

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 2018 (Resolution 13)*

ACR–SIR–SPR PRACTICE PARAMETER FOR SPECIFICATIONS AND PERFORMANCE OF IMAGE-GUIDED PERCUTANEOUS DRAINAGE/ASPIRATION OF ABSCESSSES AND FLUID COLLECTIONS (PDAFC)

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 practitioner in light of all the circumstances presented. Thus, an approach that differs from the guidance in this document, 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 this document 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 this document. However, a practitioner who employs an approach substantially different from the guidance in this document 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 the guidance in this document 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 this document 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 was revised collaboratively by the American College of Radiology (ACR), the Society of Interventional Radiology (SIR), and the Society for Pediatric Radiology.

Image-guided percutaneous drainage or aspiration of abscesses and abnormal fluid collections (PDAFC) has become the diagnostic and therapeutic treatment of choice for a wide variety of fluid collections. Use of percutaneous drainage has steadily increased, whereas use of open surgical drainage has declined [1]. The procedures have resulted in reduced morbidity and mortality and have helped to reduce length of hospital stay and hospital costs [2-19]. This practice parameter outlines the specifications and principles for performing high-quality PDAFC.

For information on breast interventional procedures, see the [ACR Practice Parameter for the Performance of Stereotactic-Guided Breast Interventional Procedures](#) or the [ACR Practice Parameter for the Performance of Ultrasound-Guided Percutaneous Breast Interventional Procedures](#) [20,21].

The procedures may be performed with ionizing radiation for image guidance, including fluoroscopy, computed tomography (CT), or with nonionizing radiation modalities, including ultrasound or magnetic resonance imaging (MRI). Optimal performance of PDAFC, and choice of imaging modality, requires knowledge of anatomy and pathophysiology, familiarity with percutaneous techniques (eg, needle, guidewire, and drainage catheter use), and knowledge of the advantages and disadvantages of one imaging modality versus another for any particular drainage procedure, including the as-low-as-reasonably-achievable (ALARA) principle. As with any invasive therapy, the patient is most likely to benefit when the procedure is performed in an appropriate environment and by qualified physicians.

This practice parameter is intended to be used in quality improvement programs to assess percutaneous drainage procedures. The most important processes of care are: 1) patient selection, 2) performing the procedure, and 3) monitoring the patient. The outcome measures or indicators for these processes are indications, success rates, and complication rates. Outcome measures are assigned threshold levels.

II. DEFINITION

Image-guided percutaneous drainage is defined as the placement of a catheter using image guidance to provide continuous drainage of a fluid collection, using access pathways that may be either transorificial (eg, transrectal, transvaginal, transgastric, peroral) or transcutaneous. It includes localization of the fluid collection by imaging and placement of one or more catheters, and may also include catheter maintenance and eventual removal of the catheter(s). It may be performed during a single session or as a staged procedure during multiple sessions.

Image-guided percutaneous aspiration is defined as therapeutic evacuation or diagnostic sampling of a fluid collection using either a catheter or a needle during a single imaging session, with removal of the catheter or needle immediately after the aspiration.

III. INDICATIONS AND CONTRAINDICATIONS

A. Indications

Because of variability in the presentation of abscesses and fluid collections, the indications for PDAFC must be stated in general terms enumerated at the end of this section. A collection may be detected by physical examination but is typically discovered by an imaging study. Additional studies may be helpful prior to the procedure to confirm the presence or nature of the fluid collection and to evaluate the feasibility of a percutaneous procedure.

Diagnostic aspiration may be the only means of determining whether a fluid collection is infected. For instance, while fever, leukocytosis, malaise, anorexia, or other systemic symptoms point to an infection, these signs and

symptoms may be absent in elderly, very ill, diabetic, or immunocompromised patients. If infected material is obtained or if the operator suspects the presence of infection, a drainage catheter may then be placed.

Percutaneous drainage or aspiration may be performed in essentially any organ system. Recently, the feasibility and safety of addressing abnormal postoperative air collections related to infection has also been described [22]. The contraindications are relative and depend on the suitability of surgical alternatives. Common relative contraindications include coagulopathy and/or the absence of an acceptable path for needle and catheter introduction.

There is a spectrum of disease complexity. Examples of more complex situations include multiple or multiloculated abscesses, abscess due to Crohn's disease, pancreatic abscesses, a drainage route that traverses the bowel or pleura, infected hematoma, and tumor abscess. Articles have documented curative or partially successful percutaneous drainage in patients with these complex situations [23-31]. However, one should expect that percutaneous drainage in such cases will potentially have a lower chance of success, be more technically difficult, require longer periods of time for drainage, require subsequent drain manipulation/repositioning/upsizing, have a higher likelihood of recurrence, may require the use of transcatheter fibrinolytic such as TPA or DNase to achieve clinically significant drainage, and have a higher rate of complications [7,18,32].

In the setting of moderate, severe, and/or necrotizing pancreatitis, the role of prospective percutaneous drainage, as part of nonoperative management is evolving [33-38]. Likewise, the decision to provide drainage for pancreatic pseudocysts in a transcutaneous or transgastric fashion versus by endoscopic ultrasound should be made in collaboration with the referring physician [39].

For other abscesses that are incompletely drained after PDAFC, some have reported success with adjunctive intracavitary fibrinolytics and/or adjunctive procedures such as upsizing to a larger catheter or one with additional side holes [40,41]. Decisions regarding percutaneous versus surgical drainage of complex collections should be made in concert with other physicians involved in the patient's care. Some have advocated the possibility of draining abscesses using needles alone [32,42,43]. However, a majority of abscesses need catheter placement for proper drainage, and the overall utility of needle drainage of abscesses awaits further study.

The indications for PDAFC include, but are not limited to, the presence of an abnormal fluid collection with:

1. Suspicion that the fluid is infected or the result of an abnormal fistulous communication.
2. Need for fluid characterization.
3. Suspicion that the collection is producing symptoms or adverse physiologic effects such as sepsis, respiratory compromise, gastrointestinal or urinary obstruction, compartment syndrome, etc.
4. Need for an adjunctive procedure to facilitate the improved outcome of a subsequent intervention (eg, paracentesis prior to liver intervention) or additional therapy to follow access (sclerotherapy, pleurodesis, laser ablation, debridement, etc).

Threshold – PDAFC should be done for 1 of the above 4 indications in 98% of the cases.

B. Contraindications

There are no absolute contraindications. However, there are relative contraindications and, as for all patients considered for this procedure, the relative benefits and risks of the procedure should be weighed carefully. These relative contraindications should be addressed and corrected or controlled before the procedure, when feasible. The relative contraindications for PDAFC include:

1. Significant coagulopathy that cannot be adequately corrected.
2. Severely compromised cardiopulmonary function or hemodynamic instability.
3. Lack of a safe pathway to **access** the abscess or fluid collection.
4. Inability of the patient to cooperate with, or to be positioned for, the procedure.

For the pregnant or potentially pregnant patient, see the [ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#) [44].

IV. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Image-based diagnosis and treatment planning require integrating the preprocedural imaging findings within the context of the patient’s history and physical findings. Therefore, the physician must be clinically informed and understand the specific questions to be answered and goals to be accomplished by PDAFC prior to the procedure in order to plan and perform it safely and effectively.

The physician performing PDAFC must have knowledge of the benefits, alternatives, and risks of the procedures. The physician must have a thorough understanding of imaging anatomy (including congenital and developmental variants), the imaging equipment to be used during the procedures, radiation safety considerations, and physiologic monitoring equipment. The physician must also have access to adequate supplies and personnel to perform the procedure safely.

PDAFC procedures must be performed by a physician who has the following qualifications. The physician’s experience in PDAFC is best documented by use of a formal case log submitted by the applicant.

1. Certification in Radiology, Diagnostic Radiology or Interventional Radiology/Diagnostic Radiology (IR/DR) 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 and has performed (with supervision) a sufficient number of PDAFC procedures to demonstrate competency as attested by the supervising physician(s).

or

2. Completion of radiology or interventional radiology 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 has performed (with supervision) a sufficient number of PDAFC procedures to demonstrate competency as attested by the supervising physician(s).

or

3. Physicians whose residency or fellowship training did not include the above may still be considered qualified to perform PDAFC provided that the following can be demonstrated:

The physician must have at least 2 years of image-guided procedural experience during which the physician performed (with supervision) a sufficient number of PDAFC procedures to demonstrate competency as attested by the supervising physician(s).

and

4. Physicians meeting any of the qualifications in 1, 2, and 3 above also must have written substantiation that they are familiar with all of the following:
 - a. Indications and contraindications for the procedure.
 - b. Periprocedural and intraprocedural assessment, monitoring, and management of the patient and potential complications.
 - c. Where applicable, pharmacology of moderate sedation medications and recognition and treatment of adverse reactions and complications.
 - d. Imaging systems that may be used for guidance during percutaneous procedures and determining which imaging modality would be optimal for a specific PDAFC procedure in terms of both safety and effectiveness.
 - e. Where applicable, principles of radiation protection, ALARA, the hazards of radiation, and radiation monitoring requirements.
 - f. Where applicable, pharmacology of contrast agents and recognition and treatment of potential adverse reactions.

- g. Percutaneous needle and catheter introduction techniques.
- h. Technical aspects of performing the procedure, including the use of various catheter and guide-wire systems.
- i. Anatomy, physiology, and pathophysiology of the structures being considered for PDAFC.

The written substantiation should come from the chief of interventional radiology, the director or chief of body imaging or ultrasound, or the chair of the radiology department of the institution in which the physician will be providing these services. Substantiation could also come from a prior institution in which the physician provided the services, but only at the discretion of the current interventional director or chair who solicits the additional input.

Maintenance of Competence

Physicians must perform a sufficient number of procedures to maintain their skills, with acceptable success and complication rates as laid out in this practice parameter. Continued competence should depend on participation in a quality improvement program that monitors these rates.

Continuing Medical Education

The physician's continuing education should be in accordance with the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#) [45].

B. Qualified Medical Physicist

A Qualified Medical Physicist should have the responsibility for overseeing the equipment quality control program and for monitoring fluoroscopy and other cross-sectional imaging studies both upon installation and routinely on an annual basis. Medical physicists assuming these responsibilities should meet the following qualifications:

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 (ACR) considers certification and 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 Physics in Medicine, or by 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, 1996 – revised in 2012, Resolution 42) [45]

The appropriate subfield of medical physics for this practice parameter is Diagnostic Medical Physics (including medical physics certification categories of Radiological Physics, Diagnostic Radiological Physics, or Diagnostic Imaging Physics).

C. Registered Radiologist Assistant

A registered radiologist assistant is an advanced level radiographer who is certified and registered as a radiologist assistant by the American Registry of Radiologic Technologists (ARRT) after having successfully completed an advanced academic program encompassing an ACR/ASRT (American Society of Radiologic Technologists) radiologist assistant curriculum and a radiologist-directed clinical preceptorship. Under radiologist supervision, the radiologist assistant may perform patient assessment, patient management and selected examinations as delineated in the Joint Policy Statement of the ACR and the ASRT titled “Radiologist Assistant: Roles and Responsibilities” [46] and as allowed by state law. The radiologist assistant transmits to the supervising radiologists those observations that have a bearing on diagnosis. Performance of diagnostic interpretations remains outside the scope of practice of the radiologist assistant. (ACR Resolution 34, adopted in 2006 – revised in 2016, Resolution 1-c)

D. Radiologic Technologist

The technologist, together with the physician and nursing personnel, should have responsibility for patient comfort and safety. The technologist should be able to prepare and position² the patient for the image-guided percutaneous procedure and, together with the nurse, monitor the patient during the procedure. The technologist should provide assistance to the physician as required, which may include operating the imaging equipment and obtaining images prescribed by the supervising physician. If intravenous contrast material is to be administered, qualifications for technologists performing intravenous injection should be in compliance with the current ACR policy³ and the operating procedures or manuals at the facility. The technologist should also perform regular quality control testing of the equipment under supervision of the medical physicist.

Technologists should be certified by the American Registry of Radiologic Technologists (ARRT) or have an unrestricted state license with documented training and experience in the imaging modality used for the imaging-guided percutaneous procedure.

E. Diagnostic Medical Sonographer

For cases performed with the assistance of a sonographer, the sonographer, together with the physician and nursing personnel, should have responsibility for patient comfort and safety. The sonographer should be able to prepare and position the patient for the image-guided percutaneous procedure and, together with the nurse, monitor the patient during the procedure. The sonographer should provide assistance to the physician as required, which may include operating the imaging equipment and obtaining images prescribed by the supervising physician. The sonographer should also perform regular quality control testing of the equipment under supervision of the physicist.

Diagnostic medical sonographers involved in PDAFC should have documented training and experience in assisting with these procedures. When possible, they should be certified by the ARRT or by the American Registry for Diagnostic Medical Sonography (ARDMS). When applicable, they should have an unrestricted state license.

²The American College of Radiology approves of the practice of certified and/or licensed radiologic technologists performing fluoroscopy in a facility or department as a positioning or localizing procedure only, and then only if monitored by a supervising physician who is personally and immediately available*. There must be a written policy or process for the positioning or localizing procedure that is approved by the medical director of the facility or department/service and that includes written authority or policies and processes for designating radiologic technologists who may perform such procedures. (ACR Resolution 26, 1987 – revised in 2007, Resolution 12m)

*For the purposes of this parameter, “personally and immediately available” is defined in manner of the “personal supervision” provision of CMS—a physician must be in attendance in the room during the performance of the procedure. Program Memorandum Carriers, DHHS, HCFA, Transmittal B-01-28, April 19, 2001.

³See the [ACR-SPR Practice Parameter for the Use of Intravascular Contrast Media](#).

F. CT or MR Technologist

See the [ACR Practice Parameter for Performing and Interpreting Diagnostic Computed Tomography \(CT\)](#) and the [ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging \(MRI\)](#) for the qualifications of CT and MR technologists [47,48].

CT or MR technologists should be certified by the ARRT or have an unrestricted state license with documented training and experience in CT and/or MR as appropriate to the modality being used.

G. Other Ancillary Personnel

Other ancillary personnel who are qualified and duly licensed or certified under applicable state law may, under supervision by a radiologist or other qualified physician, perform specific interventional fluoroscopic or other image-guided procedures. Supervision by a radiologist or other qualified physician must be direct or personal and must comply with local, state, and federal regulations. Individuals should be credentialed for specific fluoroscopic and other image-guided interventional procedures and should have received formal training in radiation management and/or application of other imaging modalities as appropriate. See the [ACR–AAPM Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures](#) [49].

H. Nursing Services

Nursing services, when deemed appropriate by the performing physician, are an integral part of the team for preprocedural, intra-procedural, and postprocedural patient management and education and are recommended in monitoring the patient during the procedure.

I. Nonphysician Practitioners

Physician assistants and nurse practitioners can be valuable members of the interventional radiology team but should not perform PDAFCs independent of supervision by physicians with training, experience, and privileges to perform the relevant procedures. See the [ACR–SIR–SNIS–SPR Practice Parameter for Interventional Clinical Practice and Management](#) [50].

V. SPECIFICATIONS AND PERFORMANCE OF THE PROCEDURE

A. Imaging Equipment and Facilities

The choice of modality for imaging guidance will depend on the site and characteristics of the collection, the skill and preference of the intervening physician, and the availability of appropriate imaging devices for guidance.

1. The minimum requirements for facilities in which PDAFC is performed include the following:
 - a. When fluoroscopic guidance is used, a high-resolution unit with adequate shielding and collimation is desirable. Ability to perform complex angle (eg, anteroposterior, lateral, or oblique) fluoroscopy views is often necessary to ensure proper needle or catheter placement. Image and written documentation of needle or drainage catheter location is essential. Overhead fluoroscopic tube suites are less desirable because of their increased radiation exposure to personnel during this procedure.
 - b. When ultrasound guidance is used, proper transducer frequency is required to direct and monitor needle placement. That is especially true for diagnostic aspiration of fluid collections in the pleural space, peritoneal cavity, etc.
 - c. CT, CT fluoroscopy, flat-panel cone-beam CT, or MRI equipment may better visualize the anatomy, particularly in:
 - i. Patients with fluid collections that are difficult to visualize or access with other imaging modalities, or are in unusual or precarious locations.
 - ii. Planning the optimal access route to avoid, when possible, transgression of vital structures.
 - iii. Patients with unusual anatomy.

- d. The facility should provide an area within the institution appropriate for patient preparation and for observation after the procedure. This might be within the radiology department, in a short-stay unit, or in a routine nursing unit as outlined in the Patient Care section below. There should be immediate access to emergency resuscitation equipment.
- e. For patients undergoing thoracic procedures, appropriate equipment for decompression of a clinically significant pneumothorax should be available. f. Access to a laboratory with expertise in cytopathology, microbiology, and chemistry should be available. (These resources need not be located in the facility.)
- g. When MR guidance is used, MR-compatible equipment must be used.

2. Performance guidelines

When using fluoroscopy, CT, or MRI guidance for PDAFC, a facility should meet or exceed the following imaging practices:

- a. Radiation doses for both X-ray and CT guidance should be kept to a minimum. The operator will use only as much fluoroscopy or CT imaging as is necessary to achieve aspiration and/or catheter drainage, consistent with the ALARA radiation safety guidelines. One method to minimize fluoroscopic time is to use units with “last image hold” capability. See the [ACR–AAPM Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures](#) [49].
- b. Tight collimation and, when appropriate, shielding (eg, thyroid, gonadal, eye) should be used for the operating radiologist, for the patient, and for any other personnel who might be affected.
- c. On units where dose-reduction pulsed fluoroscopy is available, its use is recommended.
- d. For CT-guided drainages, appropriately lowering the mAs, kVp, and/or increasing slice thickness can substantially reduce radiation dose without compromising the procedure for larger fluid collections.
- e. The MRI equipment specifications and performance must meet all state and federal requirements. The requirements include, but are not limited to, specifications of maximum static magnetic field strength, maximum rate of change of magnetic field strength (dB/dt), maximum radiofrequency power deposition (specific absorption rate), and maximum acoustic noise levels.

B. Physiologic Monitoring and Resuscitation Equipment

- 1. Appropriate equipment should be present to allow for monitoring the patient’s heart rate, cardiac rhythm, and blood pressure. For facilities using moderate sedation, a pulse oximeter and capnography, if available, should be utilized. (See the [ACR–SIR Practice Parameter for Sedation/Analgesia](#) [51].)
- 2. Any procedure performed using MRI guidance must have MRI safety compatible emergency resuscitation equipment available.
- 3. Appropriate emergency equipment and medications must be immediately available to treat procedural complications or adverse reactions associated with administered medications. The equipment should be monitored and the medications inventoried for drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and/or sizes in the patient population.

C. Acute Care Support

Although complications of PDAFC only rarely require urgent surgery, high-risk procedures should be performed in an environment in which surgical intervention can be instituted promptly. Ideally, this would be a facility with adequate surgical, anesthesia, and ancillary support. When these procedures are performed in a freestanding center, detailed protocols for the rapid transport or admission of patients to an acute-care hospital should be formalized in writing.

D. Patient Care

1. Preprocedural care

- a. The physician performing the procedure must have knowledge of the following:
 - i. Clinically significant history, including indications for the procedure and any related preprocedure imaging.
 - ii. Screening results for significant bleeding risks, relevant medications, such as anticoagulants, and allergies.
 - iii. Clinically significant physical examination findings, to include an awareness of clinical or medical conditions or comorbidities that may necessitate specific care, such as preprocedure antibiotics or other measures.
 - iv. Possible alternative methods, such as surgery, to obtain the desired diagnostic information or therapeutic result.
- b. Informed consent must be in compliance with state laws and should comply with the [ACR–SIR–SPR Practice Parameter on Informed Consent for Image-Guided Procedures](#) [52].

2. Procedural care

- a. Adherence to the Joint Commission’s current Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery™ is required for procedures in nonoperating room settings, including bedside procedures.

The organization should have processes and systems in place for reconciling differences in staff responses during the “time out.”
- b. Nursing personnel, technologists, and those directly involved in patient care during PDAFC should have protocols for use in standardizing care. These should include, but are not limited to:
 - i. Equipment needed for the procedure
 - ii. Patient monitoring
- c. Protocols should be reviewed and updated periodically.

3. Postprocedural care

- a. Orders for postprocedure patient care should include the frequency of monitoring vital signs, drainage catheter care, and discharge instructions. Discharge instructions should include instructions for following catheter outputs, appointments for physician catheter evaluation and follow-up imaging, postprocedure instructions regarding any modifications to the patient’s medications, including resumption of anticoagulants, when applicable.
- b. Specific anatomic and management considerations
 - i. Thoracic cavity: pulmonary assessment for the presence of pneumothorax and to confirm adequate catheter placement.
 - a) If guidance was by fluoroscopy or ultrasound, an upright chest radiograph should be obtained when appropriate.
 - b) If guidance was by CT, a tailored postprocedure CT scan should be obtained.
 - ii. Peritoneal and other cavities: confirmation of appropriate tube placement.
 - iii. Postprocedure imaging and follow-up may involve injection of contrast material to confirm catheter placement within the abscess or symptomatic fluid collection cavity, catheter patency, assess fistulae to bowel or other structures, or documentation of the reduction in cavity size.
 - iv. Appropriate adjunct drainage maneuvers may often include irrigation of the abscess cavity, drainage tube repositioning, drainage tube upsizing or downsizing, antibiotic therapy, fibrinolytics, etc.
- c. Clinical and imaging follow-up
 - i. The patient should be informed of which provider will be following the drainage tube and who the patient should contact for questions about or issues with the drain.
 - ii. Periodic imaging follow-up may be appropriate to evaluate for resolution or persistence of an abscess or symptomatic fluid collection and for development of new abscesses.

- iii. Clinical follow-up only may suffice if patient condition is substantially improved and there was near-complete initial drainage, as well as laboratory evidence confirming progressive improvement.
- iv. A facility or practice in concert with the clinical team should have a set protocol to address monitoring of catheter outputs and arrangements for follow-up imaging to ensure timely and consistent patient care.

E. Specifics of the Procedure

1. All image-guided percutaneous procedures involving aspiration of fluid collections with or without percutaneous catheter drainage are performed for specific indications, and the examination or procedure should therefore be tailored accordingly.
2. In the setting of image-guided percutaneous aspiration of fluid collections for diagnostic purposes, initial placement of a small needle (ie, 18-22 gauge) or centesis catheter is advised when appropriate.
3. Diagnostic percutaneous fluid aspiration may lead to therapeutic placement of a percutaneous drainage catheter using modified Seldinger (needle/guide-wire/catheter) or trocar techniques, for definitive drainage.

VI. DOCUMENTATION

Reporting should be in accordance with the [ACR–SIR–SPR Practice Parameter for the Reporting and Archiving of Interventional Radiology Procedures](#) [53].

VII. 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 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).

VIII. 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 (<https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards>).

Equipment performance monitoring should be in accordance with the [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Fluoroscopic Equipment](#) [54].

IX. QUALITY IMPROVEMENT

While practicing physicians should strive to achieve perfect outcomes (eg, 100% success, 0% complications), in practice all physicians will fall short of this ideal to a variable extent. Thus, indicator thresholds may be used to assess the efficacy of ongoing quality-improvement programs. For the purposes of these practice parameters, a threshold is a specific level of an indicator that should prompt a review. Procedure thresholds or overall thresholds refer to a group of indicators for a procedure (eg, major complications). Individual complications may also be associated with complication-specific thresholds.

When measures such as indications or success rates fall below a minimum threshold, or when complication rates exceed a maximum threshold, a review should be performed to determine causes and, if necessary, to implement changes. For example, if the incidence of sepsis is one measure of the quality of abscess drainage, then values in excess of the defined threshold (in this case 4%) should trigger a review of policies and procedures within the department to determine the causes and to implement changes to lower the incidence of the complication. Thresholds may vary from those listed here; for example, patient referral patterns and selection factors may dictate a different threshold value for a particular indicator at a particular institution. Thus, one cannot set universal thresholds, and each department should alter the thresholds as appropriate to meet its own quality-improvement program needs.

A. Success Rates and Thresholds

Table 1: Success Rates and Thresholds

Outcome	Suggested Threshold (%)
Successful diagnostic fluid aspiration Aspiration of adequate fluid for diagnostic characterization	95
Successful drainage Curative and partial success	85

From Wallace MJ, Chin KW, Bletcher TB, et al; Society of Interventional Radiology Standards of Practice Committee. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. J Vasc Interv Radiol 2010; 21: 431-435

Curative drainage is defined as complete resolution of infection requiring no further operative intervention. Curative drainage has been achieved in more than 80% of patients. Partial success is defined as either adequate drainage of the abscess with surgery subsequently performed to repair an underlying problem or as temporizing drainage performed to stabilize the patient prior to surgery. Partial success occurs in 5% to 10% of patients. It should be noted that in certain conditions the expectation of drainage is to serve as a bridge until definitive surgical treatment can be performed, as in the cases of some patients with ruptured appendicitis complicated by the development of an intra-abdominal abscess or abscesses. For the purposes of these standards, this is considered partial success even though the treatment plan may include staged interventions consisting of percutaneous abscess drainage to be followed by definitive surgical therapy for underlying disease. Failure occurs

in 5% to 10% of patients and recurrence in 5% to 10% of patients. These results are similar for both abdominal and chest drainage procedures. Success rates will depend on the proportion of collections drained in patients with relative contraindications, on the complexity of the collection, and on the severity of the underlying medical problems.

Drainage of infected collections: Because of the variability of the types of infected collections, the success rate of drainage will be highly variable, and it is not believed that a specific threshold for success can be set.

B. Complication Rates and Thresholds

Complications for PDAFC are reported to occur in approximately 10% of patients. Published complication rates and suggested thresholds are summarized in Table 2.

Table 2: Published Complication Rates and Suggested Thresholds

Specific Major Complication	Reported Rate (%)	Suggested Threshold (%)
Septic shock	1-2	4
Bacteremia requiring significant new intervention	2-5	10
Hemorrhage requiring transfusion	1	2
Superinfection (includes infection of sterile fluid collection)	1	2
Bowel transgression requiring intervention	1	2
Pleural transgression requiring intervention (abdominal interventions)	1	2
Pneumothorax/hemothorax/pleural effusion requiring further intervention (chest procedures)	2-10	20

From Wallace MJ, Chin KW, Bletcher TB, et al; Society of Interventional Radiology Standards of Practice Committee. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. J Vasc Interv Radiol 2010; 21: 431-435

In the above table, all values were supported by the weight of literature evidence and panel consensus.

Published rates for individual types of complications are highly dependent on patient selection and are based on a series comprising several hundred patients, which is a volume larger than most individual practitioners are likely to treat. Generally, the complication-specific thresholds should be set higher than the complication-specific reported rates listed above. It is also recognized that a single complication can cause a rate to cross above a complication-specific threshold when the complication occurs within a small patient volume (eg, early in a quality improvement program). In Table 3 below, the overall procedure threshold is more appropriate for use in a quality-improvement program.

Table 3: Overall Complication Rate

Overall Procedure	Suggested Threshold (%)
All major complication resulting from adult percutaneous drainage procedures	10

From Wallace MJ, Chin KW, Bletcher TB, et al; Society of Interventional Radiology Standards of Practice Committee. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. J Vasc Interv Radiol 2010; 21: 431-435

ACKNOWLEDGEMENTS

This practice parameter was revised according to the process described under the heading *The Process for Developing ACR Practice Guidelines and Technical Standards* on the ACR website (<https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards>) by the Committee on Practice Parameters – Interventional and Cardiovascular Radiology of the ACR Commission on Interventional and Cardiovascular Radiology and the Committee on Practice Parameters – Pediatric Radiology of the ACR Commission on Pediatric Radiology in collaboration with the SIR and the SPR.

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

ACR

Elizabeth A. Ignacio, MD, Chair
Brian D. Coley, MD, FACR
Robert P. Liddell, MD
J. David Prologo, MD

SIR

Joseph J. Gemmete, MD, FACR, FSIR, FAHA
Jason W. Mitchell, MD, MPH, MBA
Paul B. Shyn, MD

SPR

Matthew P Lungren, MD, MPH
Manish Patel, DO

Committee on Practice Parameters – Interventional and Cardiovascular Radiology

(ACR Committee responsible for sponsoring the draft through the process)

Clayton K. Trimmer, DO, FACR, FAOCR, FSIR, Chair
Chaitanya Ahuja, MBBS
Drew M. Caplin, MD
Douglas M. Coldwell, MD, PhD
Kevin W. Dickey, MD
Joshua A. Hirsch, MD, FACR, FSIR
Kelvin Hong, MD, FSIR
Elizabeth A. Ignacio, MD, FSIR
Sanjeeva P. Kalva, MD, FSIR

Claire Kaufman, MD
Minhajuddin S. Khaja, MD, MBA
Margaret Hsin-Shung Lee, MD
Susan K. O'Horo, MD, FSIR
John D. Prologo, MD
Stephen P. Reis, MD
Beth A. Schueler, PhD, FACR, FAAPM
Sanjit Tewari, MD

Committee on Practice Parameters – Pediatric Radiology

(ACR Committee responsible for sponsoring the draft through the process)

Beverly Newman, MB, BCh, BSc, FACR, Chair
Lorna P. Browne, MB, BCh
Timothy J. Carmody, MD, FACR
Brian D. Coley, MD, FACR
Lee K. Collins, MD
Monica S. Epelman, MD
Lynn Ansley Fordham, MD, FACR
Kerri A. Highmore, MD

Sue C. Kaste, DO
Tal Laor, MD
Terry L. Levin, MD, FACR
Marguerite T. Parisi, MD, MS
Sumit Pruthi, MBBS
Nancy K. Rollins, MD
Pallavi Sagar, MD

Philip S. Cook, MD, FACR, FSIR, Chair, Commission on Interventional and Cardiovascular Radiology
Alan H. Matsumoto, MD, FACR, Vice Chair, Commission on Interventional and Cardiovascular Radiology
Marta Hernanz-Schulman, MD, FACR, Chair, Commission on Pediatric Radiology
Jacqueline Anne Bello, MD, FACR, Chair, Commission on Quality and Safety
Matthew S. Pollack, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards

Comments Reconciliation Committee

Timothy A. Crummy, MD, FACR, Chair
Kevin L. Smith, MD, FACR, Co-Chair
Jacqueline Anne Bello, MD, FACR
Brian D. Coley, MD, FACR
Philip S. Cook, MD, FACR, FSIR
Richard Duszak, Jr., MD, FACR
Margaret Fleming, MD
Joseph J. Gemmete, MD, FACR, FSIR, FAHA
Marta Hernanz-Schulman, MD, FACR

Robert P. Liddell, MD
Matthew P Lungren, MD, MPH
Jason W. Mitchell, MD, MPH, MBA
Beverly Newman, MB, BCh, BSc, FACR
Manish Patel, DO
Matthew S. Pollack, MD, FACR
J. David Prologo, MD
Michael I. Rothman, MD, FACR
Paul B. Shyn, MD

Comments Reconciliation Committee

Elizabeth A. Ignacio, MD
Claire Kaufman, MD
Arshad A. Khan, MB, BS
Paul A. Larson, MD, FACR

Timothy L. Swan, MD, FACR, FSIR
Clayton K. Trimmer, DO, FACR, FAOCR, FSIR
Rakesh Varma, MD

REFERENCES

1. Levin DC, Eschelmann D, Parker L, Rao VM. Trends in Use of Percutaneous Versus Open Surgical Drainage of Abdominal Abscesses. *Journal of the American College of Radiology : JACR*. 2015;12(12 Pt A):1247-1250.
2. Brown CV, Abrishami M, Muller M, Velmahos GC. Appendiceal abscess: immediate operation or percutaneous drainage? *The American surgeon*. 2003;69(10):829-832.
3. Chou YH, Tiu CM, Liu JY, et al. Prostatic abscess: transrectal color Doppler ultrasonic diagnosis and minimally invasive therapeutic management. *Ultrasound in medicine & biology*. 2004;30(6):719-724.
4. Cinat ME, Wilson SE, Din AM. Determinants for successful percutaneous image-guided drainage of intra-abdominal abscess. *Arch Surg*. 2002;137(7):845-849.
5. Coelho RF, Schneider-Monteiro ED, Mesquita JL, Mazzucchi E, Marmo Lucon A, Srougi M. Renal and perinephric abscesses: analysis of 65 consecutive cases. *World journal of surgery*. 2007;31(2):431-436.
6. Cronin CG, Gervais DA, Hahn PF, Arellano R, Guimaraes AR, Mueller PR. Treatment of deep intramuscular and musculoskeletal abscess: experience with 99 CT-guided percutaneous catheter drainage procedures. *AJR. American journal of roentgenology*. 2011;196(5):1182-1188.
7. Gervais DA, Ho CH, O'Neill MJ, Arellano RS, Hahn PF, Mueller PR. Recurrent abdominal and pelvic abscesses: incidence, results of repeated percutaneous drainage, and underlying causes in 956 drainages. *AJR. American journal of roentgenology*. 2004;182(2):463-466.
8. Gjelland K, Ekerhovd E, Granberg S. Transvaginal ultrasound-guided aspiration for treatment of tubo-ovarian abscess: a study of 302 cases. *American journal of obstetrics and gynecology*. 2005;193(4):1323-1330.
9. Gupta S, Suri S, Gulati M, Singh P. Ilio-psoas abscesses: percutaneous drainage under image guidance. *Clinical radiology*. 1997;52(9):704-707.
10. Hung CH, Liou JD, Yan MY, Chang CC. Immediate percutaneous drainage compared with surgical drainage of renal abscess. *International urology and nephrology*. 2007;39(1):51-55.
11. Leborgne F. Treatment of breast abscesses with sonographically guided aspiration, irrigation, and instillation of antibiotics. *AJR. American journal of roentgenology*. 2003;181(4):1089-1091.
12. Siewert B, Tye G, Kruskal J, et al. Impact of CT-guided drainage in the treatment of diverticular abscesses: size matters. *AJR. American journal of roentgenology*. 2006;186(3):680-686.
13. Singh AK, Gervais DA, Alhilali LM, Hahn PF, Mueller PR. Imaging-guided catheter drainage of abdominal collections with fistulous pancreaticobiliary communication. *AJR. American journal of roentgenology*. 2006;187(6):1591-1596.
14. Thanos L, Dailiana T, Papaioannou G, Nikita A, Koutrouvelis H, Kelekis DA. Percutaneous CT-guided drainage of splenic abscess. *AJR. American journal of roentgenology*. 2002;179(3):629-632.
15. Thanos L, Mylona S, Kalioras V, Pomoni M, Batakis N. Potentially life-threatening neck abscesses: therapeutic management under CT-guided drainage. *Cardiovascular and interventional radiology*. 2005;28(2):196-199.
16. Wallace MJ, Chin KW, Fletcher TB, et al. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. *Journal of vascular and interventional radiology : JVIR*. 2010;21(4):431-435.
17. Yu SC, Ho SS, Lau WY, et al. Treatment of pyogenic liver abscess: prospective randomized comparison of catheter drainage and needle aspiration. *Hepatology*. 2004;39(4):932-938.
18. Jaffe TA, Nelson RC. Image-guided percutaneous drainage: a review. *Abdom Radiol (NY)*. 2016;41(4):629-636.
19. Hogan MJ, Marshalleck FE, Sidhu MK, et al. Quality improvement guidelines for pediatric abscess and fluid drainage. *Pediatric radiology*. 2012;42(12):1527-1535.
20. American College of Radiology. ACR practice parameter for the performance of stereotactic-guided breast interventional procedures. 2016; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Stereo-Breast.pdf>. Accessed November 18, 2016.

21. American College of Radiology. ACR practice parameter for the performance of ultrasound-guided percutaneous breast interventional procedures. 2016; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-guidedbreast.pdf?la=en>. Accessed November 18, 2016.
22. Patel BN, Morgan M, Tyler D, Paulson E, Jaffe TA. The role of CT-guided percutaneous drainage of loculated air collections: an institutional experience. *Abdominal imaging*. 2015;40(8):3257-3264.
23. Gervais DA, Hahn PF, O'Neill MJ, Mueller PR. Percutaneous abscess drainage in Crohn disease: technical success and short- and long-term outcomes during 14 years. *Radiology*. 2002;222(3):645-651.
24. Gutierrez A, Lee H, Sands BE. Outcome of surgical versus percutaneous drainage of abdominal and pelvic abscesses in Crohn's disease. *The American journal of gastroenterology*. 2006;101(10):2283-2289.
25. O'Moore PV, Mueller PR, Simeone JF, et al. Sonographic guidance in diagnostic and therapeutic interventions in the pleural space. *AJR. American journal of roentgenology*. 1987;149(1):1-5.
26. Parker LA, Charnock GC, Delany DJ. Small bore catheter drainage and sclerotherapy for malignant pleural effusions. *Cancer*. 1989;64(6):1218-1221.
27. Silverman SG, Mueller PR, Saini S, et al. Thoracic empyema: management with image-guided catheter drainage. *Radiology*. 1988;169(1):5-9.
28. vanSonnenberg E, D'Agostino HB, Casola G, Wittich GR, Varney RR, Harker C. Lung abscess: CT-guided drainage. *Radiology*. 1991;178(2):347-351.
29. Walser EM, Nealon WH, Marroquin S, Raza S, Hernandez JA, Vasek J. Sterile fluid collections in acute pancreatitis: catheter drainage versus simple aspiration. *Cardiovascular and interventional radiology*. 2006;29(1):102-107.
30. Zerem E, Pavlovic-Calic N, Susic A, Haracic B. Percutaneous management of pancreatic abscesses: long term results in a single center. *European journal of internal medicine*. 2011;22(5):e50-54.
31. Clancy C, Boland T, Deasy J, McNamara D, Burke JP. A Meta-analysis of Percutaneous Drainage Versus Surgery as the Initial Treatment of Crohn's Disease-related Intra-abdominal Abscess. *Journal of Crohn's & colitis*. 2016;10(2):202-208.
32. Giorgio A, de Stefano G, Di Sarno A, Liorre G, Ferraioli G. Percutaneous needle aspiration of multiple pyogenic abscesses of the liver: 13-year single-center experience. *AJR. American journal of roentgenology*. 2006;187(6):1585-1590.
33. Gurusamy KS, Belgaumkar AP, Haswell A, Pereira SP, Davidson BR. Interventions for necrotising pancreatitis. *The Cochrane database of systematic reviews*. 2016;4:CD011383.
34. Hollemans RA, Bollen TL, van Brunschot S, et al. Predicting Success of Catheter Drainage in Infected Necrotizing Pancreatitis. *Annals of surgery*. 2016;263(4):787-792.
35. Sugimoto M, Sonntag DP, Flint GS, et al. A percutaneous drainage protocol for severe and moderately severe acute pancreatitis. *Surgical endoscopy*. 2015;29(11):3282-3291.
36. Sun J, Yang C, Liu W, et al. Conservative treatment and percutaneous catheter drainage improve outcome of necrotizing pancreatitis. *Hepato-gastroenterology*. 2015;62(137):195-199.
37. Wang T, Liu LY, Luo H, et al. Intra-Abdominal Pressure Reduction After Percutaneous Catheter Drainage Is a Protective Factor for Severe Pancreatitis Patients With Sterile Fluid Collections. *Pancreas*. 2016;45(1):127-133.
38. Zhang Y, Zhang SY, Gao SL, Liang ZY, Yu WQ, Liang TB. Successful Resolution of Gastric Outlet Obstruction Caused by Pancreatic Pseudocyst or Walled-Off Necrosis After Acute Pancreatitis: The Role of Percutaneous Catheter Drainage. *Pancreas*. 2015;44(8):1290-1295.
39. Gurusamy KS, Pallari E, Hawkins N, Pereira SP, Davidson BR. Management strategies for pancreatic pseudocysts. *The Cochrane database of systematic reviews*. 2016;4:CD011392.
40. Beland MD, Gervais DA, Levis DA, Hahn PF, Arellano RS, Mueller PR. Complex abdominal and pelvic abscesses: efficacy of adjunctive tissue-type plasminogen activator for drainage. *Radiology*. 2008;247(2):567-573.
41. Gee MS, Kim JY, Gervais DA, Hahn PF, Mueller PR. Management of abdominal and pelvic abscesses that persist despite satisfactory percutaneous drainage catheter placement. *AJR. American journal of roentgenology*. 2010;194(3):815-820.
42. Rajak CL, Gupta S, Jain S, Chawla Y, Gulati M, Suri S. Percutaneous treatment of liver abscesses: needle aspiration versus catheter drainage. *AJR. American journal of roentgenology*. 1998;170(4):1035-1039.
43. Wroblecka JT, Kuligowska E. One-step needle aspiration and lavage for the treatment of abdominal and pelvic abscesses. *AJR. American journal of roentgenology*. 1998;170(5):1197-1203.

44. American College of Radiology. ACR–SPR practice parameter for imaging pregnant or potentially pregnant adolescents and women with ionizing radiation. 2013; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Pregnant-Pts.pdf>. Accessed November 18, 2016.
45. American College of Radiology. ACR practice parameter for continuing medical education (CME). 2016; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CME.pdf>. Accessed November 18, 2016.
46. American College of Radiology. ACR ASRT joint statement radiologist assistant roles and responsibilities - Appendix H. 2017; Available at: <https://www.acr.org/-/media/ACR/Files/Governance/Digest-of-Council-Actions.pdf>. Accessed February 21, 2018.
47. American College of Radiology. ACR practice parameter for performing and interpreting magnetic resonance imaging (MRI). 2017; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MR-Perf-Interpret.pdf>. Accessed November 7, 2017.
48. American College of Radiology. ACR practice parameter for performing and interpreting diagnostic computed tomography (CT). 2017; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Perf-Interpret.pdf>. Accessed November 7, 2017.
49. American College of Radiology. ACR–AAPM technical standard for management of the use of radiation in fluoroscopic procedures. 2013; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MgmtFluoroProc.pdf>. Accessed October 2, 2017.
50. American College of Radiology. ACR–SIR–SNIS–SPR practice parameter for interventional clinical practice and management. 2014; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/IRClin-Prac-Mgmt.pdf>. Accessed November 18, 2016.
51. American College of Radiology. ACR–SIR practice parameter for sedation/analgesia. 2015; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Sed-Analgesia.pdf>. Accessed November 16, 2016.
52. American College of Radiology. ACR–SIR–SPR practice parameter on informed consent for image-guided procedures. 2016; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/InformedConsent-ImagGuided.pdf>. Accessed November 18, 2016.
53. American College of Radiology. ACR–SIR–SPR practice parameter for the reporting and archiving of interventional radiology procedures. 2014; Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Reporting-Archiv.pdf>. Accessed November 18, 2016.
54. American College of Radiology. ACR–AAPM technical standard for diagnostic medical physics performance monitoring of fluoroscopic equipment. 2016; Available at: https://www.acr.org/-/media/ACR/Files/Technical-Standards/Fluoroscopic_Equipment.pdf?la=en. Accessed November 18, 2016.

APPENDIX A

Society of Interventional Radiology Standards of Practice Committee Classification of Complications by Outcome

Minor Complications

- A. No therapy, no consequence
- B. Nominal therapy, no consequence; includes overnight admission for observation only

Major Complications

- C. Require therapy, minor hospitalization (<48 hours)
- D. Require major therapy, unplanned increase in level of care, prolonged hospitalization (>48 hours)
- E. Permanent adverse sequelae
- F. Death

*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

1994 (Resolution 5)

Amended 1995 (Resolution 24, 53)

Revised 1999 (Resolution 7)

Revised 2004 (Resolution 27)

Amended 2006 (Resolution 16g, 17, 34, 35, 36)

Amended 2007 (Resolution 12m, 38)

Revised 2008 (Resolution 13)

Amended 2009 (Resolution 11)

Revised 2013 (Resolution 34)

Amended 2014 (Resolution 39)

Revised 2018 (Resolution 13)

Amended 2018 (Resolution 44)