality improvement activities addressing identified disparities. These categories are consistent with recent national efforts to standardize the collection of race and ethnicity data. A 2008 National Quality Forum (NQF) report[3] endorsed 45 practices including stratification by the aforementioned variables. A 2009 Institute of Medicine (IOM) report[4] "recommends collection of the existing Office of Management and Budget (OMB) race and Hispanic ethnicity categories as well as more fine-grained categories of ethnicity (referred to as granular ethnicity and based on one's ancestry) and language need (a rating of spoken English language proficiency of less than very well and one's preferred language for health-related encounters)."

Non-Cardiac Diagnostic Imaging Work Group Recommendations

The Non-Cardiac Diagnostic Imaging Work Group identified several desired outcomes for patients undergoing non-cardiac diagnostic imaging. Current quality gaps in imaging emphasize the need to improve specific processes that have been demonstrated to improve non-cardiac diagnostic imaging outcomes (eg, appropriate use of imaging studies, appropriate medication interventions to mitigate complications, minimizing unnecessary radiation exposure, and the promotion of patient engagement). As a result, many measures in this set focus on the overuse of some services as well as the provision of safe, timely, and efficient care.

These measures also support the efficient delivery of high quality health care in many of the IOM's six aims for quality improvement[5], as described in **Table 1**.

Table 1: Relationship between IOM domains and NCDI measures

IOM Domains of Health Care Quality		Safe	Effective		Patient-centered	Timely	Efficient	Equitable
			Underuse	Overuse				
Draft Measures								
1	Stenosis measurement in carotid imaging reports	✓					✓	
2	Inappropriate use of "probably benign" assessment category in screening mammograms	✓			✓	✓		✓
3	Reminder system for screening mammograms		✓		✓	✓	✓	✓
4	Exposure reported for procedures using fluoroscopy	✓		✓			✓	
5	Utilization of ultrasonography in children with clinically suspected appendicitis	✓		✓			✓	✓
6	Radiation consideration for adult computed tomography (CT): utilization of dose reduction techniques	✓		✓	✓		✓	✓
7	Appropriate use of Imaging for non-traumatic shoulder pain	✓		✓		✓	✓	✓
8	Appropriate use of imaging for non-traumatic knee pain	✓		✓		✓	✓	✓
9	Use of premedication before contrast-enhanced imaging studies in patients with documented contrast reaction	✓	✓		✓		✓	
10	Extravasation of contrast following contrast-enhanced computed tomography (CT)	✓			✓			
11	Appropriate follow-up imaging for incidental thyroid nodules			✓	✓		✓	✓
12	Appropriate follow-up imaging for incidental abdominal lesions			✓	✓		✓	✓
13	Appropriate follow-up imaging for incidental simple ovarian cysts			✓	✓		✓	✓

Process measures: Several processes of care demonstrated to improve outcomes for patients undergoing non-cardiac diagnostic imaging are recommended:

Measure 1: Stenosis measurement in carotid imaging reports
Measure 2: Inappropriate use of "probably benign" assessment category in screening mammograms
Measure 3: Reminder system for screening mammograms
Measure 4: Exposure reported for procedures using fluoroscopy
Measure 5: Utilization of ultrasonography in children with clinically suspected appendicitis
Measure 6: Radiation consideration for adult computed tomography (CT): utilization of dose reduction techniques
Measure 7: Appropriate use of imaging for non-traumatic shoulder pain
Measure 8: Appropriate use of imaging for non-traumatic knee pain
Measure 9: Use of premedication before contrast-enhanced imaging studies in patients with documented contrast reaction
Measure 11: Appropriate follow-up imaging for incidental thyroid nodules
Measure 12: Appropriate follow-up imaging for incidental abdominal lesions
Measure 13: Appropriate follow-up imaging for incidental simple ovarian cysts

Outcome measures: One outcome measure was developed for patients undergoing non-cardiac diagnostic imaging:

Measure 10: Extravasation of contrast following contrast-enhanced computed tomography (CT)

Retired Measures

A number of circumstances might warrant the retirement of a measure from a measurement set including, but not limited to, the following:

- The measure no longer remains clinically relevant/appropriate as determined by current guidelines and scientific evidence
- Other performance measures, such as outcome measures, may take precedence in order to avoid excessive clinician burden
- The measure demonstrates high clinician performance, implying that the measure no longer represents an opportunity for quality improvement
- Testing results demonstrate poor feasibility of data collection or weak correlation with improved health outcomes
- Identification of significant unintended consequences of measurement.

The retirement of measures does not imply that the processes themselves are not important for a given population, but rather that due to the above circumstances or others, the measures included were deemed more appropriate at the time.

The following measures were retired from the original set of radiology measures:

- Mammography assessment category data collection
- Communication of suspicious findings from the diagnostic mammogram to the practice managing ongoing care
- Communication of suspicious findings from the diagnostic mammogram to the patient

Other Potential Measures

The Work Group considered several other important constructs related to non-cardiac diagnostic imaging, though ultimately determined that they were not appropriate in the context of this performance measurement project. In particular, the following measures were considered:

Avoidable Complication: Acute Kidney Injury Following Contrast-Enhanced Imaging Studies
This measure was originally considered to look at patients who developed acute kidney injury within thirty days following intravenous iodinated contrast for a CT examination. However, there was a lack of evidence-based actions to prevent acute kidney injury apart from abstaining from contrast use altogether. Therefore, it was decided to not include this measure in the set.

Non-diagnostic Biopsy Rate Composite Measure
This measure was originally considered to look at non-diagnostic lung, liver, and kidney biopsy rates. Due to a variety of issues including heterogeneity of indications for biopsy and differences in pathology techniques, it was felt that this issue was too complex to be represented in a single composite measure.

Measure Specifications

There are several data sources available for collecting performance measures; generally different data sources require different sets of measure specifications, due to the structure of the systems storing the data. The American Medical Association (AMA)-convened Physician Consortium for Performance Improvement® (the PCPI®), recognizes that Electronic Health Records (EHRs) are the state of the art for clinical encounters and is focusing significant resources and expertise toward specifying and testing measures within EHRs, as they hold the promise of providing the relevant clinical data for measures and for providing feedback to physicians and other health care providers that is timely and actionable.

The type of specifications provided for this measurement set are aligned with the PCPI plans to focus on the development of EHR specifications for new measure development projects, consistent with the information shared at the PCPI membership meeting held in October 2011. While the PCPI values prospective claims reporting programs and the data these programs can provide, the PCPI is looking to leverage the data in EHRs. This new focus will align the PCPI with national initiatives that highlight the benefits and wealth of data that EHRs bring to healthcare. The PCPI intends to maintain prospective claims specifications for measures that are currently reportable in national reporting programs.

Another venue for advancing this work in EHR data measurement is the AMA/NCQA/HIMSS Electronic Health Record Association (EHRA) Collaborative (see www.ama-assn.org/go/collaborative).

Below, we have outlined Non-Cardiac Diagnostic Imaging measures that are appropriate for each type of reporting: prospective claims-based reporting and/or EHR reporting. To align with the national focus on EHRs, the PCPI will continue to maintain measures that have been specified for prospective claims-based reporting and are already included in such a program (eg, PQRS). The PCPI will only develop new specifications for prospective claims-based reporting if there is a lack of reportable measures for a given specialty (ie, fewer than 3 measures).

Accountability measures recommended (and to be specified by the PCPI upon finalization of the measures) for implementation in an Electronic Health Record (EHR) and in a Prospective Claims-Based reporting program:

Measure Exclusions and Exceptions

Measure Exclusions
In the context of physician performance measurement, exclusions arise when the intervention required by the numerator is not appropriate for a group of patients who are otherwise included in the initial patient or eligible population of a measure (ie, the denominator). Exclusions are absolute and are to be removed from the denominator of a measure and therefore clinical judgment does not enter the decision.

Measure Exceptions
Exceptions are used to remove a patient from the denominator of a performance measure when the patient does not receive a therapy or service AND that therapy or service would not be appropriate due to patient-specific reasons. Otherwise, the patient would otherwise meet the denominator criteria. Exceptions are not absolute, and are based on clinical judgment, individual patient characteristics, or patient preferences.

For ***process measures***, the PCPI provides two categories of reasons for which a patient may be excluded from the denominator of an individual measure:

- **Medical reasons**
  Include:
  - Contraindicated in patient (potential allergy due to previous reported allergic history, potential adverse drug interaction, other)
  - Already received/performed
  - Intolerant (therapy was tried and the patient was intolerant)
  - Other medical reason(s)

- **Patient or Non-medical reason(s)**
  Include:
  - Patient refused/declined
  - Access issues or insurance coverage/payor-related limitations (patient not covered for treatment)
  - Patient functional limitations
  - Patient preference: Social reason(s) (eg, family or support system not supportive of intervention/treatment); Religious reason(s) (eg, religious beliefs regarding blood transfusion)
  - Other patient or non-medical reason(s)

These measure exception categories are not available uniformly across all measures; for each measure, there must be a clear rationale to permit an exception for a medical or patient/non-medical reason. For some measures, examples have been provided in the measure exception language of instances that would constitute an exception. Examples are intended to guide clinicians and are not all-inclusive lists of all possible reasons why a patient could be excluded from a measure. The exception of a patient may be reported by appending the appropriate modifier to the CPT Category II code designated for the measure:

- **Medical reasons**: modifier 1P
- **Patient reasons**: modifier 2P

Although this methodology does not require the external reporting of more detailed exception data, the PCPI recommends that physicians document the *specific* reasons for exception in patients' medical records for purposes of optimal patient management and audit-readiness.

The PCPI also advocates the systematic review and analysis of each physician's exceptions data to identify practice patterns and opportunities for quality improvement. For example, it is possible for implementers to calculate the percentage of patients that physicians have identified as meeting the criteria for exception.

Please refer to documentation for each individual measure for information on the acceptable exception categories and the codes and modifiers to be used for reporting.

Testing and Implementation of the Measurement Set

The draft measures in this set are being made available for public comment without any prior testing. The PCPI recognizes the importance of testing all of its measures and encourages testing of the Non-Cardiac Diagnostic Imaging measurement set for feasibility and reliability by organizations or individuals positioned to do so. The *Measure Testing Protocol for PCPI Measures* was approved by the PCPI in 2010 and is available on the PCPI web site (see Position Papers at www.physicianconsortium.org); interested parties are encouraged to review this document and to contact PCPI staff. The PCPI will welcome the opportunity to promote the initial testing of these measures and to ensure that any results available from testing are used to refine the measures before implementation.

DRAFT Measure #1:

Stenosis measurement in carotid imaging reports

Measure Description

Percentage of final reports for carotid imaging studies (neck magnetic resonance angiography (MRA), neck computerized tomographic angiography (CTA), neck duplex ultrasound, carotid angiogram) performed that include direct or indirect reference to measurements of distal internal carotid diameter as the denominator for stenosis measurement

Measure Components

Numerator Statement	Final reports for carotid imaging studies that include direct or indirect reference to measurements of distal internal carotid diameter as the denominator for stenosis measurement Definition: Direct or indirect reference to measurements of distal internal carotid diameter as the denominator for stenosis measurement - includes direct angiographic stenosis calculation based on the distal lumen as the denominator for stenosis measurement OR an equivalent validated method referenced to the above method (eg, for duplex ultrasound studies, velocity parameters that correlate with anatomic measurements that use the distal internal carotid lumen as the denominator for stenosis measurement) Numerator Instructions: This measure requires that the estimate of stenosis included in the report of the imaging study employ a method such as the North American Symptomatic Carotid Endarterectomy Trial (NASCET) method for calculating the degree of stenosis. The NASCET method calculates the degree of stenosis with reference to the lumen of the carotid artery distal to the stenosis. For duplex imaging studies the reference is indirect, since the degree of stenosis is inferred from velocity parameters and cross referenced to published or self-generated correlations among velocity parameters and results of angiography or other imaging studies which serve as the gold standard. In Doppler ultrasound, the degree of stenosis can be estimated using Doppler parameter of the peak systolic velocity (PSV) of the internal carotid artery (ICA), with concordance of the degree of narrowing of the ICA lumen. Additional Doppler parameters of ICA-to-common carotid artery (CCA) PSV ratio and ICA end-diastolic velocity (EDV) can be used when degree of stenosis is uncertain from ICA PSV. (Grant et al, Society of Radiologists in Ultrasound, 2003)[6]. A short note can be made in the final report, such as: • “Severe left ICA stenosis of 70-80% by NASCET criteria” or • “Severe left ICA stenosis of 70-80% by criteria similar to NASCET” or • “70% stenosis derived by comparing the narrowest segment with the distal luminal diameter as related to the reported measure of arterial narrowing” or • “Severe stenosis of 70-80% - validated velocity measurements with angiographic measurements, velocity criteria are extrapolated from diameter data as defined by the Society of Radiologists in Ultrasound Consensus Conference Radiology 2003; 229;340-346.”

	Documentation-Information populating the final report may reside in a dedicated field in the electronic health record (EHR) or picture archiving and communication system (PACS), however stenosis measurement information should be included in the final report in order to be readily accessible in all circumstances
Denominator Statement	All final reports for carotid imaging studies (neck MRA, neck CTA, neck duplex ultrasound, carotid angiogram) performed
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: The panel recommended that the NASCET method of carotid stenosis measurement should be used when angiography is used to correlate the US findings (SRU, 2003)[6] When MRA techniques are used for determining carotid stenosis, the report should reflect the methodology and reference the criteria for percent stenosis outlined in the NASCET. Also, the percent stenosis must be calculated using the distal cervical ICA diameter, where the walls are parallel, for the denominator. Similar to CTA, MRA with attention to the acquisition parameters and post-processing techniques can provide cross sectional measurements of stenosis that correlate with properly performed NASCET estimates of percent stenosis obtained with catheter angiography. In the setting of near occlusion, it may not be accurate to calculate percent stenosis ratios in the presence of post-stenotic arterial diameter decrease. Some MRA techniques may not be amenable to quantitative measurements, in which case qualitative assessment of stenosis should be provided(ACR, 2010)[7]

Measure Importance

Relationship to desired outcome	Accurate assessment of the degree of carotid artery stenosis is essential to guiding proper treatment decisions for patients with carotid artery disease. Trials have demonstrated the ability of the degree of carotid artery stenosis to predict which patients will receive the greatest benefit from surgical intervention[8,9,10, 11]. To ensure accurate assessment of stenosis, it is important to use a standardized, validated approach. Rothwell et al demonstrated significant differences between measurements of stenosis made using different methods of measurement[12,13].
Opportunity for Improvement	There is wide variance in how stenosis is currently documented and reported. A 2013 study[14] by Cheng et al of 127 Veteran's Affairs medical centers found inconsistency in the method of stenosis reporting as well as which clinical thresholds were used to determine severity of stenosis. In addition, Giurgea et al[15] demonstrated significant differences in classification of carotid stenosis among different clinical settings.
IOM Domains of Health Care Quality Addressed	• Safe • Efficient

Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Administrative Data/Claims • Electronic Health/Medical Record • Registry Data

DRAFT Measure #2:

Inappropriate use of "probably benign" assessment category in screening mammograms

**For this measure, a lower score indicates higher quality*

Measure Description

Percentage of final reports for screening mammograms that are classified as "probably benign"

Measure Components

Numerator Statement	Final reports classified as "probably benign" Definition: Probably Benign Classification – Mammography Quality Standards Act (MQSA) assessment category of "probably benign"; Breast Imaging-Reporting and Data System (BI-RADS®) category 3; or Food and Drug Administration (FDA)-approved equivalent assessment category
Denominator Statement	All final reports for screening mammograms
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted <u>verbatim</u> from the referenced clinical guidelines and other references: A category 3, 4, or 5 assessment is not recommended for a screening mammogram, even though in some instances a highly suspicious abnormality may be identified that will warrant a recommendation for biopsy. Rather, all patients with screening abnormalities should be given a BI-RADS® category 0 assessment and recalled for further diagnostic studies. (ACR, 2013)[16] All the previously cited studies emphasize the need to conduct a complete diagnostic imaging evaluation before making a probably benign (category 3) assessment; hence it is recommended not to render such an assessment in interpreting a screening mammography examination. The practice of rendering category 3 assessments directly from screening examination also has been shown to result in adverse outcomes: 1) unnecessary follow-up of many lesions that could have been promptly assessed as benign, and 2)delayed diagnosis of a small number of cancers that otherwise may have been smaller in size and less likely to be advanced in stage (ACR, 2013)[17] The use of assessment category 3, probably benign, has been clarified in the lexicon of the 2013 edition. It is emphasized that this is ***not*** an indeterminate category used simply when the radiologist is unsure whether to render a benign (BI-RADS® category 2) or suspicious (BI-RADS® category 4) assessment, but one that is reserved for specific imaging findings known to have a greater than essentially 0% but ≤ 2% likelihood of representing malignancy. (ACR, 2013)[17] For mammography, there is robust literature describing three findings (noncalcified circumscribed

	solid mass, focal asymmetry and solitary group of punctate calcifications) that have likelihoods of malignancy in the defined (≤ 2%) probably benign range, for which short interval (6-month) follow-up mammography and then periodic mammographic surveillance represents appropriate management.[6-11]. Use of assessment category 3 for mammographic findings other than these three should be considered only if the radiologist has personal experience to justify a watchful-waiting approach, preferably involving observation of a sufficient number of cases of an additional mammographic finding to suggest a likelihood of malignancy within the defined (≤ 2%) probably-benign range. Two large-scale studies performed in the United States have validated that in the usual-care setting, category 3 assessments indeed are associated with a likelihood of malignancy of <2%. (ACR 2013)[17]

Measure Importance

Relationship to desired outcome	The "probably benign" assessment category is reserved for findings that have a high probability (≥98%) chance of being benign and should not be used as a category for indeterminate findings. Inappropriate designation of findings as "probably benign" can result in unnecessary follow-up of lesions that could have been quickly classified or delayed diagnosis and treatment of cancerous lesions[18]. Published guidance documents[16,17] emphasize the need to conduct a complete diagnostic imaging evaluation before making a probably benign (Category 3) assessment; making it inadvisable to use the probably benign categorization when interpreting a screening mammogram. Immediate completion of a diagnostic imaging evaluation for abnormal screening mammograms eliminates potential anxiety that women would endure with the short interval follow-up that is recommended for "probably benign" findings.
Opportunity for Improvement	Although a mammogram assessment category of "probably benign" is not recommended for use in interpreting screening mammograms, it is associated with approximately 2.3% of screening mammograms[19] Additionally, compliance is shown to be poor among women referred to short-interval follow-up[19].
IOM Domains of Health Care Quality Addressed	• Safe • Patient-centered • Timely • Equitable
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation

	• Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Administrative Data/Claims • Electronic Health/Medical Record • Registry Data

DRAFT Measure #3:

Reminder system for screening mammograms

Measure Description

Percentage of patients undergoing a screening mammogram whose information is entered into a reminder system with a target due date for the next mammogram

Measure Components

Numerator Statement	Patients whose information is entered into a reminder system* with a target due date for the next mammogram *Note: The reminder system should be linked to a process for notifying patients when their next mammogram is due and should include the following elements at a minimum: patient identifier, patient contact information, dates(s) of prior screening mammogram(s) (if known), and the target due date for the next mammogram
Denominator Statement	All patients undergoing a screening mammogram
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: The Community Preventive Services Task Force recommends the use of client reminders to increase screening for breast and cervical cancers on the basis of strong evidence of effectiveness (CPSTF, 2010)[20] The USPSTF recommends against screening mammography in women aged 40 to 49 years. The decision to start regular, biennial screening mammography before the age of 50 years should be an individual one and take into account patient context, including the patient's values regarding specific benefits and harms. (USPSTF, 2009) (Grade C)[21] The USPSTF recommends biennial screening mammography for women between the ages of 50 and 74 years. (USPSTF, 2009) (Grade B)[21] INDICATIONS A. Screening Mammography 1. Annually for asymptomatic women age 40 and older who are at average risk for breast cancer. 2. Asymptomatic women under age 40 who are at increased risk for breast cancer. a. Woman with known mutation or genetic syndrome with increased breast cancer risk: yearly starting by age 30, but not before age 25. b. Untested woman with a first-degree relative with known BRCA mutation: yearly starting by age 30, but not before age 25. c. Woman with a 20% or greater lifetime risk for breast cancer based on breast cancer risk models: yearly starting by age 30, but not before age 25, or 10 years earlier than the age at which

	the youngest first-degree relative was diagnosed, whichever is later. d. Woman with a history of chest (mantle) radiation received between the ages of 10 and 30: yearly starting 8 years after the radiation therapy, but not before age 25. e. Woman with biopsy-proven lobular neoplasia, atypical ductal hyperplasia (ADH), ductal carcinoma in-situ (DCIS), invasive breast cancer, or ovarian cancer: yearly from time of diagnosis, regardless of age. (ACR, 2013)[16] Age at which annual mammography screening should end. a. There is no defined upper age limit at which mammography may not be beneficial. b. Screening with mammography should be considered as long as the patient is in good health and is willing to undergo additional testing, including biopsy, if an abnormality is detected. (ACR, 2013)[16]

Measure Importance

Relationship to desired outcome	Although screening mammograms can reduce breast cancer mortality by 20-35% in women aged 40 years and older, recent evidence shows that only 72% of women are receiving mammograms based on current guideline recommendations[22]. The use of patient reminders is associated with an increase in screening mammography[23,24].Encouraging the implementation of a reminder system could lead to an increase in mammography screening at appropriate intervals.
Opportunity for Improvement	Many American women do not receive mammograms at recommended intervals, as illustrated by 2010 data from the National Health Interview Survey (NHIS)[22] which found that only 72% of women reported receiving a mammogram within the recommended two-year interval. Additional factors found to reduce the likelihood for a woman to receive a mammogram include Asian race, low education status, and recent immigrant status. Low mammography use was also noted for women who reported having no regular source of medical care or having no medical insurance[22].
IOM Domains of Health Care Quality Addressed	• Effective • Patient-centered • Timely • Efficient • Equitable
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center

	• Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Administrative Data/Claims

DRAFT Measure #4:

Exposure reported for procedures using fluoroscopy

Measure Description

Percentage of final reports for procedures using fluoroscopy that include radiation exposure indices, or exposure time and number of fluorographic images (if radiation exposure indices are not available)

Measure Components

Numerator Statement	Final reports for procedures using fluoroscopy that include radiation exposure indices, or exposure time and number of fluorographic images (if radiation exposure indices are not available) Definition: Radiation exposure indices- For the purposes of this measure, radiation exposure indices should, if possible, include at least one of the following: 1. Skin dose mapping 2. Peak skin dose (PSD) 3. Reference air kerma ($K_{a,r}$) 4. Kerma-area product (PKA) If the fluoroscopic equipment does not automatically provide any of the above radiation exposure indices, exposure time and the number of fluorographic images taken during the procedure may be used. Numerator Instruction: Documentation-Information populating the final report may reside in a dedicated field in the electronic health record (EHR) or picture archiving and communication system (PACS), however fluoroscopy exposure dose or time should be included in the final report in order to be readily accessible in all circumstances Image count: Only images that require additional exposure to ionizing radiation, not those that are captured electronically from the imaging chain without additional exposure, should be counted
Denominator Statement	All final reports for procedures using fluoroscopy
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted <u>verbatim</u> from the referenced clinical guidelines and other references: All available radiation dose data should be recorded in the patient's medical record [6,11,12]. If cumulative air kerma or air kerma-area-product data are not available, the fluoroscopic exposure time and the number of acquired images (radiography, cine, or digital subtraction angiography)

	should be recorded in the patient's medical record. (ACR, 2013)[25] For the present, and for the purpose of this guideline, adequate recording of dose metrics is defined as documentation in the patient record of at least one of the following for all interventional procedures requiring fluoroscopy (in descending order of desirability): skin dose mapping, PSD, Ka,r, PKA, and fluoroscopic time/number of fluorographic images (**Table 3**). Note, however, that this is adequate recording; this document recommends recording of all available dose metrics. (SIR, 2012)[26] [ACR] should now encourage practices to record actual fluoroscopy time for all fluoroscopic procedures. The fluoroscopy time for various procedures (eg, upper gastrointestinal, pediatric voiding cystourethrography, diagnostic angiography) should then be compared with benchmark figures…More complete patient radiation dose data should be recorded for all high-dose interventional procedures, such as embolizations, transjugular intrahepatic portosystemic shunts, and arterial angioplasty or stent placement anywhere in the abdomen and pelvis. (Amis et al., ACR, 2007)[27] Measure & record patient radiation dose: Record fluoroscopy time Record available measures - DAP (dose area product), cumulative dose, skin dose (NCI, 2005)[28]

Measure Importance

Relationship to desired outcome	Increasing physician awareness of patient exposure to radiation is an important step towards reducing the potentially harmful effects of radiation as a result of imaging studies. One study by Darling et al[29] found a significant correlation between documentation of fluoroscopy time by the radiologist in the dictated radiology report and reduced overall fluoroscopy time. Additional studies demonstrate that providing physicians with feedback regarding their fluoroscopy time leads to a reduction in average fluoroscopy times[30,31].
Opportunity for Improvement	Studies have demonstrated a general lack of awareness among physicians and radiologists of the relative doses of various imaging studies[32,33,34,]. In one study[32] by Lee et al, only 22% of emergency department physicians and 13% of radiologists were able to give an accurate estimate of the radiation dose of a CT scan as compared to a chest radiograph. Additionally, studies[31,35,36,37,38] have shown that fluoroscopy time for a given imaging study varies from physician to physician based on a variety of factors including gender and level of experience.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Efficient
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Administrative Data/Claims • Electronic Health/Medical Record • Registry Data

DRAFT Measure #5:

Utilization of ultrasonography in children with clinically suspected appendicitis

Measure Description

Percentage of patients aged 14 years and younger with clinically suspected appendicitis who undergo computed tomography (CT), magnetic resonance imaging (MRI), or ultrasound of the abdomen or pelvis for whom ultrasound was used as the initial imaging evaluation of the appendix

Measure Components

Numerator Statement	Patients for whom ultrasound was used as the initial imaging evaluation of the appendix
Denominator Statement	All patients aged 14 years and younger with clinically suspected appendicitis who undergo CT or MRI or ultrasound of the abdomen or pelvis Definitions: Clinically suspected appendicitis-for the purposes of this measure, clinically suspected appendicitis includes right lower quadrant pain
Denominator Exceptions	Medical reason(s) for not using ultrasound as the initial imaging evaluation of the appendix (eg, patient is obese, other medical reason(s)) Definitions: Obesity- for this measure, obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex
Supporting Guideline & Other References	The following evidence statements are quoted <u>verbatim</u> from the referenced clinical guidelines and other references: Although CT is more accurate, US is nearly as good in experienced hands, and given the lack of ionizing radiation, is the preferred examination in children, particularly if equivocal results are followed up by CT. Thus the CT – after US – approach appears to have excellent accuracy, with reported sensitivity and specificity of 94%. A single retrospective study showed that in intermediate-to-high pretest probability children, US followed by CT is most cost-effective, whereas, in low pretest probability patients, US alone is the most effective and least costly strategy. (ACR, 2010)[39] In children, US is the preferred initial examination, as it is nearly as accurate as CT for diagnosis of appendicitis without exposure to ionizing radiation. (ACR, 2010)[39] In children, use ultrasound to confirm acute appendicitis but not to definitively exclude acute appendicitis. (Level B) (ACEP, 2010)[40] In children, use an abdominal and pelvic CT to confirm or exclude acute appendicitis. (Level B) (ACEP, 2010)[40]

Measure Importance

Relationship to desired outcome	In recent years there has been growing concern about excess radiation exposure in the pediatric population. Radiation exposure is especially significant among pediatric patients due to various reasons including increased sensitivity and longer life expectancy[41]. Despite having a lower sensitivity than CT, ultrasound has been shown to have high diagnostic accuracy for patients presenting with symptoms of acute appendicitis[42]. The use of routine ultrasound with selective CT has been demonstrated to be an effective approach for accurately diagnosing appendicitis while minimizing costs and exposure to ionizing radiation[43,44,45,46,47].
Opportunity for Improvement	CT use among children presenting with abdominal pain has increased significantly over time[48]. Recent evidence has shown that imaging practices for pediatric appendicitis vary by clinical setting and physician specialty[49,50]. For example, a study by Saito et al[49] found that children's hospitals were more likely to use ultrasound as the initial imaging study while community hospitals were more likely to use CT.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Efficient • Equitable
Exception Justification	A medical reason exception has been included so that patients for whom ultrasound is not the appropriate initial imaging can be excluded from the measure.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Facility
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #6:

Radiation consideration for adult computed tomography (CT): utilization of dose reduction techniques

Measure Description

Percentage of final reports for patients aged 18 years and older undergoing computed tomography (CT) with documentation that one or more of the following dose reduction techniques were used:

- Automated exposure control
- Adjustment of the milli-amps (mA) and/or kilo-voltage (kV) according to patient size
- Use of iterative reconstruction technique

Measure Components

Numerator Statement	Final reports with documentation that one or more of the following dose reduction techniques were used: • Automated exposure control • Adjustment of the mA and/or kV according to patient size • Use of iterative reconstruction technique
Denominator Statement	All final reports for patients aged 18 years and older undergoing CT
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: CT examinations should be performed only for a valid medical reason and with the minimum exposure that provides the image quality necessary for adequate diagnostic information. (ACR, 2011)[51] Radiologists, medical physicists, registered radiologist assistants, radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. (ACR, 2011)[51] Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active; if not; manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Periodically,

	radiation exposures should be measured and patient radiation doses estimated by a medical physicist in accordance with the appropriate ACR Technical Standard. (ACR, 2011)[51]

Measure Importance

Relationship to desired outcome	Mettler et al[1] estimate that CT scans account for 17% of total imaging procedures performed in the United States each year and 49% of the collective radiation dose from imaging procedures. Current advances in technology have resulted in several methods to reduce radiation dose for patients undergoing CT. Studies show that the use of CT dose reduction techniques can reduce radiation dose by 40%-50% without sacrificing image quality or diagnostic ability[52,53,54].
Opportunity for Improvement	More than 67 million CT scans are performed in the U.S. each year[1]. With the increasing number of CT scans being performed, the use of dose reduction techniques becomes more important than ever. As these techniques are relatively new, there is paucity of data related to their current implementation and use. However, one 2013 study[55] by Vance et al showed significant variability in the use of CT scans based on patient characteristics (eg, age, sex, race, insurance status) and geographic location. These variations may result in disproportionate radiation exposure for some patient populations. With variability in the use of CT, care must be taken to ensure that dose reduction techniques are applied uniformly across patient populations to minimize excess exposure.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Patient-centered • Efficient • Equitable
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Facility
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing

	facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #7:

Appropriate use of imaging for non-traumatic shoulder pain

Measure Description

Percentage of imaging studies for patients aged 18 years and older with non-traumatic shoulder pain who undergo shoulder magnetic resonance imaging (MRI), magnetic resonance arthrography (MRA), or a shoulder ultrasound who are known to have had shoulder radiographs performed within the preceding 3 months based on information from the radiology information system (RIS), patient-provided radiological history, or other health-care source

Measure Components

Numerator Statement	Imaging studies for patients known to have had shoulder radiographs performed within the preceding 3 months based on information from the RIS, patient-provided radiological history, or other health-care source* *Note: Images and/or results of prior shoulder radiographs should be available to radiologist at the time of the shoulder MRI, MRA, or ultrasound. If the report, but not images, from prior radiographs are available, this should be noted in the final report.
Denominator Statement	All imaging studies for patients aged 18 years and older with non-traumatic shoulder pain who undergo shoulder MRI, MRA, or a shoulder ultrasound
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: Acute (<2 weeks) shoulder pain can be attributable to structures related to the glenohumeral articulation and joint capsule, the rotator cuff, acromioclavicular joint, and scapula. Radiography is a safe, fast, low-cost imaging modality that effectively demonstrates many forms of shoulder pathology. However, a multimodal approach may be required to accurately assess shoulder pathology. Radiography is a useful initial screening modality for acute shoulder pain of all causes. Radiography is useful in the evaluation of fractures of the shoulder girdle. .(ACR, 2010)[56] Radiographs are indicated as part of the initial work-up for all chronic shoulder pain. (AFP, 2008)[57] Further testing of chronic shoulder pain should be utilized when the diagnosis remains unclear or the outcome would change management. Imaging options include MRI, arthrography, computed tomography (CT), and ultrasonography. (AFP, 2008)[57]

Measure Importance

Relationship to desired outcome	Shoulder pain is common, affecting approximately 6.7% of the U.S. population[58]. Radiographs are indicated as part of the initial work-up for shoulder pain. Advanced imaging studies should only be utilized when the diagnosis remains unclear. In recent years, there has been growing concern regarding the overuse of imaging services[59]. One report estimates that 20%-50% of diagnostic imaging studies fail to provide information that improves the diagnosis or treatment of the patient[60].
Opportunity for Improvement	From 1996 to 2005, the use of musculoskeletal MRIs increased by 353.5% among Medicare recipients, while the use of musculoskeletal CT scans increased by 326.5%. In comparison, the use of musculoskeletal x-rays only increased 19.1%[61]. A recent study by George et al[62] found that approximately 35% of all shoulder MRIs were performed without recent prior radiographs.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Timely • Efficient • Equitable
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Facility
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #8:

Appropriate use of imaging for non-traumatic knee pain

Measure Description

Percentage of imaging studies for patients aged 18 years and older with non-traumatic knee pain who undergo knee magnetic resonance imaging (MRI) or magnetic resonance arthrography (MRA) who are known to have had knee radiographs performed within the preceding 3 months based on information from the radiology information system (RIS), patient-provided radiological history, or other health-care source

Measure Components

Numerator Statement	Imaging studies for patients known to have had knee radiographs performed within the preceding 3 months based on information from the RIS, patient-provided radiological history, or other health-care source* *Note: Images and/or results of prior knee radiographs should be available to the radiologist at the time of the knee MRI or MRA. If the report, but not images, from prior radiographs are available, this should be noted in the final report.
Denominator Statement	All imaging studies for patients aged 18 years and older with non-traumatic knee pain who undergo knee MRI or MRA
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: • The initial imaging examination for nontraumatic knee pain is radiography. • An MRI examination for nontraumatic knee pain is indicated when the pain is persistent and conventional radiographs are nondiagnostic or when additional information is necessary before instituting treatment. • An MRI is not indicated before a physical examination or routine conventional radiographs, or when there is diagnostic radiographic evidence of severe degenerative joint diseases, inflammatory arthritis, stress fracture, osteonecrosis, or reflex sympathetic dystrophy, for which additional imaging is not going to alter the treatment plan. (ACR, 2012)[63]

Measure Importance

Relationship to desired outcome	Knee pain is common, affecting approximately 13.3% of the U.S. population[58]. Radiographs are indicated as part of the initial work-up for knee pain. Advanced imaging studies should only be utilized when the diagnosis remains unclear. In recent years, there has been growing concern regarding

	the overuse of imaging services[59]. One report estimates that 20%-50% of diagnostic imaging studies fail to provide information that improves the diagnosis or treatment of the patient[60].
Opportunity for Improvement	From 1996 to 2005 the use of musculoskeletal MRIs increased by 353.5% among Medicare recipients, while the use of musculoskeletal CT scans increased by 326.5%. In comparison, the use of musculoskeletal x-rays only increased 19.1%[61]. A recent study by George et al[62] found that approximately 28% of all knee MRIs are performed without recent prior radiographs.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Timely • Efficient • Equitable
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Facility
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #9:

Use of premedication before contrast-enhanced imaging studies in patients with documented contrast reaction

Measure Description

Percentage of final reports for patients aged 18 years and older who had a previously documented contrast reaction who undergo any imaging examination using intravenous iodinated contrast that include documentation that the patients were pre-medicated with corticosteroids with or without H1 antihistamines

Measure Components

Numerator Statement	Final reports for patients who were pre-medicated with corticosteroids with or without H1 antihistamines
Denominator Statement	All final reports for patients aged 18 years and older with a previously documented contrast reaction* who undergo any imaging examination using intravenous iodinated contrast Definition: Contrast reaction: allergic-like reaction following a prior imaging examination with intravenous iodinated contrast
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: The primary indication for premedication is pre-treatment of "at-risk" patients who require contrast media. In this context, "at-risk" means at higher risk for an acute allergic-like reaction. (ACR, 2013)[64] Before deciding to premedicate an "at-risk" patient, some consideration should be given to the goals of such premedication. Ideally, one would like to prevent all contrast reactions, including minor, moderate, and severe ones. However, it is most important to target premedication to those who, in the past, have had moderately severe or severe reactions requiring treatment. (ACR, 2013)[63] No premedication strategy should be a substitute for the preadministration preparedness discussed in this manual. Contrast reactions occur despite premedication prophylaxis. The radiologist must be prepared and able to treat these reactions. Most commonly, a repeat reaction will be similar to the patients' initial reaction; however, there is a chance that a recurrent reaction will be more or less severe. (ACR, 2013)[63]

Measure Importance

Relationship to desired outcome	Reactions to contrast media are common, occurring in as many as 13% of patients[65]. Most reactions are mild, with severe reactions occurring in <1% of cases[64]. Premedication with corticosteroids has been shown to reduce the rate of contrast reactions by as much as 35% among "high risk" patients who have had a previous reaction to contrast media[66].
Opportunity for Improvement	In a 2011 survey[67] of uroradiologists, 86% of respondents reported having a standardized premedication regimen. Additionally, the survey found significant variability in the use of premedication for specific clinical scenarios such as an urgent or emergent situation.
IOM Domains of Health Care Quality Addressed	• Safe • Effective • Patient-centered • Efficient
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #10:

Extravasation of contrast following contrast-enhanced computed tomography (CT)

**For this measure, a lower score indicates higher quality*

Measure Description

Percentage of final reports for patients aged 18 years and older who received intravenous iodinated contrast for a computed tomography (CT) examination who had an extravasation of contrast

Measure Components

Numerator Statement	Final reports for patients who had an extravasation of contrast Definition: Extravasation- Although most patients complain of initial swelling or tightness, and/or stinging or burning pain at the site of extravasation, some experience little or no discomfort. On physical examination, the extravasation site may be edematous, erythematous, and tender (ACR Contrast Manual, 2013)
Denominator Statement	All final reports for patients aged 18 years and older who received intravenous iodinated contrast for a CT examination
Denominator Exceptions	None
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: Extravasated iodinated contrast media are toxic to the surrounding tissues, particularly to the skin, producing an acute local inflammatory response that sometimes peaks in 24 to 48 hours. The acute tissue injury resulting from extravasation of iodinated contrast media is possibly related primarily to the hyper-osmolality of the extravasated fluid. Despite this, the vast majority of patients in whom extravasations occur recover without significant sequelae. Only rarely will a low-osmolality contrast media (LOCM) extravasation injury proceed to a severe adverse event. Most extravasations are limited to the immediately adjacent soft tissues (typically the skin and subcutaneous tissues). Usually there is no permanent injury. The most commonly reported severe injuries after extravasation of LOCM are compartment syndromes. A compartment syndrome may be produced as a result of mechanical compression. A compartment syndrome is more likely to occur after extravasation of larger volumes of contrast media; however, it also has been observed after extravasation of relatively small volumes, especially when this occurs in less capacious areas (such as over the ventral or dorsal surfaces of the wrist). Less commonly, skin ulceration and tissue necrosis can occur as severe manifestations and can be encountered as early as six hours after the extravasation has occurred. (ACR,

	2013)[63] All extravasation events and their treatment should be documented in the medical record, especially in the dictated imaging report of the obtained study, and the referring physician should be notified. (ACR, 2013)[63] The reported incidence of intravenous (IV) contrast media extravasation related to power injection for CT has ranged from 0.1% to 0.9% (1/1,000 patients to 1/106 patients). (ACR, 2013)[63]

Measure Importance

Relationship to desired outcome	Extravasation of contrast leads to a local inflammatory response that can, in turn, cause acute tissue injury. Patients experiencing extravasation can have symptoms ranging from swelling and burning pain to skin ulceration, tissue necrosis, and compartment syndrome in extreme cases[63].
Opportunity for Improvement	Extravasation is a relatively common occurrence that affects 1 out of 147 patients who are given intravenous contrast[68]. Elderly patients and small children, as well as patients with limited communication abilities, severe illness or debilitation, or abnormal circulation, are at increased risk for extravasation[63].
IOM Domains of Health Care Quality Addressed	• Safe • Patient-centered
Exception Justification	This measure has no exceptions.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Outcome
Level of Measurement	• Facility
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #11

Appropriate follow-up imaging for incidental thyroid nodules

**For this measure, a lower score indicates higher quality*

Measure Description

Percentage of final reports for computed tomography (CT) or magnetic resonance imaging (MRI) studies of the chest or neck or ultrasound of the neck for patients aged 18 years and older with no known thyroid disease with a thyroid nodule < 1.0 cm noted incidentally with follow-up imaging recommended

Measure Components

Numerator Statement	Final reports for CT or MRI of the chest or neck or ultrasound of the neck with follow-up imaging recommended
Denominator Statement	All final reports for CT or MRI studies of the chest or neck or ultrasound of the neck for patients aged 18 and older with a thyroid nodule < 1.0 cm noted
Denominator Exceptions	Documentation of medical reason(s) that follow-up imaging is indicated (eg, patient has multiple endocrine neoplasia, patient has cervical lymphadenopathy, other medical reason(s))
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: Nonpalpable nodules detected on US or other anatomic imaging studies are termed incidentally discovered nodules or ''incidentalomas.'' Nonpalpable nodules have the same risk of malignancy as palpable nodules with the same size. Generally, only nodules >1 cm should be evaluated, since they have a greater potential to be clinically significant cancers. (ATA, 2009)[69]

Measure Importance

Relationship to desired outcome	Thyroid nodules are common, with estimates of prevalence as high as 50%[70]. Desser and Kamaya[71] found that the majority of incidentally noted thyroid nodules were benign with approximately 5% being malignant. Due to the common nature of small thyroid nodules combined with the low malignancy rate, additional follow-up is not recommended (ATA, 2009)[68].
Opportunity for Improvement	In their 2010 review[72] of the literature, Ahmed et al concluded that there is significant inconsistency in how incidental thyroid nodules are reported and followed up by radiologists. Given the common nature of thyroid nodules, unnecessary follow-up of these nodules can result in excessive testing and costs for patients.
IOM Domains of Health Care Quality Addressed	• Effective • Patient-centered • Efficient • Equitable

Exception Justification	A medical reason exception has been included so that clinicians can exclude patients for whom follow-up imaging is appropriate.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #12:

Appropriate follow-up imaging for incidental abdominal lesions

**For this measure, a lower score indicates higher quality*

Measure Description

Percentage of final reports for abdominal imaging studies for asymptomatic patients aged 18 years and older with one or more of the following noted incidentally with follow-up imaging recommended:

- liver lesion ≤ 1.5 cm
- kidney lesion < 1.0 cm
- adrenal lesion ≤ 4.0 cm

Measure Components

Numerator Statement	Final reports for abdominal imaging studies with follow-up imaging recommended
Denominator Statement	All final reports for abdominal imaging studies for patients aged 18 years and older with one or more of the following noted: • liver lesion ≤ 1.5 cm • kidney lesion < 1.0 cm • adrenal lesion ≤ 4.0 cm
Denominator Exceptions	Documentation of medical reason(s) that follow-up imaging is indicated (eg, patient has a known malignancy that can metastasize, other medical reason(s))
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: The Incidental Findings Committee recommends the following for low-dose unenhanced CT examinations for liver masses: 1. In low-risk and average-risk patients, sharply marginated, low-attenuation (<20 HU) solitary or multiple masses may typically not need further evaluation. 2. Small, solitary masses ≤1.5 cm that are not cystic and are discovered on unenhanced or standard-dose or low-dose scans in low-risk and average-risk patients may typically not need further evaluation. (ACR, 2010)[73] The Incidental Findings Committee recommends the following for low-dose unenhanced CT examination for renal masses: 1. It may be appropriate to interpret incidental renal masses as simple cysts unless suspicious features noted [earlier within the document] are convincingly present. The argument for adopting this approach is even stronger when considering small (<3 cm) masses, particularly those <1 cm. The smaller the mass (even when solid), the more likely it is benign. Furthermore, masses <1 cm may not be able to be fully characterized, even if renal mass-protocol CT or MRI was performed. Although this represents a consensus opinion of the committee, no data are yet

	available to support this approach. 2. If a renal mass is small (<3 cm), homogenous, any >70 HU, recent data suggest that the mass can be confidently diagnosed as a benign hyperattentuating cyst (Bosniak category II). (ACR, 2010)[72] The Incidental Findings Committee recommends the following for low-dose unenhanced CT examinations for adrenal masses: 1. Because attenuation should not be altered by a lowdose technique, if the mean attenuation of an adrenal mass is ≤10 HU on a low-dose CT examination, one may conclude that the adrenal mass is likely to be a benign adenoma. 2. If a lesion is >10 HU and 1 to 4 cm in an asymptomatic patient without cancer, 1-year follow-up CT or MRI may be considered, if no prior studies for comparison are available. Prior examinations that show stability for ≥1 year can eliminate the need for further workup, so every effort should be made to obtain prior CT or MRI examinations in these situations. 3. For adrenal masses >4 cm, dedicated adrenal MRI or CT should be considered to further characterize. (ACR, 2010)[72]

Measure Importance

Relationship to desired outcome	Incidental kidney, liver, and adrenal lesions are commonly found during abdominal imaging studies, with most of the findings being benign[74,75,76,77]. Given the low rate of malignancy, unnecessary follow-up procedures are costly and present a significant burden to patients[73,78]. To avoid excessive testing and costs, follow-up is not recommended for these small lesions.
Opportunity for Improvement	There is considerable variability among radiologists in the management of incidental findings. A 2011 survey[79] conducted by Johnson et al found significant variability in how radiologists report and manage incidental findings. In a more recent survey[80] of members of the American College of Radiology, 38% of respondents were aware of the guidance around incidental findings. Among respondents who were aware of the guidance, 89% replied that they were applying the recommendations in their practice.
IOM Domains of Health Care Quality Addressed	• Effective • Patient-centered • Efficient • Equitable
Exception Justification	A medical reason exception has been included so that clinicians can exclude patients for whom follow-up imaging is appropriate.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement

Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care: surgical center • Ambulatory care: clinician office/clinic • Ambulatory care: outpatient rehabilitation • Ambulatory care: urgent care • Hospital/acute care facility • Imaging facility • Post-acute/long term care facility: nursing home/skilled nursing facility • Post-acute/long term care facility: inpatient rehabilitation facility • Post-acute/long term care facility: long term acute care hospital
Data source	• Electronic Health/Medical Record • Registry Data

DRAFT Measure #13:

Appropriate follow-up imaging for incidental simple ovarian cysts

**For this measure, a lower score indicates higher quality*

Measure Description

Percentage of final reports for ultrasound studies of the pelvis for pre-menopausal women aged 18 and older with no known ovarian disease with a simple ovarian cyst <5.0cm noted incidentally with follow-up imaging recommended

Measure Components

Numerator Statement	Final reports of ultrasound studies of the pelvis with follow-up imaging recommended
Denominator Statement	All final reports for ultrasound studies of the pelvis for pre-menopausal women aged 18 and older with a simple ovarian cyst <5.0 cm noted
Denominator Exceptions	Documentation of medical reason(s) that follow-up imaging is indicated (eg, patient has a known malignancy that can metastasize, known to be menopausal , other medical reason(s))
Supporting Guideline & Other References	The following evidence statements are quoted verbatim from the referenced clinical guidelines and other references: In women of reproductive age: 1. Cysts ≤ 3cm: Normal physiologic findings; at the discretion of the interpreting physician whether or not to describe them in the imaging report; do not need follow up. 2. Cysts >3 and ≤ 5cm: Should be described in the imaging report with a statement that they are almost certainly benign; do not need follow up (SRU, 2010)[81] Simple cysts and hemorrhagic cysts in women of reproductive age are almost always physiologic. Small simple cysts in postmenopausal women are common, and clinically inconsequential. Ovarian cancer, while typically cystic, does not arise from these benign-appearing cysts. After a good quality ultrasound in women of reproductive age, DON'T recommend follow-up for a classic corpus luteum or simple cyst <5 cm in greatest diameter. Use 1 cm as a threshold for simple cysts in postmenopausal women. (ACR for Choosing Wisely, 2013)[59] Characterization of an adnexal mass as a cyst is important for management. US identification of a simple cyst establishes a benign process in 100% of premenopausal women and in 95-99% of postmenopausal women. A recent consensus conference at the Society of Radiologists in Ultrasound in 2009 reviewed the management of asymptomatic ovarian and other adnexal cysts. Most cysts in premenopausal women are functional in nature and will resolve spontaneously. Most ACR Appropriateness Criteria® 10 Clinically Suspected Adnexal Mass nonfunctional cysts in premenopausal women with classically complex, but benign, US features (such as endometriomas, simple cysts,

	teratomas, and hydrosalpinges) measuring <5 cm in diameter have been shown to remain unchanged during long-term follow-up. Therefore, it is possible to manage these lesions safely by US follow-up rather than surgical intervention in asymptomatic women. (ACR, 2012)[82] Simple cysts up to 10 cm in diameter on ultrasound findings are almost universally benign and may safely be followed without intervention, even in postmenopausal patients. (Level B) (ACOG, 2007)[83] In asymptomatic women with pelvic masses, whether premenopausal or postmenopausal, transvaginal ultrasonography is the imaging modality of choice. No alternative imaging modality has demonstrated sufficient superiority to transvaginal ultrasonography to justify its routine use. (Level B) (ACOG, 2007)[82]

Measure Importance

Relationship to desired outcome	Simple ovarian cysts are a common finding in ultrasound studies. A study[84] by Hui et al found simple ovarian cysts in 23% of pelvic ultrasound studies. Evidence shows that approximately 70% of small simple ovarian cysts resolve spontaneously[85]. Additionally, small simple ovarian cysts have an extremely low malignancy rate of <1%[84,86]. Due to low malignancy and high resolution rates, follow-up of these small cysts is not recommended[80,81,82].
Opportunity for Improvement	Since the Society of Radiologists in Ultrasound published their consensus statement[80] for the management of adnexal cysts in 2010, several studies[83,87,88] have been published evaluating adherence to the recommendations. Adherence to the follow-up recommendations for ovarian cysts varies widely from 59%-95%. Evidence shows that quality improvement initiatives can be effective at improving adherence with the recommendations by up to 7% and reducing the number of pelvic sonograms performed by 27%[83,86].
IOM Domains of Health Care Quality Addressed	• Effective • Patient-centered • Efficient • Equitable
Exception Justification	A medical reason exception has been included so that clinicians can exclude patients for whom follow-up imaging is appropriate.
Harmonization with Existing Measures	Harmonization with existing measures was not applicable to this measure.

Measure Designation

Measure purpose	• Accountability • Quality improvement
Type of measure	• Process
Level of Measurement	• Individual Practitioner
Care setting	• Ambulatory care

	• Inpatient care
Data source	• Electronic Health/Medical Record • Registry Data

Evidence Classification and Rating Schemes

Rating Scheme for the Strength of the Evidence for the U.S. Preventive Services Task Force (USPSTF)

Grade	Definition	Suggestions for Practice
A	The USPSTF recommends the service. There is high certainty that the net benefit is substantial	Offer/provide this service
B	The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial	Offer/provide this service
C	The USPSTF recommends against routinely providing the service. There may be considerations that support providing the service in an individual patient. There is moderate or high certainty that the net benefit is small.	Offer/provide this service only if other considerations support offering or providing the service in an individual patient.
D	The USPSTF recommends against this service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Discourage the use of this service
I statement	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.	Read the clinical considerations section of the USPSTF Recommendation Statement. If the service is offered, patients should understand the uncertainty about the balance of benefits and harms.

Rating Scheme for the Strength of the Evidence for the American College of Emergency Physicians (ACEP)

Strength of Evidence and Literature Classification Schema*

Design/Class	Therapy†	Diagnosis‡	Prognosis§
1	Randomized, controlled trial or meta-analyses of randomized trials	Prospective cohort using a criterion standard	Population prospective cohort
2	Nonrandomized trial	Retrospective observational	Retrospective cohort Case control
3	Case series Case report Other (e.g., consensus, review)	Case series Case report Other (e.g., consensus, review)	Case series Case report Other (e.g., consensus, review)

*Some designs (e.g., surveys) will not fit this schema and should be assessed individually.
†Objective is to measure therapeutic efficacy comparing ≥2 interventions.
‡Objective is to determine the sensitivity and specificity of diagnostic tests.
§Objective is to predict outcome including mortality and morbidity.

Approach to Downgrading Strength of Evidence*

	Design/Class		
Downgrading	1	2	3
None	I	II	III
1 level	II	III	X
2 levels	III	X	X
Fatally flawed	X	X	X

Strength of Recommendations

Level A recommendations. Generally accepted principles for patient management that reflect a high degree of clinical certainty (i.e., based on strength of evidence Class I or overwhelming evidence from strength of evidence Class II studies that directly address all of the issues)

Level B recommendations. Recommendations for patient management that may identify a particular strategy or range of management strategies that reflect moderate clinical certainty (i.e., based on strength of evidence Class II studies that directly address the issue, decision analysis that directly addresses the issue, or strong consensus of strength of evidence Class III studies)

Level C recommendations. Other strategies for patient management that are based on preliminary, inconclusive, or conflicting evidence, or, in the absence of any published literature, based on panel consensus

There are certain circumstances in which the recommendations stemming from a body of evidence should not be rated as highly as the individual studies on which they are based. Factors such as heterogeneity of results, uncertainty about effect magnitude and consequences, strength of prior beliefs, and publication bias, among others, might lead to such a downgrading of recommendations.

Rating Scheme for the Strength of the Evidence for the American College of Obstetricians and Gynecologists (ACOG)

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

I Evidence obtained from at least one properly designed randomized controlled trial.
II-1 Evidence obtained from well-designed controlled trials without randomization.
II-2 Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.
II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Rating Scheme for the Strength of the Evidence for the American College of Radiology (ACR) Appropriateness Criteria®

Evidence Table Development — Diagnostic Studies

The Evidence Table (ET) summarizes the results of the articles cited in the AC topic narrative and documents the collection of information used to rate the study quality. The creation and revision of the ET is performed by ACR staff in order to consistently apply the methodology and, to a lesser extent, to alleviate some of the burden on the topic authors. AC topic authors and panel members review the ETs for completeness and accuracy. The staff uses an MS Excel spreadsheet to record the findings and to produce the ET.

Description of the ET Elements recorded on MS Excel Spreadsheet:

I. Staff determines the **Study Type** among one of three categories. The inconsistency of study design names and definitions, varying degrees of adherence to study design, study design hybridization, and the lack of reliable information in an article's study methodology is best addressed by a broad categorization of study types. The guidance for staff regarding classifying these types is in the appendix.

A. *Experimental*
B. *Observational*
C. *Review/Other*

II. Staff records the **Number and Type of Patients or Events in Study**.

III. Staff copies the **Study Objective (Purpose of Study)** from the abstract or briefly paraphrases it.

IV. Staff copies the primary **Study Results** from the abstract or briefly paraphrases it.

V. Staff determines if the study has a **Statistical Measure** (e.g., sensitivity/specificity, PPV/NPV, mean, median, Kappa, Pearson r, regression co-efficient, etc.). The statistical measure must compare the results (60% diagnosed on CT versus 70% on MRI) or a defined reference standard, endpoint, or a conclusion. Statistical measures that only relate to **describing** the study population (median income) or number of events (percent who got an imaging procedure) do not meet the criteria for the **Statistical Measure** element. If there is no **Statistical Measure**, the article is categorized as **Study Type** *Review/Other* and does not meet the ACR AC criteria for the definition of a study. Study Quality Elements are not completed and the study quality is entered as "4".

VI. Staff determines whether the following **Study Quality Elements** for diagnostic studies are described in the article.

A. **Uncertainty measure (or range) of the statistical measure** (standard errors, confidence intervals, p-values, mention of statistical of comparison tests such as t-test, Fisher exact probability, Mann-Whitney U, etc.)
B. **Prospective** study, i.e., the data collection was planned before the index test and reference standard were performed
C. **Systematic recruitment** of patients or if the study has recruited a **consecutive series** of patients
D. Imaging, pathologic or clinical **standard of reference** or a comparison of at least two imaging, pathologic or clinical tests
E. **Reference standard applied** to all subjects in the same way or each imaging, pathologic or clinical tests in the study has been applied to all subjects in the same way

F. Two or more **independent readers** of the index test (not consensus reads) or two or more independent readers for each test in the study
G. **Index test results** were interpreted without knowledge of the results of the reference standard
H. **Reference standard results** were interpreted without knowledge of the results of the index

VII. The worksheet automatically assigns the Study Quality by calculating the number of elements recorded as present in the article by using the following method:
Assigning the Study Quality Category using Study Quality Elements:
Category 1 must have all eight study quality elements present
Category 2 must have 6 or 7 elements present
Category 3 must have more than 2 but less than 6 elements present (i.e., 3, 4 or 5 elements present)
Category 4 has 2 or fewer elements present, (i.e., 0, 1, or 2 elements)
Study Quality Category Definitions:
Category 1 The study is well-designed and accounts for common biases.
Category 2 The study is moderately well-designed and accounts for most common biases.
Category 3 There are important study design limitations.
Category 4 The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
c) the study is an expert opinion or consensus document.

Non-Material Interest Disclosures
Non-Cardiac Diagnostic Imaging

None of the members of the Non-Cardiac Diagnostic Imaging Work Group had any disqualifying material interests under the PCPI Conflict of Interest Policy. The following is a summary of non-disqualifying interests disclosed on Work Group members' Material Interest Disclosure Statements (not including information concerning family member interests). Completed Material Interest Disclosure Statements are available upon request.

Work Group Member	Disclosures
William Golden, MD	None
David Seidenwurm, MD	Ownership: Radiological Associates Medical Group; Financial Relationship: American College of Radiology; Non-Financial Relationship: Radiological Associates Medical Group, American College of Radiology, National Quality Forum, American Society of Neuroradiology
Michael Bettmann, MD	None
Dorothy Bulas, MD	None
Rubin I. Cohen, MD, FACP, FCCP, FCCM	Financial Relationship: Gilead Science Speaker Bureau, American Lung Association, CF Foundation; Non-Financial Relationship: American College of Chest Physicians
Richard T. Griffey, MD, MPH	None
Eric J. Hohenwalter, MD	None
Deborah Levine, MD, FACR	None
Mark Morasch, MD	None
Paul Nagy, MD, PhD	None
Mark R. Needham, MD, MBA	None
Hoang D. Nguyen	None
Charles J. Prestigiacomo, MD, FACS	Consulting Services: Aesculap, Stryker Neurovascular; Non-Financial: International Brain Research Foundation, Society of Neurointerventional Surgery, American Association of Neurological Surgeons, Congress of Neurological Surgeons, American Heart Association
William G. Preston, MD, FAAN	Ownership: William G. Preston, MD, Inc.; Financial Relationship: TEVA, Merck, Chelsea Therapeutics; Xeomin, Allergan, Accera; Fiduciary relationship: American Society of Neuroimaging, California Neurology Society; Non-Financial Relationship: Intersocietal Commission for Accreditation of MRI
Robert Pyatt, Jr., MD	Ownership: Chambersburg Imaging Associates, P.C.
Robert Rosenberg, MD	None
David A. Rubin, MD	Financial Relationship: American College of Radiology, Legal Expert Witness
B. Winifred (B.W.) Ruffner, MD, FACP	None
Frank Rybicki, MD, PhD, FAHA	None
Cheryl A. Sadow, MD	None
John Schneider, MD, PhD	None
Gary Schultz, DC, DACR	None
Paul R. Sierzenski, MD, RDMS	None
Michael Wasylik, MD	None

References

[1] Mettler FA, Bhargavan M, Faulkner K, et al. Radiologic and nuclear medicine studies in the United States and worldwide: frequency, radiation dose, and comparison with other radiation sources—1950-2007. *Radiology.* 2009;253(2):520-531.
[2] Smith-Bindman R, Miglioretti DI, Johnson E, et al. Use of diagnostic imaging studies and associated radiation exposure for patients enrolled in large integrated health care systems, 1996-2010. *JAMA.* 2012;307(22):2400-2409. http://jama.jamanetwork.com/ Accessed October 1, 2013.
[3] National Quality Forum Issue Brief (No.10). Closing the Disparities Gap in Healthcare Quality with Performance Measurement and Public Reporting. Washington, DC: NQF, August 2008.

[4] Ulmer C, McFadden B, Nerenz DR, eds; IOM (Institution of Medicine) Subcommittee on Standardized Collection of Race/Ethnicity Data for Healthcare Quality Improvement. *Race, ethnicity, and language data: standardization for health care quality improvement.* Washington, DC: The National Academies Press; 2009.
[5] Institute of Medicine. *Crossing the quality chasm: a new health system for the 21st century*. Washington, DC: National Academy Press; 2001.
[6] Grant EG, Benson CB, Moneta GL, et al. Carotid artery stenosis: gray-scale and doppler US diagnosis—Society of Radiologists in Ultrasound consensus conference. *Radiology.* 2003; 229:340-346. doi: 10.1148/radiol.2292030516
[7] American College of Radiology, American Society of Neuroradiology, Society of NeuroInterventional Surgery, Society for Pediatric Radiology. ACR-ASNR-SNIS-SPR Practice Guideline for the Performance of Cervicocerebral Magnetic Resonance Angiography (MRA). http://www.acr.org/~/media/D1BC4FB23D4B4005872FDDAE018E0CE7.pdf. Revised 2010. Accessed March 21, 2014.
[8] North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Engl J Med.* 1991;325(7):445-453.
[9] Mayberg MR, Wilson E, Yatsu F, et al. Carotid endarterectomy and prevention of cerebral ischemia in symptomatic carotid stenosis. *JAMA.* 1991;266:3289-3294.
[10] Hobson RW II, Weiss DG, Fields WS, et al; Veterans Affairs Cooperative Study Group. Efficacy of carotid endarterectomy for asymptomatic carotid stenosis. *N Engl J Med.* 1993;328(4):221-227.
[11] Walker MD, Marler JR, Goldstein M; et al. Endarterectomy for asymptomatic carotid artery stenosis. *JAMA.* 1995;273(18):1421-1428. doi:10.1001/jama.1995.03520420037035.
[12] Rothwell PM, Gibson RJ, Slattery J, Sellar RJ, and Warlow CP. Equivalence of measurements of carotid stenosis. A comparison of three methods on 1001 angiograms. European Carotid Surgery Trialists' Collaborative Group. *Stroke.* 1994;25:2435-2439. doi:10.1161/01.STR.25.12.2435. doi:10.1161/01.STR.25.12.2435.
[13] Rothwell PM, Gibson RJ, Slattery J, Warlow CP. Prognostic value and reproducibility of measurements of carotid stenosis. A comparison of three methods on 1001 angiograms. European Carotid Surgery Trialists' Collaborative Group. *Stroke.* 1994;25:2440-2444. doi:10.1161/01.STR.25.12.2440.
[14] Cheng EM, Bravata DM, El-Saden S, et al. Carotid artery stenosis: wide variability in reporting formats—a review of 127 Veterans Affairs medical centers. *Radiology.* 2013;266(1):289-294. doi:10.1148/radiol.12120453.
[15] Giurgea GA, Lilaj I, Gschwandtner ME, et al. Poor agreement in carotid artery stenosis detection by ultrasound between external offices and a vascular center. *Wien Klin WOchenschr*. 2012;124(21-22):769-774. doi:10.1007/s00508-012-0259-1.
[16] American College of Radiology. ACR practice guideline for the performance of screening and diagnostic mammography. http://www.acr.org/~/media/3484ca30845348359bad4684779d492d.pdf. Revised October 2013. Accessed March 21, 2014.
[17] D'Orsi CJ, Bassett LW, Berg WA, et al. BI-RADS: Mammography, 4th edition in: D'Orsi CJ, Mendelson EB, Ikeda DM, et al: Breast Imaging Reporting and Data System: ACR BI-RADS – Breast Imaging Atlas, Reston, VA, American College of Radiology, 2003
[18] Kerlikowske K, Smith-Bindman R, Abraham LA, et al. Breast cancer yield for screening mammographic examinations with recommendation for short-interval follow-up. *Radiology.* 2005;234:684-692. doi:10.1148/radiol.2343031976.
[19] Baum JK, Hanna LG, Acharyya S, et al. Use of BI-RADS 3—probably benign category in the American College of Radiology Imaging Network Digital Mammographic Imaging Screening Trial. *Radiology.* 2011;260(1):61-67.

[20] Community Preventive Services Task Force. Updated recommendations for client- and provider-oriented interventions to increase breast, cervical, and colorectal cancer screening. *Am J Prev Med.* 2012;43(1):92-96. doi:10.1016/j.ampre.2012.04.008.
[21] U.S. Preventive Services Task Force. Screening for breast cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2009;151:716-726.
[22] Centers for Disease Control and Prevention (CDC). Cancer screening—United States, 2010. *MMWR* 2012;61(3):41-45. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6103a1.htm. Accessed 2/3/2014.
[23] Sabatino SA, Lawrence B, Elder R, et al; Community Preventive Services Task Force. Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers: nine updated systematic reviews for the Guide to Community Preventive Services. *Am J Prev Med.* 2012;43(1):97-118. doi:10.1016/j.ampre.2012.04.009
[24] Gardner MP, Adams A, Jeffreys M. Interventions to increase the uptake of mammography amongst low income women: a systematic review and meta-analysis. *PLoS ONE.* 2013;8(2):e55574. doi:10.1371/journal.pone.0055574.
[25] American College of Radiology, American Association of Physicists in Medicine. ACR-AAPM technical standard for management of the use of radiation in fluoroscopic procedures. http://www.acr.org/~/media/f22c9d1ff46f43aab001f9ed0466b7e9.pdf. Revised October 2013. Accessed March 21, 2014.
[26] Miller DL, Balter S, Dixon RG, et al; for Society of Interventional Radiology Standards of Practice Committee. Quality improvement guidelines for recording patient radiation dose in the medical record for fluoroscopically guided procedures. *J Vasc Interv Radiol.* 2012;23:11-18. doi:10.1016/j.jvir.2011.09.004.
[27] Amis ES Jr., Butler PF, Applegate KE, et al. American College of Radiology white paper on radiation dose in medicine. *J Am Coll Radiol.* 2007;4:272-284. doi:10.1016/j.jacr.2007.03.002.
[28] National Cancer Institute; National Institutes of Health. Interventional Fluoroscopy: Reducing Radiation Risks for Patients and Staff. http://www.cancer.gov/cancertopics/causes/radiation/interventionalfluoroscopy/page7. Published April 18, 2005. Accessed March 21, 2014.
[29] Darling S, Sammer M, Chapman T, Parisi MT. Physician documentation of fluoroscopy time in voiding cystourethrography reports correlates with lower fluoroscopy times: a surrogate marker of patient radiation exposure. *Am J Roentgenol.*2011;196:W777-W780. doi:10.2214/AJR.10.5827.
[30] Ngo TC, Macleod LC, Rosenstein DI, Reese JH, Shinghal R. Tracking intraoperative fluoroscopy utilization reduces radiation exposure during ureteroscopy. *J Endourol.* 2011;25(5):763-767. doi:10.1089/end.2010.0624
[31] Ritter M, Siegel F, Krombach P, et al. Influence of surgeon's experience on fluoroscopy time during endourological interventions. *World J Urol.* 2013;31(1):183-187. doi:10.1007/s00345-012-0923-0.
[32] Lee CI, Halms AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. *Radiology.* 2004;231:393-398. doi:10.1148/radiol.2312030767.
[33] Puri S, Hu R, Quazi RR, Voci S, Veazie P, Block R. Physicians' and midlevel providers' awareness of lifetime radiation-attributable cancer risk associated with commonly performed CT studies: relationship to practice behavior. *Am J Roentgenol.* 2012;199:1328-1336. doi:10.2214/AJR.12.8581.
[34] Thomas KE, Parnell-Parmley JE, Haidar S, et al. Assessment of radiation dose awareness among pediatricians. *Pediatr Radiol.* 2006;36:823-832. doi:10.1007/s00247-006-0170-x.
[35] Jorgensen JE, Rubenstein JH, Goodsitt MM, Elta GH. Radiation doses to ERCP patients are significantly lower with experienced endoscopists. *Gastrointest Endosc.* 2010;72(1):58-65. doi:10.1016/j.gie.2009.12.060.
[36] Kim E, McLoughlin M, Lam EC, et al. Prospective analysis of fluoroscopy duration during ERCP: critical determinants. *Gastrointest Endosc.* 2010;72(1):50-57. doi:10.1016/j.gie.2010.04.012.
[37] Kim E, McLoughlin M, Lam EC, et al. Retrospective analysis of radiation exposure during endoscopic retrograde cholangiopancreatography: critical determinants. *Can J Gastroenterol.* 2011;25(10):555-559.
[38] Uradomo LT, Lustberg ME, Darwin PE. Effect of physician training on fluoroscopy time during ERCP. *Dig Dis Sci.* 2006;51(5):909-914. doi: 10.1007/s10620-005-9007-y.
[39] Smith MP, Katz DS, Rosen MP, et al; American College of Radiology Expert Panel on Gastrointestinal Imaging. ACR Appropriateness Criteria® right lower quadrant pain—suspected appendicitis. http://www.acr.org/~/media/ACR/Documents/AppCriteria/Diagnostic/RightLowerQuadrantPainSuspectedAppendicitis.pdf. Reviewed 2013. Accessed March 24, 2014.

[40] Howell JM, Eddy OL, Lukens TW, et al; for American College of Emergency Physicians. Clinical policy: critical issues in the evaluation and management of emergency department patients with suspected appendicitis. *Ann Emerg Med.* 2010;55:71-116. doi:10.1016/j.annemergmed.2009.10.004.
[41] Brenner DJ. Estimating cancer risks from pediatric CT: going from the qualitative to the quantitative. *Pediatr Radiol.* 2002;32:228-231. doi:10.1007/s00247-002-0671-1
[42] Hernandez JA, Swischuk LE, Angel CA, Chung D, Chandler R, Lee S. Imaging of acute appendicitis: US as the primary imaging modality. *Pediatr Radiol.* 2005;35:392-395. doi:10.1007/s00247-004-1372-8.
[43] Toorenvliet BR, Wiersma F, Bakker RFR, Merkus JWS, Breslau PJ, Hamming JF. Routine ultrasound and limited computed tomography for the diagnosis of acute appendicitis. *World J Surg.* 2010;34:2278-2285. doi:10.1007/s00268-010-0694-y.
[44] Ramarajan N, Krishnamoorthi R, Barth R, et al. An interdisciplinary initiative to reduce radiation exposure: evaluation of appendicitis in a pediatric emergency department with clinical assessment supported by a staged ultrasound and computed tomography pathway. *Acad Emerg Med.* 2009;16:1258-1265. doi:10.1111/j.1553-2712.2009.00511.x.
[45] Le J, Kurian J, Cohen HW, Weinberg G, Scheinfeld MH. Do clinical outcomes suffer during transition to an ultrasound-first paradigm for the evaluation of acute appendicitis in children? *Am J Roentgenol.* 2013;201(6):1348-1352. doi:10.2214/AJR.13.10678.
[46] Thirumoorthi AS, Fefferman NR, Ginsburg HB, Kuenzler KA, Tomita SS. Managing radiation exposure in children—reexamining the role of ultrasound in the diagnosis of appendicitis. *J Pediatr Surg.* 2012;47(12):2268-2272. doi:10.1016/j.jpedsurg.2012.09.018.
[47] Krishnamoorthi R, Ramarajan N, Wang NE, et al. Effectiveness of a staged US and CT protocol for the diagnosis of pediatric appendicitis: reducing radiation exposure in the age of ALARA. *Radiology.* 2011;259(1):231-239.
[48] Fahimi J, Herring A, Harries A, Gonzales R, Alter H. Computed tomography use among children presenting to emergency departments with abdominal pain. *Pediatrics.* 2012;130:e1069-e1075. doi:10.1542/peds2012-0739.
[49] Saito JM, Yan Y, Evashwick TW, Warner BW, Tarr PI. Use and accuracy of diagnostic imaging by hospital type in pediatric appendicitis. *Pediatrics.* 2013;131:e37-e44. doi:10.1542/peds2012-1685.
[50] Grim PF. Emergency medicine physicians' and pediatricians' use of computed tomography in the evaluation of pediatric patients with abdominal pain without trauma in a community hospital. *Clin Pediatr.* 2014 Jan. [Epub ahead of print]. doi:10.1177/0009922813517170.
[51] American College of Radiology. ACR practice guideline for performing and interpreting diagnostic computed tomography (CT). http://www.acr.org/~/media/ADECC9E11A904B4D8F7E0F0BCF800124.pdf. Revised October 2011. Accessed March 24, 2014.
[52] Ozdoba C, Slotboom J, Schroth G, et al. Dose reduction in standard head CT: first results from a new scanner using iterative reconstruction and a new detector type in comparison with two previous generations of multi-slice CT. *Clin Neuroradiol.* 2014;24(1):23-28. doi:10.1007/s00062-013-0263-5.
[53] May MS, Eller A, Stahl C, et al. Dose reduction in computed tomography of the chest: image quality of iterative reconstructions at a 50% radiation dose compared to filtered back projection at a 100% radiation dose. *Fortschr Röntgenstr.* 2013; doi: 10.1055/s-0033-1356254.
[54] Kalra MK, Prasad S, Saini S, et al. Clinical comparison of standard-dose and 50% reduced-dose abdominal CT: effect on image quality. *Am J Roentgenol.* 2002;179:1101-1106.
[55] Vance EA, Xie X, Henry A, Wernz C, Slonim AD. Computed tomography scan use variation: patient, hospital, and geographic factors. *Am J Manag Care.* 2013;19(3):e93-e99. http://www.ajmc.com/publications/issue/2013/2013-1-vol19-n3/computed-tomography-scan-use-variation-patient-hospital-and-geographic-factors/1. Accessed March 24, 2014.
[56] Wise JN, Daffner RH, Weissman BN, et al; American College of Radiology Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria®-acute shoulder pain. http://www.acr.org/~/media/ACR/Documents/AppCriteria/Diagnostic/AcuteShoulderPain.pdf. Reviewed 2010. Accessed March 24, 2014.
[57] Burbank KM, Stevenson JH, Czarnecki GR, Dorfman J. Chronic shoulder pain: part I. evaluation and diagnosis. *Am Fam Physician.* 2008;77(4):453-460. http://www.aafp.org/afp/2008/0215/p453.pdf. Accessed March 24, 2014.
[58] Cunningham LS, Kelsey JL. Epidemiology of musculoskeletal impairments and associated disability. *Am J Public Health.* 1984;74:574-579.

[59] American College of Radiology for ABIM Choosing Wisely Campaign. Five things physicians and patients should question. http://www.choosingwisely.org/doctor-patient-lists/american-college-of-radiology/. Accessed March 24, 2014.
[60] America's Health Insurance Plans. Ensuring quality through appropriate use of diagnostic imaging. http://www.medsolutions.com/clinical_quality/facts/AHIP%202008%20Imaging%20Stats.pdf. Published July 2008. Accessed March 24, 2014.
[61] Parker L, Nazarian LN, Carrino JA, et al. Musculoskeletal imaging: medicare use, costs, and potential for cost substitution. *J Am Coll Radiol.* 2008;5:182-188. doi:10.1016/j.jacr.2007.07.016.
[62] George E, Tsipas S, Wozniak G, et al. Magnetic resonance imaging of the knee and shoulder performed before radiography. *J Am Coll Radiol.* 2014; In Press.
[63] Bennett DL, Nelson JW, Weissman BN, et al; American College of Radiology Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria®-nontraumatic knee pain. http://www.acr.org/~/media/ACR/Documents/AppCriteria/Diagnostic/NontraumaticKneePain.pdf. Reviewed October 2012. Accessed March 24, 2014.
[64] American College of Radiology Committee on Drugs and Contrast Media. ACR manual on contrast media-Version 9. http://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/Contrast%20Manual/2013_Contrast_Media.pdf. Published 2013. Accessed March 24, 2014.
[65] Bush WH, Swanson DP. Acute reactions to intravascular contrast media: types, risk factors, recognition, and specific treatment. *Am J Roentgenol.* 1991;157:1153-1161.
[66] Lasser EC, Berry CC, Mishkin MM, Williamson B, Zheutlin N, Silverman JM. Pretreatment with corticosteroids to prevent adverse reactions to nonionic contrast media. *Am J Roentgenol.* 1994;162:523-525.
[67] O'Malley RB, Cohan RH, Ellis JH, et al. A survey on the use of premedication prior to iodinated and gadolinium-based contrast material administration. *J Am Coll Radiol.* 2011;8:345-354. doi:10.1016/j.jacr.2010.09.001.
[68] Wang CL, Cohan RH, Ellis JH, Adusumilli S, Dunnick NR. Frequency, management, and outcome of extravasation of nonionic iodinated contrast medium in 69657 intravenous injections. *Radiology.* 2007;243(1):80-87. doi:10.1148/radiol.2431060554.
[69] Cooper DS, Doherty GM, Haugen BR, et al; American Thyroid Association (ATA) Guidelines Taskforce on Thyroid Nodules and Differentiated Thyroid Cancer. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. *Thyroid.* 2009;19(11):1-48. doi:10.1089/thy.2009.0110.
[70] Mortensen JD, Woolner LB, Bennet WA. Gross and microscopic findings in clinically normal thyroid glands. *J Clin Endocrinol Metab.* 1955;15(10):1270-1280. doi:10.1210/jcem-15-10-1270.
[71] Desser TS, Kamaya A. Ultrasound of thyroid nodules. *Neuroimaging Clin N Am.* 2008;18(3):463-478. doi:10.1016/j.nic.2008.03.005.
[72] Ahmed S, Horton KM, Jeffrey RB Jr., Sheth S, Fishman EK. Incidental thyroid nodules on chest CT: review of the literature and management suggestions. *Am J Roentgenol.* 2010;195:1066-1071. doi:10.2214/AJR.10.4506.
[73] Berland LL, Silverman SG, Gore RM, et al. Managing incidental findings on abdominal CT: white paper of the ACR Incidental Findings Committee. *J Am Coll Radiol.* 2010;7:754-773. doi:10.1016/j.jacr.2010.06.013.
[74] Pickhardt PJ, Hanson ME, Vanness DJ, et al. Unexpected extracolonic findings at screening CT colonography: clinical and economic impact. *Radiology.* 2008;249(1):151-159. doi:10.1148/radiol.2491072148.
[75] Yee J, Kumar NN, Godara S, et al. Extracolonic abnormalities discovered incidentally at CT colonography in a male population. *Radiology.* 2005;236:519-526. doi:10.1148/radiol.2362040166.
[76] Song JH, Chaudhry FS, Mayo-Smith WW. The incidental adrenal mass on CT: prevalence of adrenal disease in 1,049 consecutive adrenal masses in patients with no known malignancy. *Am J Roentgenol.* 2009;190:1163-1168. doi:10.2214/AJR.07.2799.
[77] Silverman SG, Israel GM, Herts BR, Richie JP. Management of the incidental renal mass. *Radiology.* 2008;249:16-31. doi:10.1148/radiol.2491070783.
[78] Casarella WJ. A patient's viewpoint on a current controversy. *Radiology.* 2002;224(3):927.
[79] Johnson PT, Horton KM, Megibow AJ, Jeffrey RB, Fishman EK. Common incidental findings on MDCT: survey of radiologist recommendations for patient management. *J Am Coll Radiol.* 2011;8:762-767. doi:10.1016/j.jacr.2011.05.012.

[80] Berland LL, Silverman SG, Megibow AJ, Mayo-Smith WW. ACR members' response to JACR white paper on management of incidental abdominal CT findings. *J Am Coll Radiol.* 2014;11:30-35. doi:10.1016/j.jacr.2013.06.002.
[81] Levine D, Brown DL, Andreotti RF, et al. Management of asymptomatic ovarian and other adnexal cysts imaged at US: Society of Radiologists in Ultrasound consensus conference statement. *Radiology.* 2010;256:943-954. doi:10.1148/radiol.10100213.
[82] Harris RD, Javitt MC, Glanc P, et al; American College of Radiology Expert Panel on Women's Imaging. ACR Appropriateness Criteria®-clinically suspected adnexal mass. http://www.acr.org/~/media/ACR/Documents/AppCriteria/Diagnostic/ClinicallySuspectedAdnexalMass.pdf. Reviewed October 2012. Accessed March 24, 2014.
[83] American College of Obstetricians and Gynecologists (ACOG). Management of adnexal masses. Washington, DC: American College of Obstetricians and Gynecologists (ACOG); 2007 Jul. 14p. (ACOG practice bulletin; no. 83).
[84] Hui JS, Kramer DJ, Blackmore CC, Hashimoto BE, Coy DL. A quality improvement initiative to reduce unnecessary follow-up imaging for adnexal lesions. *J Am Coll Radiol.* 2013 Oct. 17. doi:10.1016/j.jacr.2013.07.002.
[85] Modesitt SC, Pavlik EJ, Ueland FR, DePriest PD, Kryscio RJ, van Nagell JR Jr. Risk of malignancy in unilocular ovarian cystic tumors less than 10 centimeters in diameter. *Obstet Gynecol.* 2003;102:594-599. doi:10.1016/S0029-7844(03)00670-7.
[86] Valentin L, Ameye L, Franchi D, et al. Risk of malignancy in unilocular cysts: a study of 1148 adnexal masses classified as unilocular cysts at transvaginal ultrasound and review of the literature. *Ultrasound Obstet Gynecol.* 2013;41:80-89. doi:10.1002/uog.12308.
[87] Ghosh E, Levine D. Recommendations for adnexal cysts: have the Society of Radiologists in Ultrasound consensus conference guidelines affected utilization of ultrashound? *Ultrasound Q.* 2013;29(1):21-24. doi:10.1097/RUQ.0b013e31827c6ab1.
[88] Rosenkrantz AB, Kierans AS. US of incidental adnexal cysts: adherence of radiologists to the 2010 Society of Radiologists in Ultrasound guidelines. *Radiology.* 2014;271(1):262-271. doi: 10.1148/radiol.13131203.