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American College of Radiology Appropriateness Criteria: Advancing Evidence-Based Imaging Practice

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ACR Appropriateness Criteria (ACR AC) are evidence-based guidelines to assist referring physicians, other providers, and patients in making the most appropriate imaging or treatment decision for a specific clinical condition. The ACR AC are created by expert panels consisting of multidisciplinary physicians, using principles outlined by the Agency for Healthcare Research and Quality as designed by the Institute of Medicine. The ACR AC are qualified appropriate use criteria as designated under the Protecting Access to Medicare Act legislation of 2014. The ACR AC development process includes topic selection, literature search, evidence table development, appropriateness (risk-benefit) assessment, patient and public input, document publication and ACR AC content dissemination through clinical decision support mechanisms, and periodic review. These criteria benchmark the selection of the most appropriate imaging or treatments, as well as educating radiology, nuclear medicine, and other clinical discipline trainees.
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The ACR Appropriateness Criteria (ACR AC) are evidence-based guidelines created by the American College of Radiology to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition.[1] By employing these guidelines, providers enhance quality of care and contribute to the most efficacious use of imaging. The guidelines are developed and reviewed by expert panels in diagnostic imaging (DI) and interventional radiology (IR). Each panel includes leaders in radiology and other specialties. In 2018, there are 179 DI and IR topics with over 898 variants and 1560 clinical scenarios. As an additional service to the medical community, the College maintains all up-to-date documents online for the general public at www.acr.org/ac.

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In addition to the ACR AC, ACR publishes practice parameters and technical standards for guidance regarding performing DI or interventional procedures or nuclear medicine therapies. These documents are created by a committee of radiology experts through a consensus process. The practice parameters and technical standards recognize that the safe and effective use of diagnostic and therapeutic imaging requires specific training, skills, and techniques, as described in each document. Existing practice parameters and technical standards are reviewed every 5 years or sooner, if needed. There are 26 practice parameters and technical standards relating to nuclear medicine imaging tests or procedures.[2]

History

In 1993, the ACR AC were formally introduced by K.K. Wallace, MD, during testimony to the US House Ways and Means Committee. Dr Wallace stated that the ACR was ready to create guidelines for radiology to eliminate inappropriate utilization of radiologic services.[3] The ACR Task Force on Appropriateness Criteria was created and panel chairs were appointed in late 1993. In 1994, deliberations had begun to

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develop nationally accepted, scientifically based guidelines to assist referring physicians in making appropriate imaging decisions for given patient clinical conditions in order to provide the College's perspective on how to best use limited health care resources. In creating the ACR AC, the Task Force incorporated principles for developing acceptable medical practice guidelines used by the Agency for Healthcare Research and Quality[4] as designed by the Institute of Medicine. These principles included validity, reliability/reproducibility, clinical applicability, clinical flexibility, clarity, multidisciplinary process, scheduled review, and documentation. From the beginning, the methodology relied on a combination of evidence and, when the data from scientific outcome and technology assessment studies are insufficient, expert consensus. Additionally, the methodology employs the input of physicians from other medical specialties to provide important clinical perspectives.

ACR AC and Expert Panel Structure

In 2000, the ACR Task Force on Appropriateness Criteria became the Committee on Appropriateness Criteria under the ACR Commission on Quality and Safety. In 2012, two separate AC Committees were created—the Committee on DI/IR Appropriateness Criteria and the Committee on Radiation Oncology Appropriateness Criteria.[4] DI panels are divided along the practice types or organ systems, for example, thoracic, cardiac, gastrointestinal, pediatrics, and genitourinary. The organization of the AC[5] includes a Specialty Chair for each organ-based system who reports to the overall AC Chair.[6] Each Specialty Chair oversees two or three panels that have a Chair and Vice Chair managing the individual topics assigned for development. Those assignments are prioritized by the Gaps and Harmonization Committee, a group tasked with evaluating feedback from stakeholders, including clinical end-users and patients. The Rapid Response Committee responds to CDS (Clinical Decision Support) and other ACR AC implementers who may have questions about ACR AC guidance. There are three additional AC subcommittees: the Methodology Subcommittee, the Radiation Dose Subcommittee, and the Patient Engagement Subcommittee.[7] As of May 2017, all new and revised ACR AC documents are published in the peer-reviewed literature, enabling the work over time to form a citable literature on appropriate medical imaging ordering.[8] The ACR AC forms the basis of clinical decision support mechanisms, such as CareSelect, that must be consulted for Medicare reimbursement starting January 1, 2020.

Each ACR AC panel is multidisciplinary. For example, a musculoskeletal panel may include physicians who have expertise in DI (MRI, CT, nuclear medicine, sonography, etc), clinical practice (perhaps rheumatology, orthopedic surgery, etc), methodology, clinical trials research, etc. Panel members are selected to provide wide representation of the clinical practice related to the topic. The ACR AC Chair and ACR AC staff liaise with other medical specialties to populate the panels with nonradiologists. Regarding imaging expertise, each panel may include at least one radiologist who is dual board certified in radiology and nuclear medicine with clinical expertise in the focus area. There is also broad geographic representation from academic centers, private practices, and medical centers across the country. Currently, over 500 volunteer physicians are involved in the ACR AC development process.[4]

Appropriateness Criteria Process

Topics Selection and Literature Search

Topics are selected based on disease prevalence, practice variability, economic impact, effect on morbidity, mortality, and potential to improve care. New topics must be evaluated by the Gaps and Harmonization Committee and approved by the Chair of the Committee on Appropriateness Criteria. All topics are reviewed annually and typically updated every 3 years. Each AC topic has a narrative, an evidence table (ET), a literature search summary, and an appendix that includes the strength of evidence assessment and rating-round tabulations for each recommendation.[4]

Once a topic is selected and author is assigned, the variants are defined to reflect the most likely or relevant presentations of the clinical condition. ACR staff then conduct a systematic literature search of the peer-reviewed literature to identify the articles related to the topic using keywords and MeSH terms provided by the author and other defined search parameters. The goal of the ACR AC literature search process[9] is to ensure the consideration of all relevant evidence contributing to a topic. The ACR AC literature search process is transparent, replicable, and systematically identifies the available peer-reviewed medical literature. At the end of the process, the search strategy is documented and includes a listing of database(s) searched, a summary of search terms used, the specific time period covered by the literature search including the beginning date (mo/y) and end date (mo/y), and the date(s) when the literature search was done. The study selection description details the number of studies identified, the number of studies included, and a summary of inclusion and exclusion criteria. The author assesses the literature to identify relevant articles to include in the topic and may request staff conduct additional searches, may use citations found in the bibliographies of relevant articles, or incorporate a limited number of citations known from personal expertise. The author drafts (or revises) the summary of literature review, which summarizes the evidence, and embeds the relevant citations identified from the literature search.

ACR staff completes the ET[10] information for all of the citations embedded in the narrative. The ET includes five components extracted from a source. These are the reference citation information, study type, number of patients or events, study objective(s), and study result(s). In addition, the ET quantifies a source's quality based on the number of

study quality elements described in that source. For DI studies, these elements include statistical measure, uncertainty measure of the statistical measure, prospective study, systematic or consecutive recruitment, standard of reference, independent readers, index test results, and reference standard results. The creation and revision of the ET is performed by ACR staff in order to apply the methodology consistently. Once an ET is constructed, the topic's author and panel members review the ET for completeness and validity. ET is adjusted based on the feedback before the rating rounds.

Panel Member Ratings

The purpose of the rating rounds is to systematically and transparently determine the panel's recommendations while mitigating any undue influence of one or more panel members on another individual panel member's interpretation of the evidence. The panel member's rating is determined by reviewing the evidence presented in the summary of literature review and assessing the potential risks or harms of performing the procedure or treatment balanced with the benefits of performing the procedure or treatment. The individual panel member ratings are used to determine the panel's rating. The assessment of the amount of deviation of individual ratings from the panel rating determines whether there is disagreement among the panel about the rating.[11]

The process used in the rating rounds is a modified Delphi method based on the methodology described in the RAND/UCLA Appropriateness Method User Manual.[12]

The appropriateness is rated on an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "Usually not appropriate", where the harms of doing the procedure or treatment outweigh the benefits; and 7, 8, or 9 are in the category "Usually appropriate" where the benefits of doing a procedure or treatment outweigh the harms or risks. The middle category is called "May be appropriate" and is represented by 4, 5, or 6 on the scale (Table 1). The middle category describes when the risks and benefits are equivocal or unclear, the dispersion of the individual ratings from the panel rating is too large, the evidence is contradictory or unclear, or there are special circumstances or subpopulations that could influence the risks or benefits which are embedded in the variant.

The primary assessment is the extent to which the benefits of improved patient management or outcomes are achieved given the potential risks or harms of performing the radiological procedure for a specific clinical scenario. When assigning appropriateness ratings to procedures or treatments, panelists assume that (1) the patients do not have contraindications for any of the procedures or treatments listed in the variant table, (2) all procedures in the variant table are available and accessible, and (3) all procedures in the variant table are performed and interpreted by an expert. Some potential risks (or benefits) not considered include the direct or indirect costs of a procedure and the relative radiation level, radiation exposure, radiation dose or the amount of radiation produced from performing a procedure. The cost and radiation estimates vary widely for individuals and various factors which make any meaningful assessment confounding to the appropriateness of the procedure. Relative radiation levels may be considered when assessing risks and benefits only when other radiological procedures have nearly equivalent diagnostic accuracy or test performance.

Two rating rounds are conducted typically. Those recommendations that have no disagreement after the first rating round are not rated in the second round unless two-thirds of the panel decides the appropriateness category does not reflect the evidence. A conference call is held after the first rating round to discuss the evidence, the rating trends, and the clarity of the document.

Panel Recommendation

The appropriateness category for a procedure and clinical scenario is determined by the panel's median rating without disagreement. The panel's median rating is calculated after each rating round. If there is disagreement after the second rating round, the rating category is "May be appropriate (Disagreement)" with a rating of "5" so users understand the group disagreed on the final recommendation. The actual panel median rating is documented to provide additional context. Disagreement is defined as excessive dispersion of the individual ratings from the AC panel median as determined by comparison

Table 1 Appropriateness Category Names and Definitions

Name	Rating	Definition
Usually appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May be appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May be appropriate (disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually not appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

of the interpercentile range (IPR) and the interpercentile range adjusted for symmetry (IPRAS). In those instances when the interpercentile range is greater than the interpercentile range adjusted for symmetry, there is disagreement.[12] Once the final recommendations have been determined, the panel reviews the document and finalizes the recommendations and an appropriateness criteria document is developed. Each appropriateness criteria document on a topic typically has multiple variants or clinical scenarios. For example, ACR AC on post-treatment follow-up of prostate cancer[13] has three variants and each variant has the expert panel recommendation of appropriateness criteria for each radiological procedure considered (Tables 2–4). If two-thirds of the panel feel a final recommendation does not accurately reflect the evidence, may negatively impact patient health, or has unintended consequences that may harm health care, the process must be started again from the beginning.

Patient Perspectives

In addition to the peer-review publication of the AC documents, the Patient Engagement Subcommittee[7] members

Table 2 Variant 1: Prostate Cancer Follow-up, Status Postradical Prostatectomy, Clinical Concern for Residual or Recurrent Disease

Procedure	Appropriateness Category	Relative Radiation Level
C-11 choline PET/CT skull base to midthigh	Usually appropriate	+++
MRI pelvis without and with IV contrast	Usually appropriate	O
F-18 fluciclovine PET/CT skull base to midthigh	Usually appropriate	++++
CT abdomen and pelvis with IV contrast	May be appropriate	+++
MRI-targeted biopsy prostate	May be appropriate	O
Tc-99m bone scan whole body	May be appropriate	+++
TRUS-guided biopsy prostate	May be appropriate	O
MRI abdomen and pelvis without and with IV contrast	May Be appropriate (disagreement)	O
CT abdomen and pelvis without IV contrast	Usually not appropriate	+++
CT chest abdomen pelvis with IV contrast	Usually not appropriate	++++
FDG-PET/CT skull base to midthigh	Usually not appropriate	++++
MRI abdomen and pelvis without IV contrast	Usually not appropriate	O
MRI pelvis without IV contrast	Usually not appropriate	O
CT abdomen and pelvis without and with IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without and with IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without IV contrast	Usually not appropriate	++++
TRUS prostate	Usually not appropriate	O
X-ray skeletal survey	Usually not appropriate	+++

Table 3 Variant 2: Prostate Cancer Follow-up, Clinical Concern for Residual or Recurrent Disease After Nonsurgical Local and Pelvic Treatments

Procedure	Appropriateness Category	Relative Radiation Level
C-11 choline PET/CT skull base to midthigh	Usually appropriate	+++
MRI pelvis without and with IV contrast	Usually appropriate	O
F-18 fluciclovine PET/CT skull base to midthigh	Usually appropriate	++++
MRI-targeted biopsy prostate	Usually appropriate	O
TRUS-guided biopsy prostate	Usually appropriate	O
CT abdomen and pelvis with IV contrast	May be appropriate	+++
MRI abdomen and pelvis without and with IV contrast	May be appropriate (disagreement)	O
Tc-99m bone scan whole body	May be appropriate (disagreement)	+++
CT abdomen and pelvis without IV contrast	Usually not appropriate	+++
CT chest abdomen pelvis with IV contrast	Usually not appropriate	++++
FDG-PET/CT skull base to midthigh	Usually not appropriate	++++
MRI abdomen and pelvis without IV contrast	Usually not appropriate	O
CT abdomen and pelvis without and with IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without and with IV contrast	Usually not appropriate	++++
MRI pelvis without IV contrast	Usually not appropriate	O
TRUS prostate	Usually not appropriate	O
X-ray skeletal survey	Usually not appropriate	+++

Table 4 Variant 3: Follow-up of Metastatic Prostate Cancer Treated by Systemic Therapy (ADT, chemotherapy, immunotherapy)

Procedure	Appropriateness Category	Relative Radiation Level
CT abdomen and pelvis with IV contrast	Usually appropriate	+++
Tc-99m bone scan whole body	Usually appropriate	+++
C-11 choline PET/CT skull base to midthigh	Usually appropriate	+++
F-18 fluciclovine PET/CT skull base to midthigh	Usually appropriate	++++
CT chest abdomen pelvis with IV contrast	May be appropriate	++++
MRI abdomen and pelvis without and with IV contrast	May be appropriate	O
MRI pelvis without and with IV contrast	May be appropriate	O
FDG-PET/CT skull base to midthigh	May be appropriate	++++
MRI pelvis without IV contrast	May be appropriate	O
CT abdomen and pelvis without IV contrast	Usually not appropriate	+++
CT abdomen and pelvis without and with IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without IV contrast	Usually not appropriate	++++
CT chest abdomen pelvis without and with IV contrast	Usually not appropriate	++++
MRI abdomen and pelvis without IV contrast	Usually not appropriate	O
TRUS-guided biopsy prostate	Usually not appropriate	O
TRUS prostate	Usually not appropriate	O
X-ray skeletal survey	Usually not appropriate	+++

ADT, androgen deprivation therapy; TRUS, Transrectal ultrasound.

coauthor Patient-Friendly Summaries of the AC in the *Journal of the American College of Radiology*. These patient-friendly synopses are written to help patients better understand imaging study recommendations, and serve as a method for imaging care providers to communicate with patients. These summaries are available at https://www.jacr.org/content/ac-patient-summaries.

Implementing the Appropriateness Criteria into Practice

In June 2016, the Centers for Medicare & Medicaid Services named the ACR a "qualified Provider-Led Entity" approved to provide appropriate use criteria under the Medicare Appropriate Use Criteria program for advanced DI. This means that medical providers can consult ACR AC to fulfill the Protecting Access to Medicare Act requirements that they consult appropriate use criteria prior to ordering advanced DI for Medicare patients.

The intended use of ACR AC is to provide assistance to clinicians, radiologists, and patients in deciding appropriate imaging procedures for a clinical condition. By using the ACR AC, more appropriate tests are selected, leading to fewer unnecessary tests. These documents are also valuable in educating radiology, nuclear medicine, and other clinical discipline trainees.

In conclusion, the ACR AC are evidence-based guidelines to assist referring physicians, other providers, and patients in making the most appropriate imaging or treatment decision for a specific clinical condition. They are created, vetted, and published by a team of multidisciplinary physicians, using principles outlined by the Agency for Healthcare Research and Quality as designed by the Institute of Medicine. These criteria are also very useful in educating radiology, nuclear medicine, and other clinical discipline trainees.

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