

The American College of Radiology, with more than 30,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

The American College of Radiology will periodically define new practice parameters and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice parameters and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice parameter and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review and approval. The practice parameters and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice parameter and technical standard by those entities not providing these services is not authorized.

Revised 2013 (Resolution 47)*

ACR–AAPM PRACTICE PARAMETER FOR DIAGNOSTIC REFERENCE LEVELS AND ACHIEVABLE DOSES IN MEDICAL X-RAY IMAGING

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care¹. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the practice parameters, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the practice parameters when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the practice parameters. However, a practitioner who employs an approach substantially different from these practice parameters is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these practice parameters will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these practice parameters is to assist practitioners in achieving this objective.

¹ *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing*, ___ N.W.2d ___ (Iowa 2013) Iowa Supreme Court refuses to find that the *ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures* (Revised 2008) sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, *Stanley v. McCarver*, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.

I. INTRODUCTION

This practice parameter has been revised collaboratively by the American College of Radiology (ACR) and the American Association of Physicists in Medicine (AAPM) to guide appropriately trained and licensed physicians and Qualified Medical Physicists involved in diagnostic procedures using ionizing radiation. The establishment of reference levels in diagnostic medical imaging requires close cooperation and communication between the clinical team of physicians who are responsible for the clinical management of the patient, the Qualified Medical Physicist responsible for monitoring equipment and image quality and estimating patient dose, and the radiologic technologist who is responsible for adherence to protocols. Adherence to this practice parameter should help to maximize the efficacious use of these procedures, optimize patient radiation dose and image quality, minimize radiation dose to staff, maintain safe conditions, and ensure compliance with applicable regulations. This is particularly important for children who are more vulnerable than adults to the potential risks of ionizing radiation.

Application of this practice parameter should be in accordance with the specific ACR practice parameters or technical standards for the relevant imaging modality; considerations of image quality monitoring; radiation safety; and the radiation protection of patients, personnel, and the public. There must also be compliance with applicable laws and regulations.

The goal of this practice parameter is to provide guidance and advice to physicians and Qualified Medical Physicists on the establishment and implementation of diagnostic reference levels in the practice of diagnostic medical X-ray imaging. The goal in medical imaging is to obtain image quality consistent with the medical imaging task. Diagnostic reference levels are used to help manage radiation dose to the patient. Medical radiation dose must be controlled, avoiding unnecessary radiation that does not contribute to the clinical objective of the procedure. A dose significantly lower than the reference level may also be cause for concern, since it may indicate that adequate image quality is not being achieved. The specific purpose of the diagnostic reference level is to provide a benchmark for comparison, not to define a maximum or minimum dose limit.

II. DEFINITION

A diagnostic reference level (DRL) is an investigational level used to identify unusually high radiation doses for common diagnostic medical X-ray imaging procedures [1-6]. DRLs are suggested action levels above which a facility should review its methods and determine if acceptable image quality can be achieved at lower doses.

DRLs are based on standard phantom or patient measurements under specific conditions at a number of representative clinical facilities. DRLs have been set at approximately the 75th percentile of measured patient or phantom data. This means that procedures performed at 75% of the institutions surveyed have exposure levels at or below the DRL.

In the United Kingdom, the Health Protection Agency (HPA) (formerly the National Radiological Protection Board [NRPB]) reported a 55% reduction in the 75th percentile of radiation patient dose following 20 years of use of and education about DRLs and achievable doses (ADs) [2].

Achievable dose (AD) can be used with DRLs to assist in optimizing image quality and dose. ADs are set at approximately the median (50th percentile) of the study dose distribution i.e., half of the facilities are producing images at lower doses and half are using higher doses. Further information on ADs is available in the recent National Council on Radiation Protection and Measurements (NCRP) Report 172 [6].

DRLs and ADs are part of the optimization process. It is essential to assure that image quality appropriate for the diagnostic purpose is achieved when changing patient doses. Optimization must balance image quality and patient dose, i.e., image quality must be maintained at an appropriate level as radiation doses are decreased.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Procedures using radiation for diagnostic medical purposes must be performed under the supervision of, and interpreted by, a licensed physician with the following qualifications:

1. Certification in Radiology or Diagnostic Radiology by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec.
or
2. Completion of a residency program approved by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) and have documented a minimum of 6 months of formal dedicated training in the interpretation and formal reporting of general images and fluoroscopy for patients of all ages that includes radiographic training on all body areas. For computed tomography (CT) the physician should meet the personnel qualifications outlined in the [ACR Practice Parameter for Performing and Interpreting Diagnostic Computed Tomography \(CT\)](#).
and
3. The physician should have documented training in and understanding of the physics of diagnostic radiography (including fluoroscopy and CT) and experience with the equipment needed to safely produce the images. This should include generation of the X-ray beam, image receptor technology, and image processing.

The physician is the principal individual involved in establishing and implementing reference levels in diagnostic medical imaging using ionizing radiation. The physician should work closely with a Qualified Medical Physicist in this process. The clinical objectives of all diagnostic medical imaging procedures must be in accordance with current ACR practice parameters or technical standards and should be periodically reviewed by the physician.

Continuing Medical Education

The physician's continuing medical education should be in accordance with the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#) and should include CME in general radiography as is appropriate to his/her practice.

B. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently in one or more of the subfields in medical physics. The American College of Radiology considers certification, continuing education, and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice one or more of the subfields in medical physics, and to be a Qualified Medical Physicist. The ACR strongly recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physicists in Medicine, or the American Board of Medical Physics (ABMP).

A Qualified Medical Physicist should meet the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#). (ACR Resolution 17, adopted in 1996 – revised in 2012, Resolution 42).

The appropriate subfield of medical physics for this practice parameter is Diagnostic Medical Physics. (Previous medical physics certification categories including Radiological Physics, Diagnostic Radiological Physics, and Diagnostic Imaging Physics are also acceptable.)

CME should include education in radiation dosimetry, radiation protection, and equipment performance related to the use of medical imaging.

Regular performance of radiation measurements, dosimetric calculations, and performance evaluation of equipment in use is essential to maintain competence.

The Qualified Medical Physicist must be familiar with the principles of imaging physics, radiation dosimetry, and radiation protection; the current guidelines of the National Council on Radiation Protection and Measurements; laws and regulations pertaining to the performance and operation of medical X-ray imaging equipment; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments used for radiation measurement. The Qualified Medical Physicist must also be familiar with relevant clinical procedures.

IV. DIAGNOSTIC REFERENCE LEVELS FOR IMAGING WITH IONIZING RADIATION

This practice parameter recommends DRLs and ADs for procedures in radiography, noninterventional fluoroscopy, and CT.

A. Radiography

For radiography, including screen-film and digital imaging, this practice parameter bases DRLs and ADs on a measurement of air kerma at the skin plane (without backscatter) to a standard phantom using the X-ray technique factors the facility would typically select for an average size adult or pediatric patient. DRLs are provided for five radiographic projections (Table 1).

The phantoms and details of measurements are provided in NCRP Report 172 and the appropriate Nationwide Evaluation of X-Ray Trends Reports [6,7]. The sizes of the adult and pediatric patient modeled by the phantom measurement are given in Table 1.

Table 1
Diagnostic Reference Levels and Achievable Doses
for Adult and Pediatric X-Ray Examinations (incident air kerma, free-in-air)

	DRL (mGy)	AD (mGy)
Adult PA chest (23 cm), with grid	0.15	0.11
Pediatric PA chest (12.5 cm), without grid	0.06	0.04
Pediatric PA chest (12.5 cm), with grid	0.12	0.07
Adult AP abdomen (22 cm)	3.4	2.4
Adult AP lumbosacral spine (22 cm)	4.2	2.8

B. Fluoroscopy

DRLs and ADs are provided for abdominal fluoroscopy in Table 2. For fluoroscopy, this practice parameter bases DRLs and ADs on a measurement of air kerma at the skin plane (with some backscatter due to the geometry) to a standard phantom using the X-ray technique factors the facility would typically select for an average size adult patient. Published reference levels are currently not available for pediatric patients.

The phantoms and details of measurements are provided in NCRP Report 172. In Table 2 a 22 cm PA abdomen was modeled by phantom measurements with a grid.

Table 2
Diagnostic Reference Levels and Achievable Doses for Under Table Adult (22 cm PA Abdomen)
Fluoroscopic Imaging

Phantom: Adult PA Abdomen with grid	DRL	AD
Upper GI fluoroscopy, without oral contrast media	54 mGy min ⁻¹	40 mGy min ⁻¹
Upper GI fluoroscopy, with oral contrast media	80 mGy min ⁻¹	72 mGy min ⁻¹
Phantom: Adult PA Abdomen with grid	DRL	AD
Fluorographic image, without contrast		
Film	3.9 mGy	2.5 mGy
Digital	1.5 mGy	0.9 mGy
Fluorographic image, with contrast		
Film	27.5 mGy	18.7 mGy
Digital	9.9 mGy	5.3 mGy

C. Computed Tomography

The DRLs and ADs for CT are based on the volume CT dose index (CTDI_{vol}). The International Electrotechnical Commission (IEC) has specifically defined the CTDI₁₀₀, weighted CTDI_w, and CTDI_{vol} [8]. For the values reported below, the 16 cm diameter phantom was used for all head and pediatric abdomen CT examinations, and the 32 cm diameter phantom was used for all adult body CT examinations.

DRLs and ADs are provided for three adult and two pediatric CT procedures in Table 3.

Table 3
Diagnostic Reference Levels and Achievable Doses for Adult and Pediatric CT (CTDI_{vol})

	Patient Lateral (LAT) Dimension	CTDI Phantom Diameter (cm)	DRL (mGy)	AD (mGy)
Adult head [6,9]	16	16	75	57
Adult abdomen-pelvis [6,9]	38	32	25	17
Adult Chest [6]	35	32	21	14
Pediatric 5 year old head [6]	15	16	40	31
Pediatric 5 year old abdomen-pelvis [9]	20	16	20	14

The recommended CT DRLs were derived from analysis of the data gathered from the first 3 years of the ACR CT Accreditation Program [9], 2005 CT National Evaluation of X-Ray Trends (NEXT) data and NCRP Report 172. The LAT dimensions are for average patients of the specified age [10].

Table 3 is based on phantom data. Individual patient data should not be compared against these values. A recent publication from six pediatric hospitals [11] is based on actual patient data and suggests a DRL for a 20 cm LAT 5 year old abdomen-pelvis of 14 mGy and an AD of 11 mGy. Only patients of these sizes should be compared against these values.

V. PATIENT SPECIFIC DOSIMETRY

Because the diagnostic reference levels are derived from standard phantom measurements and are used as benchmarks for comparing X-ray dose estimates from a given facility, they should not be used as a substitute for estimating specific doses delivered to a patient. For example, $CTDI_{100}$, $CTDI_w$, and $CTDI_{vol}$ are estimates of dose delivered to phantoms of a specified size and material as a result of the X-ray production of the CT scanner in question. CTDI doses do not indicate the dose to an individual patient [12]. To address this need, the AAPM has developed a better estimate of the patient dose during CT examinations of the trunk of the body called size specific dose estimate (SSDE) that corrects for changes in patient dose as a function of the patient's size [13].

On occasion the need may arise to estimate the dose delivered to an individual patient because of a specific situation (e.g., pregnancy, prolonged fluoroscopy, multiple examinations). In these situations it is recommended that the physician consider executing a formal written medical physics consultation with the Qualified Medical Physicist. Using the specific X-ray parameters of the diagnostic examination, the Qualified Medical Physicist can render an estimate of the specific dose to a given location in the patient, such as the location of the embryo or fetus, the patient's midline, or the patient's skin [14]. The consultation request should be signed by the requesting physician. The Qualified Medical Physicist's report should be signed by the Qualified Medical Physicist and should be incorporated into the patient's medical record. DRLs or ADs should not be used for patient dose estimates.

An estimate of the dose to a patient is sometimes needed to assess the potential risk associated with a high dose examination involving ionizing radiation. Deterministic radiation risks are typically the primary concern due to the size of the patient and the relatively large skin doses that occur. Since stochastic effects may not develop until decades after the examination, older, seriously ill adults may not survive long enough for a stochastic effect to develop. In contrast, pediatric patients are at greater stochastic risk due to longer remaining lifespans and their greater sensitivity to ionizing radiation. Finally, both stochastic and deterministic effects are a potential risk for larger adolescent patients who receive relatively large skin doses and who have a longer life expectancy than adults [15].

VI. RADIATION SAFETY IN IMAGING

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. All personnel that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels)

http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.pdf

Nationally developed guidelines, such as the ACR's [Appropriateness Criteria](#)[®], should be used to help choose the most appropriate imaging procedures to prevent unwarranted radiation exposure.

Facilities should have and adhere to policies and procedures that require varying ionizing radiation examination protocols (plain radiography, fluoroscopy, interventional radiology, CT) to take into account patient body habitus (such as patient dimensions, weight, or body mass index) to optimize the relationship between minimal radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used whenever appropriate. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available at the Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org) websites. These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR technical standards. Regular auditing of patient dose indices should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry, the NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

VII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR website (<http://www.acr.org/guidelines>).

Performance evaluation, quality control, acceptance testing, written survey reports and follow-up procedures should be in accordance with the appropriate ACR Medical Physics Technical Standards (<http://www.acr.org/Quality-Safety/Standards-Guidelines/Technical-Standards-by-Modality/Medical-Physics>).

The Qualified Medical Physicist's annual survey report should include estimates of radiation dose for representative examinations and types of patients (e.g., adults, pediatric) as applicable. The Qualified Medical Physicist should also compare these values with current DRLs and provide recommendations for improvement if the dose estimates exceed the DRLs.

ACKNOWLEDGEMENTS

This practice parameter was revised according to the process described under the heading *The Process for Developing ACR Practice Parameters and Technical Standards* on the ACR website (<http://www.acr.org/guidelines>) by the Guidelines and Standards Committee of the ACR Commission on Medical Physics in collaboration with the AAPM.

Collaborative Committee – members represent their societies in the initial and final revision of this practice parameter

ACR

Ralph P. Lieto, MS, FACR, FAAPM Co-Chair
Thomas G. Ruckdeschel, MS, Co-Chair
James A. Brink, MD, FACR
Marilyn J. Goske, MD, FACR

AAPM

Joel E. Gray, PhD, FAAPM, FACMP
Melissa C. Martin, MS, FACR, FAAPM, FACMP
Keith J. Strauss, MS, FACR, FAAPM

Committee on Practice Parameters and Technical Standards - Medical Physics
(ACR Committee responsible for sponsoring the draft through the process)

Tariq A. Mian, PhD, FACR, FAAPM, Chair
Maxwell R. Amurao, PhD, MBA
Ishtiaq H. Bercha, MSc
Chee-Wai Cheng, PhD, FAAPM
Laurence E. Court, PhD
Nicholas J. Hangiandreou, PhD
Bruce E. Hasselquist, PhD
Ralph P. Lieto, MS, FACR, FAAPM
Jeffrey P. Limmer, MSc
Matthew A. Pacella, MS
Doug Pfeiffer, MS
Thomas G. Ruckdeschel, MS
Christopher J. Watchman, PhD
Gerald A. White, Jr., MS, FACR, FAAPM
John W. Winston, Jr., MS

Richard A. Geise, PhD, FACR, FAAPM, Chair, Medical Physics Commission
Debra L. Monticciolo, MD, FACR, Chair, Quality and Safety Commission
Julie K. Timins, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards

Comments Reconciliation Committee

Alexander M. Norbash, MD, FACR, Chair
Tariq A. Mian, PhD, FACR, FAAPM, Co-Chair
Kimberly E. Applegate, MD, MS, FACR
James A. Brink, MD, FACR
Karen L. Brown, MHP
Howard B. Fleishon, MD, MMM, FACR
Richard A. Geise, PhD, FACR, FAAPM
Marilyn J. Goske, MD, FACR
Joel E. Gray, PhD, FAAPM, FACMP
Paul A. Larson, MD, FACR
Ralph P. Lieto, MS, FACR, FAAPM
Melissa C. Martin, MS, FACR, FAAPM, FACMP
Cynthia H. McCollough, PhD, FACR
Debra L. Monticciolo, MD, FACR
Thomas G. Ruckdeschel, MS
Keith J. Strauss, MS, FACR, FAAPM
Julie K. Timins, MD, FACR

REFERENCES

1. Gray JE, Archer BR, Butler PF, et al. Reference values for diagnostic radiology: application and impact. *Radiology* 2005;235:354-358.
2. Hart D, Hillier MC, Wall BF. *Doses to patients from radiographic and fluoroscopic x-ray imaging procedures in the UK - 2005 Review*. HPA-RPD-029; 2007 [http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947413167]. Accessed August 24, 2012.
3. International Commission on Radiological Protection. *Data for protection against ionizing radiation from external sources*. Bethesda, MD. ICRP Report 21: Publication 60; 1990.
4. International Commission on Radiological Protection. *Radiological protection and safety in medicine*. Bethesda, MD. ICRP Report 26; Publication 73; 1996.

5. International Commission on Radiological Protection. *Diagnostic reference levels in medical imaging: review and additional advice*. http://www.icrp.org/docs/DRL_for_web.pdf. Accessed August 24, 2012.
6. National Council on Radiation Protection and Measurement Diagnostic. *Reference levels and achievable doses in medical and dental imaging: recommendations for the United States*. Bethesda, MD. NCRP Report #172; 2012.
7. Food and Drug Administration, in collaboration with the Conference of Radiation Control Program Directors,. *What's Nationwide Evaluation of X-ray Trends (NEXT)*. <http://www.crcpd.org/Pubs/NextTrifolds/ThirtyYearsOfNext.pdf>. Accessed December 6, 2012.
8. International Electrotechnical Commission. *Medical electrical equipment. Part 2-44, Particular requirements for the safety of x-ray equipment for computed tomography*. Geneva, Switzerland. 2nd edition. IFC publication number 60601-2-44 amendment 1. IFC: 2003.
9. McCollough C, Branham T, Herlihy V, et al. Diagnostic reference levels from the ACR CT Accreditation Program. *J Am Coll Radiol* 2011;8:795-803.
10. Kleinman PL, Strauss KJ, Zurakowski D, Buckley KS, Taylor GA. Patient size measured on CT images as a function of age at a tertiary care children's hospital. *AJR* 2010;194:1611-1619.
11. Goske M, Strauss KJ, Coombs L, et al. Diagnostic reference ranges for pediatric abdominal CT. *Radiology* In Press.
12. McCollough CH, Leng S, Yu L, Cody DD, Boone JM, McNitt-Gray MF. CT dose index and patient dose: they are not the same thing. *Radiology* 2011;259:311-316.
13. Boone JM, Strauss KJ, Cody DD, et al. *Size-specific dose estimate (SSDE) in pediatric and adult body CT examinations*. http://www.aapm.org/pubs/reports/rpt_204.pdf. Accessed August 24, 2012.
14. Angel E, Wellnitz CV, Goodsitt MM, et al. Radiation dose to the fetus for pregnant patients undergoing multidetector CT imaging: Monte Carlo simulations estimating fetal dose for a range of gestational age and patient size. *Radiology* 2008;249:220-227.
15. National Council on Radiation Protection and Measurement Diagnostic. *Radiation dose management for fluoroscopically-guided interventional medical procedures*. NCRP Report No. 168; 2010:pp325.

*Practice parameters and technical standards are published annually with an effective date of October 1 in the year in which amended, revised, or approved by the ACR Council. For practice parameters and technical standards published before 1999, the effective date was January 1 following the year in which the practice parameter or technical standard was amended, revised, or approved by the ACR Council.

Development Chronology for this Practice Parameter

2002 (Resolution 20)
 Amended 2006 (Resolution 16g, 36)
 Revised 2008 (Resolution 3)
 Amended 2009 (Resolution 11)
 Revised 2013 (Resolution 47)
 Amended 2014 (Resolution 39)