

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

Revised 2023 (Resolution 4)\*

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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.

## 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 care<sup>1</sup>. 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 considering 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 variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and 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 purpose of this document is to assist practitioners in achieving this objective.

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1 Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (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 (SPR).

Image-guided drainage or aspiration of abscesses and fluid collections (DAFC) has become the diagnostic and therapeutic treatment of choice for a wide variety of fluid collections [1,2]. DAFC is a safe and effective alternative or adjunct to surgery, reducing morbidity and mortality, length of hospital stay, and costs [1-38].

Image-guided drainage involves the placement of a catheter into a fluid collection using imaging guidance to provide continuous drainage, using access pathways that may be either percutaneous or transorificial (eg, transrectal, transvaginal, transgastric, peroral) [1,2]. The target fluid collection is localized by imaging; the procedure may involve placement of one or more catheters and may be performed during a single session or as a staged procedure in multiple sessions. Care may include catheter maintenance and eventual removal of the catheter(s). Image-guided 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 [1,2].

These image guided procedures may be performed with ionizing radiation(eg, fluoroscopy or computed tomography (CT)), or with nonionizing radiation [eg, ultrasound or magnetic resonance imaging (MRI)]. Optimal performance of DAFC, 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 outlines the specifications and principles for performing a quality DAFC and is intended to be used in quality improvement programs to assess drainage procedures. The most important processes of care are 1) patient selection, 2) performing the procedure, and 3) monitoring the patient [1,2]. The outcome measures or indicators for these processes are indications, success rates, and complication rates and are assigned threshold levels [1,2].

For information on breast interventional procedures, see the [ACR Practice Parameter for the Performance of Stereotactic/Tomosynthesis-Guided Breast Interventional Procedures](#) or the [ACR Practice Parameter for the Performance of Ultrasound-Guided Percutaneous Breast Interventional Procedures](#) [39,40].

## II. INDICATIONS AND CONTRAINDICATIONS

### A. Indications [1]

The indications for DAFC include, but are not limited to, the presence of fluid collection with [1]:

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, vascular compression, compartment syndrome, etc.
4. Need as an adjunctive procedure to facilitate improved outcome of a subsequent intervention (eg,

paracentesis prior to liver intervention) or additional therapy following access (eg, sclerotherapy, pleurodesis).

Threshold: DAFC should be done for 1 of the above 4 indications in 98% of cases [2].

Diagnostic aspiration may be the only means of determining whether a fluid collection is infected. If infected material is obtained or if the operator suspects the presence of infection, a drainage catheter may then be placed.

Curative or partially successful drainage in patients with more complex situations including multiple or multiloculated abscesses, abscess due to Crohn's disease, pancreatic abscesses, drainage routes traversing bowel or pleura, infected hematoma, and tumor abscess has been reported [1,2,41-54]. Decisions regarding image-guided versus surgical drainage of complex collections should be made in concert with other physicians involved in the patient's care [1,2]. For complex fluid collections or abscesses that are incompletely drained after DAFC, some have reported success with adjunctive intracavitary fibrinolysis and/or subsequent procedures such as upsizing to a larger catheter or one with additional side holes [55,56]. Some have advocated the possibility of draining abscesses using needles alone [50,57,58]. However, a majority of abscesses need catheter placement to prevent reaccumulation of fluid, and the overall utility of needle drainage of abscesses awaits further study [1,2].

Drainage or aspiration may be performed in essentially any organ system in either the adult or the pediatric patients [1-34]. In addition to fluid, the feasibility and safety of addressing abnormal postoperative air collections related to infection has also been described [59].

## II. INDICATIONS AND CONTRAINDICATIONS

### B. Contraindications [1]

For all patients considered for DAFC, the relative benefits and risks of the procedure should be weighed carefully [1]. There are no absolute contraindications for DAFC. Relative contraindications for DAFC include [1]:

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.

These relative contraindications should be addressed and corrected or optimized before the procedure, whenever feasible.

For the pregnant or potentially pregnant patient, see the [ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation](#) [60].

## III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

### A. Physician

Core Privileging: This procedure is considered part of or amendable to image-guided core privileging.

#### Initial Qualifications

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 DAFC prior to the procedure to plan and perform it safely and effectively.

The physician performing DAFC 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.

DAFC procedures must be performed by a physician who has the following qualifications. The physician's experience in DAFC 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 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 DAFC 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 the Royal College of Physicians and Surgeons of Canada, the Collège des Médecins du Québec, or the American Osteopathic Association and has performed (with supervision) a sufficient number of DAFC 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 DAFC provided that the following can be demonstrated:

The physician must have image-guided procedural experience during which the physician performed (with supervision) a sufficient number of DAFC 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 DAFC 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 and transorificial 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

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 overall procedures applicable to the spectrum of core privileges to

maintain their skills, with acceptable success and complication rates as laid out in this parameter. Continued competence should depend on participation in a quality improvement program that monitors these rates. Consideration should be given to the physician's lifetime practice experience.

#### Continuing Medical Education

The physician's continuing education should be in accordance with the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#) [61].

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### 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 modalities 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, the American Board of Science in Nuclear Medicine (ABSNM), or the American Board of Medical Physics (ABMP).

A Qualified Medical Physicist should meet the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#) [62].

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). (ACR Resolution 17, adopted in 1996 – revised in 2008, 2012, 2022, Resolution 41f)

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### C. Non-Physician Radiology Provider (NPRP)

NPRPs are all Non-Physician Providers (e.g., RRA, RPA, RA, PA, NP, ...) who assist with or participate in portions of the practice of a radiologist-led team (Radiologists = diagnostic, interventional, neurointerventional radiologists, radiation oncologists, and nuclear medicine physicians). The term "NPRP" does not include radiology, CT, US, NM MRI technologists, or radiation therapists who have specific training for radiology related tasks (e.g., acquisition of images, operation of imaging and therapeutic equipment) that are not typically performed by radiologists.

The term 'radiologist-led team' is defined as a team supervised by a radiologist (i.e., diagnostic, interventional, neurointerventional radiologist, radiation oncologist, and nuclear medicine physician) and consists of additional healthcare providers including RRAs, PAs, NPs, and other personnel critical to the provision of the highest quality of healthcare to patients. (ACR Resolution 8, adopted 2020).

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### 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 position<sup>[2]</sup> 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 policy<sup>[3]</sup> 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 image guided procedure.

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[2] The 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

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

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### 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 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 DAFC 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. When applicable, they should have an unrestricted state license.

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### 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 [63,64].

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.

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

#### 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](#) [65].

### III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

## H. Nursing Services

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

## IV. SPECIFICATIONS 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 DAFC is performed include the following:
  - a. When fluoroscopic guidance is used, a high-resolution unit with adequate shielding and collimation is desirable. The 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. The patient should be oriented so the staff who are performing the procedure are on the beam-exit side, reducing the exposure to scattered radiation.
  - b. When ultrasound guidance is used, proper transducer frequency is required to direct and monitor needle placement to avoid damage to surrounding structures.
  - 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 or who are of large size.
    - iv. When MR guidance is used, MR-compatible equipment must be used.
  - d. The facility should provide an area within the institution appropriate for patient preparation and for postoperative observation . 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
  - 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.)
2. Performance guidelines

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

- a. Radiation doses for both fluoroscopy 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 a successful procedure, 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](#) [65].
- b. The radiation beam should be restricted to the area of interest to reduce the volume of tissue irradiated.
- c. All personnel in the room should wear protective garments (eg, aprons, thyroid collars, eyeglasses) or stand behind protective barriers.
- d. For CT-guided drainages, appropriately lowering the milliamperes-seconds (mAs) and kilovoltage peak (kVp), and/or using an appropriate slice thickness can substantially reduce radiation dose without compromising the procedure for larger fluid collections.

## IV. SPECIFICATIONS OF THE PROCEDURE

### 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. In cases using moderate sedation, a pulse oximeter and capnography should be used. (See the [ACR–SIR Practice Parameter for Minimal and/or Moderate Sedation/Analgesia](#) [66].)
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.

#### **IV. SPECIFICATIONS OF THE PROCEDURE**

##### **C. Acute Care Support**

Although complications of DAFC 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.

#### **IV. SPECIFICATIONS OF THE PROCEDURE**

##### **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 (eg, anticoagulants), and allergies [67].
  - 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 [68] 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](#) [69].

###### **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 DAFC 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 output, appointments for physician catheter evaluation and follow-up imaging, and 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 procedure-related 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 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. 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.

#### **IV. SPECIFICATIONS OF THE PROCEDURE**

##### **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.

#### **V. DOCUMENTATION**

Reporting should be in accordance with the [ACR–SIR–SPR Practice Parameter for the Reporting and Archiving of Interventional Radiology Procedures](#) [70].

#### **VI. EQUIPMENT SPECIFICATIONS**

Equipment performance monitoring should be in accordance with the [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Fluoroscopic Equipment](#) [71], [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography \(CT\) Equipment](#) [72], and [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance \(MR\) Imaging Equipment](#) [73].

#### **VII. RADIATION SAFETY IN IMAGING**

Radiologists, medical physicists, non-physician radiology providers, 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 who work with ionizing radiation must understand the

key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). [https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775\\_web.pdf](https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf)

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

Facilities should have and adhere to policies and procedures that require ionizing radiation examination protocols (radiography, fluoroscopy, interventional radiology, CT) to vary according to diagnostic requirements and patient body habitus to optimize the relationship between appropriate radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used, except when inappropriate for a specific exam. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently<sup>®</sup> for children ([www.imagegently.org](http://www.imagegently.org)) and Image Wisely<sup>®</sup> for adults ([www.imagewisely.org](http://www.imagewisely.org)). 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 periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, 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; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

## **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/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement>).

## **IX. QUALITY IMPROVEMENT**

Although practicing physicians should strive to achieve perfect outcomes (eg, 100% success, 0% adverse events), in practice all physicians will fall short of this ideal to a variable extent. A Medical Outcome Audit may be performed to assess and monitor the outcomes of procedures. A comparison of the audit results against indicator thresholds may be used to assess the efficacy of ongoing quality-improvement programs. 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.

Deviation from the recommended success rates and adverse event threshold (Tables 1-3 below) should prompt a review of policies and procedures within the department to determine the causes and to implement changes to lower the incidence of the complication [1]. Because patient referral patterns and selection factors may dictate a different threshold value for a metric at a particular institution, each department should alter the thresholds as appropriate to meet its own quality- improvement program needs [1].

## **IX. QUALITY IMPROVEMENT**

### **A. Success Rates and Thresholds**

*(Pending: Permission request to use table with modifications)*

Table 1: Success Rates and Thresholds [1]

Outcome	Suggested Threshold (%)
Successful diagnostic fluid aspiration Aspiration of adequate fluid for diagnostic characterization	89
Successful drainage Curative and partial success	76

From Dariushnia SR, Mitchell JW, Chaudry G, Hogan MJ. Society of Interventional Radiology Quality Improvement Standards for Image-Guided Percutaneous Drainage and Aspiration of Abscess and Fluid Collections. *J Vasc Interv Radiol* 2020;31:662-666.

Curative drainage is defined as complete resolution of infection requiring no further operative intervention. 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.

**IX. QUALITY IMPROVEMENT**

**B. Complication Rates and Thresholds**

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

*(Pending: Permission request to use table with modifications)*

Table 2: Published Adverse Event Rates and Suggested Thresholds [1]

Specific Major Complication	Reported Rate (%)	Suggested Threshold (%)
Septic shock	0-2	4
Bacteremia requiring significant new intervention	0-3	5
Hemorrhage requiring transfusion*	0-13	8
Superinfection (includes infection of sterile fluid collection)	0-5	7
Bowel transgression requiring intervention	0-2	2
Pleural transgression requiring intervention	0-1	2

Specific Major Complication	Reported Rate (%)	Suggested Threshold (%)
(abdominal interventions)		
Pneumothorax/hemothorax/pleural effusion requiring further intervention (chest procedures)	0-12	14

*\*Includes data in which adjunctive intracavitary fibrinolytic therapy is used.*

*From Dariushnia SR, Mitchell JW, Chaudry G, Hogan MJ. Society of Interventional Radiology Quality Improvement Standards for Image-Guided Percutaneous Drainage and Aspiration of Abscess and Fluid Collections. J Vasc Interv Radiol 2020;31:662-666*

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

Generally, the complication-specific thresholds should be set higher than the complication-specific reported rates listed above, because the 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 [1]. When the complication occurs within a small patient volume (eg, early in a quality improvement program), the overall procedure threshold (Table 3) is more appropriate for use in a quality-improvement program.

*(Pending: Permission request to use table with modifications)*

Table 3: Overall Adverse Events Rate [1]

Overall Procedure	Suggested Threshold (%)
All major adverse events resulting from adult and pediatric percutaneous drainage procedures	15

*From Dariushnia SR, Mitchell JW, Chaudry G, Hogan MJ. Society of Interventional Radiology Quality Improvement Standards for Image-Guided Percutaneous Drainage and Aspiration of Abscess and Fluid Collections. J Vasc Interv Radiol 2020;31:662-666*

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## REFERENCES

1. Dariushnia SR, Mitchell JW, Chaudry G, Hogan MJ. Society of Interventional Radiology Quality Improvement Standards for Image-Guided Percutaneous Drainage and Aspiration of Abscesses and Fluid Collections. *Journal of vascular and interventional radiology : JVIR* 2020;31:662-66.e4.
2. 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;21:431-5.
3. Ballard DH, Gates MC, Hamidian Jahromi A, Harper DV, Do DV, D'Agostino HB. Transrectal and transvaginal catheter drainages and aspirations for management of pelvic fluid collections: technique, technical success rates, and outcomes in 150 patients. *Abdominal radiology (New York)* 2019;44:2582-93.
4. Brown CV, Abrishami M, Muller M, Velmahos GC. Appendiceal abscess: immediate operation or percutaneous drainage? *The American surgeon* 2003;69:829-32.
5. Burke LM, Bashir MR, Gardner CS, et al. Image-guided percutaneous drainage vs. surgical repair of gastrointestinal anastomotic leaks: is there a difference in hospital course or hospitalization cost? *Abdominal imaging* 2015;40:1279-84.
6. 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;30:719-24.
7. Cinat ME, Wilson SE, Din AM. Determinants for successful percutaneous image-guided drainage of intra-abdominal abscess. *Arch Surg* 2002;137:845-9.
8. 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;31:431-6.
9. Commander CW, Wilson SB, Bilaj F, Isaacson AJ, Burke CT, Yu H. CT-Guided Percutaneous Drainage Catheter Placement in the Abdomen and Pelvis: Predictors of Outcome and Protocol for Follow-up. *Journal of vascular and interventional radiology : JVIR* 2020;31:667-73.
10. 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;196:1182-8.
11. 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;182:463-6.
12. 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;193:1323-30.
13. Gupta S, Suri S, Gulati M, Singh P. Ilio-psoas abscesses: percutaneous drainage under image guidance. *Clinical radiology* 1997;52:704-7.
14. Haaga JR, Weinstein AJ. CT-guided percutaneous aspiration and drainage of abscesses. *AJR. American journal of roentgenology* 1980;135:1187-94.
15. Haaga JR, Alfidri RJ, Havrilla TR, et al. CT detection and aspiration of abdominal abscesses. *AJR. American journal of roentgenology* 1977;128:465-74.
16. Hogan MJ, Marshalleck FE, Sidhu MK, et al. Quality improvement guidelines for pediatric abscess and fluid

- drainage. *Pediatric radiology* 2012;42:1527-35.
17. Hung CH, Liou JD, Yan MY, Chang CC. Immediate percutaneous drainage compared with surgical drainage of renal abscess. *International urology and nephrology* 2007;39:51-5.
  18. Jaffe TA, Nelson RC. Image-guided percutaneous drainage: a review. *Abdominal radiology (New York)* 2016;41:629-36.
  19. Leborgne F. Treatment of breast abscesses with sonographically guided aspiration, irrigation, and instillation of antibiotics. *AJR. American journal of roentgenology* 2003;181:1089-91.
  20. 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;12:1247-50.
  21. Lewis MR, Micic TA, Doull IJM, Evans A. Real-time ultrasound-guided pigtail catheter chest drain for complicated parapneumonic effusion and empyema in children - 16-year, single-centre experience of radiologically placed drains. *Pediatric radiology* 2018;48:1410-16.
  22. McDaniel JD, Warren MT, Pence JC, Ey EH. Ultrasound-guided transrectal drainage of deep pelvic abscesses in children: a modified and simplified technique. *Pediatric radiology* 2015;45:435-8.
  23. Mubarak WM, Sheikh N, John P, Temple MJ, Amaral JG, Connolly BL. Use of the Transrectal Ultrasound Probe in Aspiration and Drainage in Pediatric Patients: A Retrospective Observational Study. *Journal of vascular and interventional radiology : JVIR* 2019;30:908-14.
  24. Mukthinthalapati V, Attar BM, Parra-Rodriguez L, Cabrera NL, Araujo T, Gandhi S. Risk Factors, Management, and Outcomes of Pyogenic Liver Abscess in a US Safety Net Hospital. *Digestive diseases and sciences* 2020;65:1529-38.
  25. Porcel JM. Minimally invasive treatment of complicated parapneumonic effusions and empyemas in adults. *The clinical respiratory journal* 2018;12:1361-66.
  26. Pugmire BS, Gee MS, Kaplan JL, et al. Role of percutaneous abscess drainage in the management of young patients with Crohn disease. *Pediatric radiology* 2016;46:653-9.
  27. Rosenfeld EH, Vogel AM, Jafri M, et al. Management and outcomes of peripancreatic fluid collections and pseudocysts following non-operative management of pancreatic injuries in children. *Pediatric surgery international* 2019;35:861-67.
  28. 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;186:680-6.
  29. Singh AK, Gervais DA, Alhilali LM, Hahn PF, Mueller PR. Imaging-Guided Catheter Drainage of Abdominal Collections with Fistulous Pancreaticobiliary Communication. *American Journal of Roentgenology* 2006;187:1591-96.
  30. 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;179:629-32.
  31. 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;28:196-9.
  32. vanSonnenberg E, Wittich GR, Goodacre BW, Casola G, D'Agostino HB. Percutaneous abscess drainage: update. *World journal of surgery* 2001;25:362-9; discussion 70-2.
  33. Yu SC, Ho SS, Lau WY, et al. Treatment of pyogenic liver abscess: prospective randomized comparison of catheter drainage and needle aspiration. *Hepatology (Baltimore, Md.)* 2004;39:932-8.
  34. Zhang Y, Stringel G, Bezahler I, Maddineni S. Nonoperative management of periappendiceal abscess in children: A comparison of antibiotics alone versus antibiotics plus percutaneous drainage. *Journal of pediatric surgery* 2020;55:414-17.
  35. Towbin RB, Strife JL. Percutaneous aspiration, drainage, and biopsies in children. *Radiology* 1985;157:81-5.
  36. Ball WS, Jr., Bisset GS, 3rd, Towbin RB. Percutaneous drainage of chest abscesses in children. *Radiology* 1989;171:431-4.
  37. Amundson GM, Towbin RB, Mueller DL, Seagram CG. Percutaneous transgastric drainage of the lesser sac in children. *Pediatric radiology* 1990;20:590-3.
  38. Cahill AM, Baskin KM, Kaye RD, Fitz CR, Towbin RB. Transgluteal approach for draining pelvic fluid collections in pediatric patients. *Radiology* 2005;234:893-8.
  39. American College of Radiology. ACR Practice Parameter for the Performance of Stereotactic/Tomosynthesis Guided Breast Interventional Procedure. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Stereo-Breast.pdf>. Accessed January 26, 2023.



40. American College of Radiology. ACR Practice Parameter for the Performance of Ultrasound-Guided Percutaneous Breast Interventional Procedures. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/us-guidedbreast.pdf?la=en>. Accessed January 25, 2023.
41. 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;10:202-8.
42. 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;222:645-51.
43. 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;101:2283-9.
44. 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;149:1-5.
45. Parker LA, Charnock GC, Delany DJ. Small bore catheter drainage and sclerotherapy for malignant pleural effusions. *Cancer* 1989;64:1218-21.
46. Silverman SG, Mueller PR, Saini S, et al. Thoracic empyema: management with image-guided catheter drainage. *Radiology* 1988;169:5-9.
47. vanSonnenberg E, D'Agostino HB, Casola G, Wittich GR, Varney RR, Harker C. Lung abscess: CT-guided drainage. *Radiology* 1991;178:347-51.
48. 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;29:102-7.
49. 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:e50-4.
50. 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;187:1585-90.
51. Gurusamy KS, Belgaumkar AP, Haswell A, Pereira SP, Davidson BR. Interventions for necrotising pancreatitis. *The Cochrane database of systematic reviews* 2016;4:CD011383.
52. Hollemans RA, Bollen TL, van Brunschot S, et al. Predicting Success of Catheter Drainage in Infected Necrotizing Pancreatitis. *Annals of surgery* 2016;263:787-92.
53. Sugimoto M, Sonntag DP, Flint GS, et al. A percutaneous drainage protocol for severe and moderately severe acute pancreatitis. *Surgical endoscopy* 2015;29:3282-91.
54. Sun J, Yang C, Liu W, et al. Conservative treatment and percutaneous catheter drainage improve outcome of necrotizing pancreatitis. *Hepato-gastroenterology* 2015;62:195-9.
55. 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;247:567-73.
56. 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;194:815-20.
57. 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;170:1035-9.
58. Wroblecka JT, Kuligowska E. One-step needle aspiration and lavage for the treatment of abdominal and pelvic abscesses. *AJR. American journal of roentgenology* 1998;170:1197-203.
59. 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;40:3257-64.
60. American College of Radiology. ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Pregnant-Pts.pdf> Accessed January 23, 2023.
61. American College of Radiology. ACR Practice Parameter for Continuing Medical Education (CME). Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CME.pdf>. Accessed January, 2023.
62. American College of Radiology. ACR Practice Parameter for Continuing Medical Education (CME). Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CME.pdf>. Accessed January 25, 2023.
63. American College of Radiology. ACR Practice Parameter for Performing and Interpreting Diagnostic

- Computed Tomography (CT). Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Perf-Interpret.pdf>. Accessed January 26, 2023.
64. American College of Radiology. ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging (MRI). Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MR-Perf-Interpret.pdf>. Accessed January 26, 2023.
  65. American College of Radiology. ACR–AAPM Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MgmtFluoroProc.pdf>. Accessed January 25, 2023.
  66. American College of Radiology. ACR–SIR Practice Parameter for Minimal and/or Moderate Sedation/Analgesia. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Sed-Analgesia.pdf>. Accessed January 26, 2023.
  67. Patel IJ, Rahim S, Davidson JC, et al. Society of Interventional Radiology Consensus Guidelines for the Periprocedural Management of Thrombotic and Bleeding Risk in Patients Undergoing Percutaneous Image-Guided Interventions-Part II: Recommendations: Endorsed by the Canadian Association for Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe. *Journal of vascular and interventional radiology* : JVIR 2019;30:1168-84.e1.
  68. Chehab MA, Thakor AS, Tulin-Silver S, et al. Adult and Pediatric Antibiotic Prophylaxis during Vascular and IR Procedures: A Society of Interventional Radiology Practice Parameter Update Endorsed by the Cardiovascular and Interventional Radiological Society of Europe and the Canadian Association for Interventional Radiology. *Journal of vascular and interventional radiology* : JVIR 2018;29:1483-501.e2.
  69. American College of Radiology. ACR–SIR–SPR Practice Parameter on Informed Consent for Image-Guided Procedures. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/InformedConsent-ImagGuided.pdf>. Accessed January 26, 2023.
  70. American College of Radiology. ACR–SIR–SPR Practice Parameter for the Reporting and Archiving of Interventional Radiology Procedure. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Reporting-Archiv.pdf>. Accessed December 6, 2022.
  71. American College of Radiology. ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Fluoroscopic Equipment. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Fluoro-Equip.pdf>. Accessed January 26, 2023.
  72. American College of Radiology. ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography (CT) Equipment Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CT-Equip.pdf>. Accessed January 25, 2023.
  73. American College of Radiology. ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance (MR) Imaging Equipment. Available at: <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/MR-Equip.pdf>. Accessed January 25, 2023.

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