ACR–SAR–SPR PRACTICE PARAMETER FOR THE PERFORMANCE OF MAGNETIC RESONANCE IMAGING (MRI) OF THE ABDOMEN (Excluding the Liver)

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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.

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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[1]. 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

Magnetic resonance imaging (MRI) of the abdomen is a proven and useful tool for the evaluation, assessment of severity, and follow-up of diseases of the abdomen. It should be performed only for a valid medical reason. MRI of the abdomen is an evolving technology involving a variety of pulse sequences and protocols that are continuously being modified and improved. Detailed imaging protocols are not presented here to avoid promoting obsolete methodology. This document pertains to the MRI assessment of the abdomen, excluding the liver. For practice parameters pertaining to the liver, see the ACR–SAR–SPR Practice Parameter for the Performance of Magnetic Resonance Imaging (MRI) of the Liver [1].

The choice of MRI of the abdomen requires an analysis of the strengths of MRI as well as its suitability for each unique patient and clinical situation. In patients without a contraindication (see Section IV below), MRI is appropriately used for lesion characterization requiring high soft-tissue contrast, multiplanar evaluation of a lesion not well depicted on other imaging modalities, and multiphasic contrast enhanced imaging. MRI benefits from a lack of ionizing radiation. See the ACR Guidance Document on MR Safe Practices: 2013 [2] and the ACR Manual on Contrast Media [3].

Peer-reviewed literature pertaining to MR safety should be reviewed on a regular basis [2,4].

II. INDICATIONS

Indications for MRI of the abdomen (excluding the liver) include, but are not limited to, the following:

A. Pancreas
1. Detection of pancreatic masses and preoperative staging in patients unable to receive iodinated contrast media
2. Characterization of indeterminate lesions and/or unexplained gland enlargement detected with other imaging modalities
3. Identification of causes of pancreatic duct obstruction, including calculi, stricture, or mass
4. Detection and characterization of pancreatic duct anomalies
5. Evaluation of pancreatic or peripancreatic fluid collections or fistulae
6. Evaluation of chronic pancreatitis, including assessment of pancreatic exocrine function, evaluation of acute pancreatitis, and associated complications
7. Postoperative/treatment follow-up after pancreatic surgery

B. Spleen
1. Characterization of indeterminate lesions detected with other imaging modalities
2. Detection and characterization of suspected diffuse abnormalities of the spleen
3. Evaluation of suspected accessory splenic tissue

C. Kidneys, Ureters, and Retroperitoneum
1. Detection of renal tumors
2. Characterization of indeterminate lesions detected with other imaging modalities
3. Preoperative assessment of renal neoplasms to include evaluation of the arterial supply, renal vein, and inferior vena cava
4. Evaluation of the urinary tract for abnormalities of anatomy or physiology (MR urography)
5. Postprocedure surveillance after renal tumor ablation or surgical extirpation via partial or complete nephrectomy
6. Evaluation of ureteral abnormalities
7. Evaluation of suspected retroperitoneal fibrosis and other benign lesions
8. Characterization and staging of retroperitoneal malignant neoplasms
9. Evaluation or follow-up of lymphadenopathy
10. Surveillance imaging of the upper urinary tract in patients with urothelial carcinoma
11. Characterization of complex congenital anomalies
12. Identification of causes of urinary tract obstruction

D. Adrenal Glands
1. Detection of suspected pheochromocytoma and functioning adrenal adenoma
2. Characterization of indeterminate lesions detected with other imaging modalities
3. Staging of malignant adrenal neoplasms
4. Detection and characterization of congenital anomalies

E. Vascular (see the ACR–NASCI–SPR Practice Parameter for the Performance of Body Magnetic Resonance Angiography (MRA) [5]).

F. Bile Ducts and Gallbladder
1. Detection, staging, and posttreatment follow-up of bile duct and gallbladder cancer
2. Detection of bile duct or gallbladder stones
3. Evaluation of bile duct dilation and/or narrowing
4. Evaluation of suspected congenital abnormalities of the gallbladder or bile ducts
5. Detection and anatomic delineation of bile leaks
6. Delineation of ductal anatomy prior to liver transplantation
7. Assessment of post–liver transplant biliary complications

G. Gastrointestinal Tract and Peritoneum
1. Preoperative assessment of gastric neoplasms
2. Detection of small-bowel neoplasms
3. Assessment of inflammatory disorders of the small or large bowel and mesenteries (including MR enterography); for MR enterography, see the ACR–SAR–SPR Practice Parameter for the Performance of Magnetic Resonance (MR) Enterography [6]
4. Assessment of peritoneal adhesive disease
5. Detection and evaluation of primary and metastatic peritoneal or mesenteric neoplasms
6. Detection and characterization of intra-abdominal fluid collections as well as follow-up after percutaneous or surgical drainage
7. Second-line imaging tests after an initial ultrasound for diagnosis of acute appendicitis in children and adults, including pregnant women [7-9]
8. Evaluation and follow-up of lymphadenopathy

H. Other
1. Imaging follow-up of abnormalities of the abdomen deemed indeterminate on initial MRI and for which surgery is not advised
2. Detection and characterization of extraperitoneal neoplasms other than those mentioned above
3. Evaluation of the abdomen as an alternative to CT when radiation exposure is an overriding concern in susceptible patients, such as pregnant or pediatric patients or in patients with a contraindication to iodinated contrast agents
4. Assessment of treatment response to medical therapy of malignant neoplasms of the abdomen
5. Determining organ of origin of an indeterminate (benign or malignant) lesion in the abdomen when the origin is not obvious from other imaging modalities
6. Identification and characterization of vascular malformations (see the ACR–NASCI–SPR Practice Parameter for the Performance of Body Magnetic Resonance Angiography (MRA) [5])
7. Evaluation of abdominal wall abnormalities not adequately assessed by other imaging modalities
8. Assessment of traumatic injury of the abdomen when CT is contraindicated

See the ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging (MRI) [10], the ACR Guidance Document on MR Safe Practices: 2013 [2], and the ACR Manual on Contrast Media [3].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging (MRI) [10].

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for MRI of the abdomen should provide sufficient information to demonstrate the medical necessity of the examination and allow for the proper performance and interpretation of the examination.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). The provision of additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state scope of practice requirements. (ACR Resolution 35 adopted in 2006 – revised in 2016, Resolution 12-b)

The supervising physician must have adequate understanding of the indications, risks, and benefits of the examination as well as alternative imaging procedures. The physician must be familiar with potential hazards associated with MRI, including potential adverse reactions to contrast media. The physician should be familiar with relevant prior ancillary studies. The physician performing MRI interpretation must have a clear understanding and knowledge of the relevant anatomy and pathophysiology.

The supervising physician must also understand the pulse sequences to be used and their effect on the appearance of the images, including the potential generation of image artifacts. Standard imaging protocols may be established and varied on a case-by-case basis when necessary. These protocols should be reviewed and updated on a regular basis.

A. Patient Selection

The physician responsible for the examination should supervise patient selection and preparation and be available for consultation by direct communication. Patients and any family members or others who will accompany the patient into the MRI suite must be screened and interviewed prior to the examination to exclude individuals who may have contraindications to MRI, in which the risks may outweigh the benefits. All sites should have an established and documented screening mechanism for establishing MRI compatibility.

Certain indications require administration of intravenous (IV) contrast media. IV contrast enhancement should be performed using appropriate injection protocols and in accordance with the institution's policy on IV contrast use (see the ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media [11]).

Patients suffering from anxiety or claustrophobia, or who are unable to cooperate or suspend respiration, may require sedation or additional assistance. Administration of sedation may be necessary to achieve a successful examination. If sedation is necessary, refer to the ACR–SIR Practice Parameter for Sedation/Analgesia [12].

B. Facility Requirements

Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications. The equipment and medications should be monitored for inventory and drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and sizes in the patient population. Furthermore, regular training on the use of such equipment and medication is recommended for those providing patient care in the MRI environment.

All sites should employ site-access restrictions, with clear demarcation of safety zones I–IV, utilizing signage and physical barriers as appropriate (see the ACR Guidance Document on MR Safe Practices 2020 [2]).

C. Examination Technique

A phased array surface coil should be used unless precluded by patient body habitus or condition. In pediatric patients, coil selection will depend on patient size and the region being imaged. In small neonates, a surface coil should be considered, whereas infants and children may be imaged with a cardiac, flex, or body coil, depending on the size of the abdomen. The field of view (FOV) should be selected to provide the highest resolution possible to include the entire region or organ of interest, allowing for an adequate signal-to-noise ratio (SNR) and minimization of relevant artifacts. Multiple acquisitions with repositioning of the surface coil may be necessary when the region of interest exceeds the potential FOV of the surface coil. For most applications, evaluation of the abdomen should include T1 and T2-weighted images. Acquisitions in multiple imaging planes may be beneficial in defining anatomic relationships. For most applications, slice thickness for acquisitions should not exceed 8 mm, with the interslice gap not exceeding 2 mm, although thinner slices and gaps are desirable. In children, slice thicknesses typically range from 3-8 mm, depending on the size of the area to be imaged.

T1-weighted imaging may be performed using an echo train spin-echo (turbo spin-echo [TSE] or fast spin-echo [FSE]) sequence, although the gradient-echo technique is typically favored because it has a much shorter acquisition time. T2-weighted images may be accomplished using one of the echo train spin-echo sequences (TSE or FSE) or a hybrid gradient and spin-echo technique [13]. Fat suppression is frequently beneficial and may be accomplished using chemical shift/Dixon-based techniques [14-16].

Although fast gradient-echo T1-weighted images can usually be acquired during breath-holding, some patients are unable to cooperate with even short breath holds. Compressed sensing, often in combination with parallel imaging (PI) and view sharing or non-Cartesian acquisition, is a technique offered by multiple vendors that allow dramatic reduction in scan time and even free-breathing dynamic postcontrast imaging [17-19]. The duration of conventional and FSE T2-weighted imaging is often too long for complete acquisition during breath holding. Breath-hold techniques can be used for T2-weighted imaging if the scan time is reduced by a) long echo trains, b) partial-Fourier imaging, c) use of PI techniques, and/or d) dividing the volume of interest into several smaller volumes that can each be imaged in individual breath holds. Traditional strategies to reduce respiratory motion during free-breathing image acquisition include respiratory compensation (respiratory-ordered phase encoding), respiratory triggering with respiratory bellows, the use of navigator pulses [20,21], the acquisition of k-space data in concentric rectangular strips [22] and signal averaging. Familiarity with these methods is helpful when scanning young children or other patients who may not be able to follow breath-hold commands, as well as sedated/anesthetized patients.

Inclusion of at least one in-phase and out-of-phase gradient-echo sequence is useful for detecting intracellular lipid within certain adrenal (eg, adenoma) and renal (eg, clear-cell carcinoma) tumors and to confirm fatty infiltration of organs, such as the pancreas [23-27]. The technique can also be useful for the detection of hemosiderin, such as can occur in renal masses, or other sources of susceptibility artifact [28,29]. A single dual-echo gradient-echo sequence is more effective than separate gradient-echo sequences that differ in echo times (TEs) because the former will depict the exact same anatomy, without misregistration artifacts. It is essential that the out-of-phase TE is shorter than the in-phase TE so that signal reduction on the out-of-phase TE will be unambiguous evidence of lipid content. Breath-held dual-echo sequences are generally preferable.

Three-dimensional (3-D) techniques are available for both T1 and T2-weighted imaging. Numerous advantages over traditional two-dimensional (2-D) sequences include higher inherent SNR, higher in-plane and through-plane resolution, and homogenous fat suppression, most of which are better realized in T1-weighted imaging. Isotropic voxel dimensions allow for multiplanar reconstructions that may obviate the need for additional acquisition in other planes. Several publications have illustrated the value of T2-weighted 3-D imaging for the depiction of complex anatomy and volumetric imaging [30-32].

IV gadolinium-based contrast agents (GBCAs) are beneficial to detect and characterize many intra-abdominal neoplasms, vascular abnormalities, and inflammatory processes. However, the use of those agents may be omitted when noncontrast images are sufficiently diagnostic, in the opinion of the supervising physician such that the administration of IV contrast is unlikely to be of further benefit to the patient or where the risks of the administration outweigh the potential benefits. IV contrast may also be omitted when there is a) no IV access, b) a history of prior allergic-like reaction to GBCAs and the patient has not been premedicated, c) a relative contraindication exists to parenteral exposure to gadolinium chelates (eg, pregnancy), d) severe renal insufficiency with an estimated glomerular filtration rate (eGFR)

<30 mL/min/1.73 m^2 or acute renal injury of any severity, or e) known or suspected diagnosis of nephrogenic systemic fibrosis. Of note, for an eGFR of 15–30, many practices are now opting to perform a clinically indicated contrast-enhanced MR examination utilizing a macrocyclic GBCA. Detailed information that can help in forming practice-specific policies regarding handling of GBCA administration is provided in the ACR Manual on Contrast Media [3].

Multiphase contrast-enhanced sequences acquired through the abdomen are commonly composed of precontrast, arterial, venous, and delayed phase images, which are beneficial for evaluating various blood vessels and solid organ tumors [33,34]. Subtraction images may also be generated, which can aid in identifying tumor enhancement [35]. Postcontrast enhanced imaging may be performed with a 2-D or 3-D technique. 3-D imaging allows isotropic or near-isotropic resolution and facilitates multiplanar reconstructions [36]. The use of fat suppression during dynamic contrast-enhanced, T1-weighted imaging is strongly encouraged, as it improves the conspicuity of enhancing structures and abnormalities. Fat suppression can typically be accomplished using frequency selective saturation or chemical shift/Dixon techniques. Inversion recovery sequences should be avoided for postcontrast imaging, as the relative enhancement of tissues due to gadolinium that falls within the nulling range for fat is also suppressed by this technique.

Specific timings and adjunctive measures in dynamic contrast-enhanced imaging can be employed for particular applications. For instance, delayed postcontrast T1-weighted imaging (5 minutes or later after administration of extracellular GCBA) can be useful in excretory MR urography for detecting pathology of the urinary tract [37,38], and IV hydration and/or diuretic administration has been shown to improve visualization of the nondilated collecting system [39] and ureters [40]. Delayed imaging with extracellular gadolinium-based agents may also be useful in diagnosing cancer of the biliary system [41]. Note that different GBCAs that allow visualization of particular organs and organ systems are available. Specifically, hepatobiliary agents (eg, gadoxetate disodium, gadobenate dimeglumine) localize to the liver and biliary tree, and fat-suppressed T1-weighted imaging during the hepatobiliary phase provide images based on hepatocyte uptake and biliary excretion of these agents [42]. (See the ACR–SAR–SPR Practice Parameter for the Performance of Magnetic Resonance Imaging (MRI) of the Liver [1].)

The addition of a heavily T2-weighted MR cholangiopancreatography (MRCP) sequence may be beneficial for evaluating the biliary and pancreatic ducts [41-43]. Such heavily T2-weighted sequences may also serve to evaluate dilated renal collecting systems (static-fluid MR urography) [34,43] as well as in the evaluation of the lymphatic system to demonstrate pathologic lymphatic structures and the presence and distribution of lymphatic fluid in different body cavities [44,45].

The use of secretin has been shown to significantly improve visualization of the pancreatic duct during MRCP, which can aid in the diagnosis of anatomic variants [44-46], chronic pancreatitis [47,48], and side-branch intraductal papillary mucinous neoplasms [49]. Secretin has also been used to measure pancreatic exocrine function [50,51]. T2-weighted imaging can be performed using a rapid acquisition relaxation enhancement (RARE) or half-Fourier single-shot echo train spin-echo sequence. These sequences can be performed as a thick slab acquisition in multiple projections or as multiple thin (< 5 mm) slices in at least one imaging plane during breath holding. 3-D respiratory triggered T2-weighted FSE techniques can also be used, potentially offering improved SNR and isotropic spatial resolution [52]. Additional sequences, such as postcontrast T1-weighted and FSE T2-weighted sequences, can aid in the assessment of periductal tissues, the evaluation for causes of extrinsic ductal compression, and the staging of cholangiocarcinoma [54,55].

The use of an oral contrast agent for MRI of the abdomen is considered optional but may occasionally be beneficial for gastrointestinal imaging [46]. For MR enterography, see the ACR–SAR–SPR Practice Parameter for the Performance of Magnetic Resonance (MR) Enterography [6]. Negative oral contrast agents may be helpful in selected cases to suppress signal and reduce artifact from bowel contents when imaging other organs or structures, such as the peritoneum, pancreaticobiliary tree, or urinary system. When using oral contrast media for assessing the small bowel and its serosal surface, a nonabsorbable agent that produces a dark enteric lumen on T1-weighted images can optimize detection of mural enhancement after IV administration of GBCA. Administration of spasmolytic agents, such as glucagon [47], can reduce peristalsis and its resultant motion artifact. This can be particularly helpful for contrast-enhanced fast gradient-echo T1-weighted imaging of the bowel [48] or for evaluating the mesentery and peritoneal surfaces [49].

Steady-state free-precession (SSFP) sequences display bright fluid and blood while minimizing motion and flow-related artifacts. Such sequences can provide a rapid abdominal survey [50] and can be useful for cine imaging of the bowel during MR enterography and for demonstration of intra-abdominal adhesions [50-53].

3T imaging systems have become widely available, and potential advantages include increased SNR [54],

increased conspicuity of enhancement after administration of a gadolinium chelate [55], and more rapid chemical shift-type sequences (based on shorter in-phase and opposed-phase TEs compared with 1.5T). Potential disadvantages include decreased image contrast on T1-weighted images, increased susceptibility artifact, increased chemical shift artifact, increased specific absorption rate (SAR), and standing wave phenomena from B1 inhomogeneity [56]. The latter can be partially compensated for by the use of radiofrequency cushions [57]. In short, 3T imaging can offer substantial improvements in SNR and spatial resolution and/or decreases in imaging times, but careful sequence optimization is required to maintain desired image contrast and reduce artifacts [58,59].

PI techniques take advantage of spatial sensitivity information from multiple independent receiver coil elements in order to reduce the number of phase encoding steps, thereby reducing scan times [60]. These can also expand the options for breath-hold imaging and provide shorter effective TEs and decreased blurring on echo-train sequences, such as single-shot FSE. The primary penalty of this method of time savings is reduced SNR [61]. However, there is a potentially synergistic effect between PI and imaging at 3T: 1) the decreased SNR inherent to PI is partially offset by the increased SNR of 3T, and 2) the SAR issues inherent to 3T can be offset by a reduced number of excitations [62]. 2-D PI techniques have become available, which provide higher-order acceleration factors by reducing the number of measurements required to fill k-space in both the phase and partition directions [63,64]. Emerging applications are also being developed with other means of image acquisition acceleration, such as non-Cartesian kernels and simultaneous multislice techniques (SMS) [65].

Diffusion-weighted imaging (DWI) can be utilized for abdominal application [66]. Most research to date has centered on oncologic applications, either for staging disease or monitoring response to therapy [67-73]. The most common technique uses single-shot echo-planar imaging (SS-EPI). Breath-held, free-breathing multiple-averaging, and respiratory-gated SS-EPI techniques have been described [74,75]. PI can be used to decrease imaging time, reduce susceptibility-related signal loss by shortening the effective TE, and has been shown to result in accurate apparent diffusion coefficient (ADC) values [76]. DWI is a value-added sequence capable of improving lesion detection and characterization, as restricted diffusion can be quite sensitive in suggesting the presence of hypercellularity, such as with small metastases or the purulent core of an abscess, and is useful in examinations for which IV contrast is not or cannot be utilized [77]. There is also increasing evidence of its utility in the evaluation of infectious and inflammatory processes, possibly obviating the need for IV gadolinium-based contrast in the study of inflammatory bowel disease during MR enterography and for the diagnosis of acute appendicitis and its postoperative complications [78-84]. ADC maps can be generated to help differentiate between restricted diffusion and T2 shine-through when at least 2 b-values are obtained, such as b = 0 to 50 s/mm2 and b = 500 to 1,000 s/mm2. Many vendors offer computed DWI, in which additional higher b-value images are generated from a set of measured v-values by voxel-wise fitting, thus providing images with greater diffusion weighting in less time and with higher relative SNR than directly acquired DWIs [85]. In addition, more complex models of diffusion, such as the intravoxel incoherent motion (IVIM) model, have shown the potential to separate perfusion effects from true restricted diffusion and may provide more robust measures of diffusion compared with the ADC model [86].

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [87].

VI. EQUIPMENT SPECIFICATIONS

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance (MR) Imaging Equipment [88].

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 strength, maximum rate of change of magnetic field strength (dB/dt), maximum radiofrequency power deposition (specific absorption rate), and maximum acoustic noise levels.

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

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *ACR Position Statement on Quality Control and 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).

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