

**American College of Radiology  
ACR Appropriateness Criteria®  
Fibroids**

**Variant 1:**                      **Clinically suspected fibroids. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US duplex Doppler pelvis	Usually Appropriate	O
US pelvis transabdominal	Usually Appropriate	O
US pelvis transvaginal	Usually Appropriate	O
MRI pelvis without and with IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT pelvis with IV contrast	Usually Not Appropriate	⚠⚠⚠
CT pelvis without IV contrast	Usually Not Appropriate	⚠⚠⚠
CT pelvis without and with IV contrast	Usually Not Appropriate	⚠⚠⚠⚠

**Variant 2:**                      **Known fibroids. Treatment planning. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US duplex Doppler pelvis	Usually Appropriate	O
US pelvis transabdominal	Usually Appropriate	O
US pelvis transvaginal	Usually Appropriate	O
MRI pelvis without and with IV contrast	Usually Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT pelvis with IV contrast	Usually Not Appropriate	⚠⚠⚠
CT pelvis without IV contrast	Usually Not Appropriate	⚠⚠⚠
CT pelvis without and with IV contrast	Usually Not Appropriate	⚠⚠⚠⚠

**Variant 3:**                      **Known fibroids. Surveillance or posttreatment imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
US duplex Doppler pelvis	Usually Appropriate	O
US pelvis transabdominal	Usually Appropriate	O
US pelvis transvaginal	Usually Appropriate	O
MRI pelvis without and with IV contrast	Usually Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT pelvis with IV contrast	May Be Appropriate	⚠⚠⚠
CT pelvis without IV contrast	Usually Not Appropriate	⚠⚠⚠
CT pelvis without and with IV contrast	Usually Not Appropriate	⚠⚠⚠⚠

## FIBROIDS

Expert Panel on GYN and OB Imaging: Susan M. Ascher, MD<sup>a</sup>; Ashish P. Wasnik, MD<sup>b</sup>; Jessica B. Robbins, MD<sup>c</sup>; Marisa Adelman, MD<sup>d</sup>; Olga R. Brook, MD<sup>e</sup>; Myra K. Feldman, MD<sup>f</sup>; Lisa P. Jones, MD<sup>g</sup>; Erica M. Knavel Koepsel, MD<sup>h</sup>; Krupa K. Patel-Lippmann, MD<sup>i</sup>; Michael N. Patlas, MD<sup>j</sup>; Wendaline VanBuren, MD<sup>k</sup>; Katherine E. Maturen, MD, MS<sup>l</sup>.

### **Summary of Literature Review**

#### **Introduction/Background**

Uterine fibroids (leiomyomas or myomas) are the most common neoplasm of the uterus. They are composed of benign smooth muscle cells embedded in an extracellular matrix of collagen, fibronectin, and proteoglycan [1]. The prevalence of fibroids varies with race. Black women have an estimated incidence of fibroids by age 50 exceeding 80%, whereas White women have an incidence approaching 70% [2]. Although incompletely understood, fibroid etiology is multifactorial. A combination of genetic alterations and endocrine, autocrine, environmental, and other factors such as race, age, parity, and body mass index all play a role in fibroid development. Black women are more likely to develop clinically significant disease at an earlier age and are subject to racial disparities, including higher rates of surgical intervention when compared with medical therapy, as well as lower rates of minimally invasive approaches [3-6].

Fibroid-associated symptoms peak in the perimenopausal years and decline after menopause. Menorrhagia is the most frequent symptom and often results in iron deficiency anemia. Other common symptoms include dysmenorrhea, pelvic pain and pressure, urinary urgency and frequency, and constipation. Fibroids may also impair fertility and/or cause obstetric complications [7]. Despite the high prevalence and protean symptoms, there are few randomized trials to guide therapy. Patient preferences and symptom severity help inform treatment choice with options ranging from medical therapy to surgery. Hysterectomy is curative. One-half to one-third of the approximately 600,000 hysterectomies performed annually in the United States are for symptomatic fibroids [1,4]. Uterine sparing therapies include medical therapy (eg, GnRH agonists, levonorgestrel-releasing intrauterine devices, contraceptive steroid hormones, and tranexamic acid), myomectomy, endometrial ablation, uterine fibroid embolization (UFE), MR-guided focused ultrasound (MRgFUS), and laparoscopic radiofrequency ablation. Of these, myomectomy and UFE are the most common, and in a recent multicenter, randomized, open-label trial comparing myomectomy to UFE, both therapies resulted in equivalent symptomatic improvement at 2 years [8].

In addition to an individual woman's symptoms, the economic burden of symptomatic fibroids to society is large. Total estimated societal costs range from \$5.9 to \$34.4 billion annually, with lost work hours accounting for the largest proportion of these costs [7].

#### **Special Imaging Considerations**

Saline infusion sonohysterography (SIS), a minimally invasive procedure distending the endometrial cavity with saline, enables better delineation between endometrial pathologies (polyps, hyperplasia, synechiae, etc) and submucosal fibroids. Studies have shown an overall good agreement (kappa 0.80) between 3-D SIS and diagnostic hysteroscopy to classify submucosal fibroids [9,10]. SIS has also been shown to accurately depict the percentage intracavitary component of submucosal fibroids, a finding that often has treatment implications [11,12].

Three-dimensional transvaginal ultrasound (3-D TVUS) is a reconstruction of the US volumetric data into high-resolution multiplanar imaging, including real-time surface rendered images [13]. In initial assessment, 3-D US has been used along with 2-D US for uterine pathologies, mostly submucosal fibroids, and endometrial polyps. A study of 139 cases comparing 3-D US against hysteroscopy in diagnosing uterine cavity abnormalities showed a sensitivity and specificity of 87% and 100% in diagnosing submucosal leiomyoma [14]. However, another study showed no significant advantage of 3-D US over 2-D US in estimating intracavitary protrusion of submucosal

<sup>a</sup>Georgetown University Hospital, Washington, District of Columbia. <sup>b</sup>Panel Vice-Chair, University of Michigan, Ann Arbor, Michigan. <sup>c</sup>Panel Chair, University of Wisconsin, Madison, Wisconsin. <sup>d</sup>University of Utah, Salt Lake City, Utah; American College of Obstetricians and Gynecologists. <sup>e</sup>Beth Israel Deaconess Medical Center, Boston, Massachusetts. <sup>f</sup>Cleveland Clinic, Cleveland, Ohio. <sup>g</sup>Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. <sup>h</sup>University of Wisconsin, Madison, Wisconsin. <sup>i</sup>Vanderbilt University Medical Center, Nashville, Tennessee. <sup>j</sup>McMaster University, Hamilton, Ontario, Canada. <sup>k</sup>Mayo Clinic, Rochester, Minnesota. <sup>l</sup>Specialty Chair, University of Michigan, Ann Arbor, Michigan.

The American College of Radiology seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through representation of such organizations on expert panels. Participation on the expert panel does not necessarily imply endorsement of the final document by individual contributors or their respective organization.

Reprint requests to: [publications@acr.org](mailto:publications@acr.org)

fibroid with a reference standard of hysteroscopy and a moderate interobserver agreement of 3-D US for submucosal fibroid [15].

US elastography/sonoelastography is a technique that measures tissue strain. Strain elastography used with routine TVUS has shown increased diagnostic accuracy in identifying myometrial pathologies (fibroids and adenomyosis) from normal myometrium [16,17]. On sonoelastography, foci of adenomyosis are seen as brighter irregular shaped lesions (because of the presence of endometrial glands and stroma implanted within the myometrium), whereas fibroids are seen as well-delineated dark areas (secondary to stiffer/compressed smooth muscle fibers) [18,19]. Compression sonoelastography is a method of applying gentle compression causing alteration in size and shape of the lesion based on the tissue stiffness, which can be qualitatively (as a color map) or quantitatively recorded. Studies have shown high interobserver and intermethod agreement for the measurement of uterine and fibroid volumes on compression elastography [19] and excellent agreement between elastography-based diagnosis of fibroids and adenomyosis with MRI-based diagnosis [18].

The role of artificial intelligence in imaging fibroids is currently under investigation. There are several studies evaluating machine learning with textural analysis to improve the diagnostic accuracy of differentiating fibroids from sarcomas [20].

### **Initial Imaging Definition**

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient's care).

### **Discussion of Procedures by Variant**

#### **Variant 1: Clinically suspected fibroids. Initial imaging.**

##### **CT Pelvis**

There is no relevant literature to support the use of pelvic CT without or with intravenous (IV) contrast as initial imaging modality for clinically suspected fibroids.

##### **MRI Pelvis**

MRI excels at identifying and mapping fibroids [21-25]. When MRI is clinically useful, the use of a gadolinium-based IV contrast agent is preferred for identification of fibroid vascularity and other characteristics [26]. Please see the ACR Manual on Contrast Media for additional information [27].

Signal intensity and contrast enhancement allow diagnosis of fibroids to include size, number and location, and assessment of vascularity and to help characterize them as classic, degenerated (hyaline, carneous, hydropic, fatty, cystic, and myxoid), cellular, or atypical [28-30]. Conventional MRI, however, cannot accurately differentiate fibroids from sarcomas, a critical distinction for surgical planning and optimizing outcomes [31-33]. Diffusion-weighted imaging with apparent diffusion coefficient (ADC), especially when incorporated into an MRI algorithm, has shown promising results in distinguishing the two entities [20,34-40]. In a large, case-controlled retrospective study of women with atypical uterine masses, a diagnostic algorithm based on enlarged lymph nodes, peritoneal implants, high diffusion MRI signal, and low ADC values was developed and validated. The resulting algorithm achieved a 98% sensitivity and a 96% specificity in the training set and 83% to 88% sensitivity and 97% to 100% specificity in the validation sets [34]. Machine learning with texture analysis is under investigation and may have the potential to improve diagnostic accuracy [20].

MRI can differentiate fibroids from alternative or comorbid conditions such as adenomyosis and endometriosis that often cause similar symptoms [41,42].

##### **US Pelvis Transabdominal**

A combination of transabdominal US (TAUS) and TVUS of the pelvis is the most useful modality in the initial evaluation of suspected uterine fibroid or abnormal uterine bleeding [43-45]. TAUS is often useful in significantly

enlarged fibroid uterus or large subserosal/pedunculated fibroids that may render poor visualization on TVUS because of limited field-of-view from poor acoustic penetration. A potential limitation of TAUS is the poor acoustic window from decompressed urinary bladder, retroverted uterus, large body habitus, and bowel gas [46].

### **US Pelvis Transvaginal**

TVUS provides higher contrast and spatial resolution and should be combined with the TAUS whenever possible to evaluate suspected uterine fibroid [46,47]. TVUS has a reported sensitivity of 90% to 99% for detecting uterine fibroids and a sensitivity of 90% and specificity of 98% for the diagnosis of submucosal fibroids [43,48,49]. Three-dimensional TAUS and TVUS along with Doppler has shown high accuracy in differentiating uterine fibroids from adenomyosis with a sensitivity, specificity, and negative predictive value of 93%, 96%, and 88% for fibroids and 96%, 93%, and 98% for adenomyosis [50].

In a meta-analysis by Bittencourt et al [51], the pooled sensitivity and specificity of 2-D TVUS with SIS in diagnosing submucosal fibroids was 94% and 81%, respectively. The limitations of TVUS are a limited depth of penetration and a shallow focal length that can limit the evaluation of large or subserosal/pedunculated fibroids.

### **US Duplex Doppler Pelvis**

Although Doppler imaging is labeled under separate imaging procedure per ACR methodology, this document considers it to be a standard component of pelvic US. Color Doppler is routinely used in pelvic US examinations to evaluate internal vascularity of pelvic/uterine findings and to differentiate between vascular and nonvascular tissue [47].

Uterine fibroids show increased peripheral vascular flow on color Doppler imaging [52]. The presence of interface vessels between the uterus and juxtauterine masses (“bridging vessel sign”) is an important feature to differentiate subserosal fibroid from extrauterine tumors [53,54]. Duplex color Doppler typically shows high velocity, low resistive index, and low pulsatility index in the uterine arteries of uteri with fibroids than with normal uteri [55,56]. A resistive index  $<0.7$  and pulsatility index  $<1.2$  on spectral Doppler US showed a sensitivity of 93.4% and specificity of 95.6% and diagnostic accuracy of 93.8% in differentiating uterine leiomyoma from adenomyosis [50].

US duplex Doppler evaluation may also help in differentiating submucosal/intracavitary fibroids from endometrial polyps. Visualization of a vascular pedicle on transvaginal color Doppler imaging has a specificity of 95% to 98% and a negative predictive value of 81% to 94% for the detection of endometrial polyps [57,58].

## **Variant 2: Known fibroids. Treatment planning. Initial imaging.**

### **CT Pelvis**

There is no relevant literature to support the use of pelvic CT without or with IV contrast as initial imaging in treatment planning for symptomatic fibroids. CT, however, can better delineate calcified fibroids relative to US and MRI that may have treatment implications.

### **MRI Pelvis**

MRI is superior to US (transabdominal followed by transvaginal) for identifying and mapping fibroids and may alter management in up to 28% of patients [22-25,59-61]. When MRI is clinically useful, the use of a gadolinium-based IV contrast agent is preferred [26]. Please see the ACR Manual on Contrast Media for additional information [27].

Fibroid location, volume, number, T1- and T2-weighted signal intensity, and enhancement provide important pretreatment information [25,62-65]. Intracavitary fibroids may be amenable to hysteroscopic resection, whereas submucosal, intramural, and broad-based subserosal fibroids are amenable to UFE. Cervical fibroids may not respond as well or have a durable response to embolization. Submucosal and intramural fibroids that contact the endometrium may be expelled following successful UFE in 2.2% to 7.7% of cases [1,25,66]. Pedunculated fibroids, depending on location and stalk caliber, may be treated hysteroscopically, laparoscopically, or with UFE [25]. Postcontrast imaging allows assessment of fibroid viability, uterine artery anatomy, and detection of ovarian arterial collateral supply to the uterus [67-71]. Nonviable/autoinfarcted fibroids, found in up to 20% of UFE candidates, do not respond to UFE and are therefore important to identify at time of treatment planning [71]. A meta-analysis on the utility of ADC values concluded that, because of heterogeneity, it is unclear whether ADC values are useful to predict UFE response [72].

Conventional MRI, however, cannot accurately differentiate fibroids from sarcomas, a critical distinction for surgical planning and optimizing outcomes [31-33]. Diffusion-weighted imaging with ADC, especially when

incorporated into an MRI algorithm, has shown promising results in distinguishing the two entities [20,34-40]. In a large, case-controlled retrospective study of women with atypical uterine masses, a diagnostic algorithm based on enlarged lymph nodes, peritoneal implants, high diffusion MRI signal, and low ADC values was developed and validated. The resulting algorithm achieved a 98% sensitivity and a 96% specificity in the training set and 83% to 88% sensitivity and 97% to 100% specificity in the validation sets [34]. Machine learning with texture analysis is under investigation and may have the potential to improve diagnostic accuracy [20].

For patients undergoing MRgFUS, prediction models and multivariate analyses have found that nonperfused volume, a surrogate of symptom improvement, is a function of fibroid signal intensity, peak and time to peak enhancement, subcutaneous fat thickness, and distance from spine. A nonperfused volume >80% predicted clinical success in more than 80% of patients [73-76].

### **US Pelvis Transabdominal**

A combination of TAUS and TVUS of the pelvis is a frequently used imaging modality in pretreatment evaluation of known uterine fibroids [77,78]. TAUS is often useful in significantly enlarged fibroid uterus or large subserosal/pedunculated fibroids that may render poor visualization on TVUS because of limited field-of-view from poor acoustic penetration. A limitation of TAUS is a poor acoustic window from decompressed urinary bladder, retroverted uterus, large body habitus, and bowel gas [46].

### **US Pelvis Transvaginal**

TVUS provides higher contrast and spatial resolution and should be combined with the TAUS whenever possible to evaluate suspected uterine fibroid [46,47]. TVUS has a reported sensitivity of 90% to 99% for detecting uterine fibroids and a sensitivity of 90% and specificity of 98% for the diagnosis of submucosal fibroids [43,48,49]. The limitations of TVUS are a limited depth of penetration and a shallow focal length that can limit the evaluation of large or subserosal/pedunculated fibroids. The presence of numerous fibroids may also pose challenge in clearly delineating and precisely measuring the fibroids because of too poor an acoustic window.

### **US Duplex Doppler Pelvis**

Although Doppler imaging is labeled under separate imaging procedure per ACR methodology, this document considers it to be a standard component of pelvic US. Color and spectral Doppler are routinely used in pelvic US examinations to evaluate internal vascularity of pelvic/uterine findings and to differentiate between vascular and nonvascular tissue [47].

The growth of a uterine fibroid is proportional to its vascularity, and determining growth potential of the fibroid is helpful in clinical decision making [79,80]. Uterine artery Doppler flow measurements with peak systolic velocity >64 cm/s in uteri with fibroids have been shown as a predictor of UFE failure [81]. In a study by Nieuwenhuis et al [82], fibroid vascularization evaluated by 3-D TVUS with power Doppler correlated with fibroid volume and predicted fibroid growth rate per year. However, MRI pelvis has a higher sensitivity and accuracy than US in identifying number, location, size, volume, and vascularity of uterine fibroids for treatment planning [24,49,59].

### **Variant 3: Known fibroids. Surveillance or posttreatment imaging.**

#### **CT Pelvis**

Although CT pelvis has no direct role in routine surveillance or posttreatment follow-up of uterine fibroids, CT, preferably with IV contrast, may be used following UFE in patients with pelvic pain, fever for acute postprocedural complications such as infection, hemorrhage, or pelvic venous thrombosis [83]. The overall serious post-UFE complication rate is 1.25%, with pulmonary embolism and infection (endometritis, pyometra, pyomyoma) occurring in up to 0.25% and 2% of patients, respectively [25,41,83].

#### **MRI Pelvis**

When MRI is clinically indicated, the use of a gadolinium-based IV contrast agent is preferred [26]. Please see the ACR Manual on Contrast Media for additional information [27].

Routine posttreatment surveillance is controversial, and there is no consensus when to image asymptomatic women postintervention. Most studies evaluate patients immediately, 3 months, and/or 12 months after treatment and rely on T1-weighted, T2-weighted, and postcontrast sequences. Parameters commonly assessed include uterine volume, fibroid volume, percent infarcted/nonperfused volume, ovarian arterial collateral supply to the uterus, and fibroid location [25,41,67,70,83-87]. Following technically successful UFE, >90% fibroid infarction on postcontrast imaging correlates with better symptom control and fewer reinterventions [88]. Fibroid location after treatment is also important, especially in cases of suspected fibroid expulsion, which occurs in 2.2% to 7.7% of cases [1,25,66].

Specifically, intracavitary devascularized fibroid location predisposes to fibroid expulsion. Several studies show an association between diffusion-weighted imaging and ADC values and fibroid devascularization after UFE and MRgFUS [89-94]. Quantitative perfusion parameters have also been used to predict immediate MRgFUS ablation response [95].

### **US Pelvis Transabdominal**

A combination of TAUS and TVUS of the pelvis is a frequently used imaging modality in surveillance and posttreatment follow-up of known uterine fibroids [77,78]. TAUS is often useful in significantly enlarged fibroid uterus or large subserosal/pedunculated fibroids that can have poor visualization on TVUS because of limited field-of-view from poor acoustic penetration. Another potential limitation of TAUS is a poor acoustic window from decompressed urinary bladder, retroverted uterus, large body habitus, and bowel gas [46].

### **US Pelvis Transvaginal**

TVUS provides higher contrast and spatial resolution and should be combined with TAUS whenever possible in surveillance or posttreatment follow-up of uterine fibroids [46,47]. Currently, there is no specific consensus on imaging surveillance of asymptomatic patients with fibroids [43,45,96]. TVUS remains an efficient modality in determining fibroid size-reduction post-UFE [78]. Following UFE, most of the fibroid size reduction occurs within the first 6 months, with a continued decrease in size between 6 and 12 months [77,97]. A treated fibroid may have varied sonographic appearance ranging from hypoechoic to heterogeneous increased echogenicity, primarily based on the histologic composition of the fibroids [77,78]. Gas may be seen within the treated fibroid secondary to infarction within 1 month following UFE [98]. Peripheral rim calcification has been described in UFE-treated fibroid (“fetal head sign”) in contrast to the central dystrophic calcification from hyaline degeneration [77,99].

### **US Duplex Doppler Pelvis**

Although labeled under separate imaging procedure per ACR methodology, this document considers Doppler imaging to be a standard component of pelvic US. Color Doppler has been routinely used in pelvic US examinations to evaluate internal vascularity of pelvic/uterine findings and differentiate between vascular and nonvascular tissue [47]. UFE results in a marked reduction in fibroid size and disappearance of intrafibroid vascularity without a reduction in uterine vascularization that can be assessed with Doppler US [100]. In a retrospective study of 227 patients treated with UFE for fibroids, Doppler evaluation showed a significant decrease in uterine artery peak systolic velocity (mean, 21.85 cm/s) relative to pre-embolization peak systolic velocity (mean, 40.33 cm/s) and correlated with a decrease in fibroid size and volume [81].

### **Summary of Recommendations**

- **Variation 1:** US pelvis transabdominal, US pelvis transvaginal, and US duplex Doppler are usually appropriate for the initial imaging of clinically suspected fibroids. These procedures are complementary (ie, more than 1 procedure is ordered as a set or simultaneously in which each procedure provides unique clinical information to effectively manage the patient’s care).
- **Variation 2:** US pelvis transabdominal, US pelvis transvaginal, US duplex Doppler, and MRI pelvis without and with IV contrast are usually appropriate for the initial imaging for treatment planning of known fibroids. These procedures are complementary (ie, more than one procedure is ordered as a set or simultaneously where each procedure provides unique clinical information to effectively manage the patient’s care).
- **Variation 3:** US pelvis transabdominal, US pelvis transvaginal, US duplex Doppler, and MRI pelvis without and with IV contrast are usually appropriate for surveillance or posttreatment imaging of known fibroids. These procedures are complementary (ie, more than 1 procedure is ordered as a set or simultaneously in which each procedure provides unique clinical information to effectively manage the patient’s care).

### **Supporting Documents**

The evidence table, literature search, and appendix for this topic are available at <https://acsearch.acr.org/list>. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to [www.acr.org/ac](http://www.acr.org/ac).

## Appropriateness Category Names and Definitions

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

## Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document [101].

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	0 mSv	0 mSv
⦿	<0.1 mSv	<0.03 mSv
⦿⦿	0.1-1 mSv	0.03-0.3 mSv
⦿⦿⦿	1-10 mSv	0.3-3 mSv
⦿⦿⦿⦿	10-30 mSv	3-10 mSv
⦿⦿⦿⦿⦿	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

## References

- Goodwin SC, Spies JB. Uterine fibroid embolization. N Engl J Med 2009;361:690-7.
- Baird DD, Dunson DB, Hill MC, Cousins D, Schectman JM. High cumulative incidence of uterine leiomyoma in black and white women: ultrasound evidence. Am J Obstet Gynecol 2003;188:100-7.



3. Stewart EA. Clinical practice. Uterine fibroids. *N Engl J Med* 2015;372:1646-55.
4. Walker CL, Stewart EA. Uterine fibroids: the elephant in the room. *Science* 2005;308:1589-92.
5. Alexander AL, Strohl AE, Rieder S, Holl J, Barber EL. Examining Disparities in Route of Surgery and Postoperative Complications in Black Race and Hysterectomy. *Obstet Gynecol* 2019;133:6-12.
6. Laughlin-Tommaso SK, Jacoby VL, Myers ER. Disparities in Fibroid Incidence, Prognosis, and Management. *Obstet Gynecol Clin North Am* 2017;44:81-94.
7. Cardozo ER, Clark AD, Banks NK, Henne MB, Stegmann BJ, Segars JH. The estimated annual cost of uterine leiomyomata in the United States. *Am J Obstet Gynecol* 2012;206:211 e1-9.
8. Manyonda I, Belli AM, Lumsden MA, et al. Uterine-Artery Embolization or Myomectomy for Uterine Fibroids. *N Engl J Med* 2020;383:440-51.
9. Lee C, Salim R, Ofili-Yebovi D, Yazbek J, Davies A, Jurkovic D. Reproducibility of the measurement of submucous fibroid protrusion into the uterine cavity using three-dimensional saline contrast sonohysterography. *Ultrasound Obstet Gynecol* 2006;28:837-41.
10. Salim R, Lee C, Davies A, Jolaoso B, Ofuasia E, Jurkovic D. A comparative study of three-dimensional saline infusion sonohysterography and diagnostic hysteroscopy for the classification of submucous fibroids. *Hum Reprod* 2005;20:253-7.
11. Sabry ASA, Fadl SA, Szmigielski W, et al. Diagnostic value of three-dimensional saline infusion sonohysterography in the evaluation of the uterus and uterine cavity lesions. *Pol J Radiol* 2018;83:e482-e90.
12. Davis PC, O'Neill MJ, Yoder IC, Lee SI, Mueller PR. Sonohysterographic findings of endometrial and subendometrial conditions. *Radiographics* 2002;22:803-16.
13. Ong CL. The current status of three-dimensional ultrasonography in gynaecology. *Ultrasonography* 2016;35:13-24.
14. Grigore M, Pristavu A, Iordache F, Gafitanu D, Ursulescu C. Comparative Study of Hysteroscopy and 3D Ultrasound for Diagnosing Uterine Cavity Abnormalities. *Rev Med Chir Soc Med Nat Iasi* 2016;120:866-73.
15. Keizer AL, Nieuwenhuis LL, Twisk JWR, Huirne JAF, Hehenkamp WJK, Brolmann HAM. Role of 3-Dimensional Sonography in the Assessment of Submucous Fibroids: A Pilot Study. *J Ultrasound Med* 2018;37:191-99.
16. Frank ML, Schafer SD, Mollers M, et al. Importance of Transvaginal Elastography in the Diagnosis of Uterine Fibroids and Adenomyosis. *Ultraschall Med* 2016;37:373-8.
17. Zhang M, Wasnik AP, Masch WR, et al. Transvaginal Ultrasound Shear Wave Elastography for the Evaluation of Benign Uterine Pathologies: A Prospective Pilot Study. *J Ultrasound Med* 2019;38:149-55.
18. Stoelinga B, Hehenkamp WJ, Brolmann HA, Huirne JA. Real-time elastography for assessment of uterine disorders. *Ultrasound Obstet Gynecol* 2014;43:218-26.
19. Stoelinga B, Hehenkamp WJK, Nieuwenhuis LL, et al. Accuracy and Reproducibility of Sonoelastography for the Assessment of Fibroids and Adenomyosis, with Magnetic Resonance Imaging as Reference Standard. *Ultrasound Med Biol* 2018;44:1654-63.
20. Lakhman Y, Veeraraghavan H, Chaim J, et al. Differentiation of Uterine Leiomyosarcoma from Atypical Leiomyoma: Diagnostic Accuracy of Qualitative MR Imaging Features and Feasibility of Texture Analysis. *Eur Radiol* 2017;27:2903-15.
21. Hossain MZ, Rahman MM, Ullah MM, et al. A Comparative Study of Magnetic Resonance Imaging and Transabdominal Ultrasonography for the Diagnosis and Evaluation of Uterine Fibroids. *Mymensingh Med J* 2017;26:821-27.
22. Battista C, Capriglione S, Guzzo F, et al. The challenge of preoperative identification of uterine myomas: Is ultrasound trustworthy? A prospective cohort study. *Arch Gynecol Obstet* 2016;293:1235-41.
23. Malartic C, Morel O, Rivain AL, et al. Evaluation of symptomatic uterine fibroids in candidates for uterine artery embolization: comparison between ultrasonographic and MR imaging findings in 68 consecutive patients. *Clin Imaging* 2013;37:83-90.
24. Rajan DK, Margau R, Kroll RR, et al. Clinical utility of ultrasound versus magnetic resonance imaging for deciding to proceed with uterine artery embolization for presumed symptomatic fibroids. *Clin Radiol* 2011;66:57-62.
25. Kirby JM, Burrows D, Haider E, Maizlin Z, Midia M. Utility of MRI before and after uterine fibroid embolization: why to do it and what to look for. *Cardiovasc Intervent Radiol* 2011;34:705-16.



26. Kubik-Huch RA, Weston M, Nougaret S, et al. European Society of Urogenital Radiology (ESUR) Guidelines: MR Imaging of Leiomyomas. *Eur Radiol* 2018;28:3125-37.
27. American College of Radiology. ACR Committee on Drugs and Contrast Media. Manual on Contrast Media. Available at: [https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast\\_Media.pdf](https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf). Accessed March 31, 2022.
28. Ueda H, Togashi K, Konishi I, et al. Unusual appearances of uterine leiomyomas: MR imaging findings and their histopathologic backgrounds. *Radiographics* 1999;19 Spec No:S131-45.
29. Arleo EK, Schwartz PE, Hui P, McCarthy S. Review of Leiomyoma Variants. *AJR Am J Roentgenol* 2015;205:912-21.
30. Bolan C, Caserta MP. MR imaging of atypical fibroids. *Abdom Radiol (NY)* 2016;41:2332-49.
31. DeMulder D, Ascher SM. Uterine Leiomyosarcoma: Can MRI Differentiate Leiomyosarcoma From Benign Leiomyoma Before Treatment? *AJR Am J Roentgenol* 2018;211:1405-15.
32. Barral M, Place V, Dautry R, et al. Magnetic resonance imaging features of uterine sarcoma and mimickers. *Abdom Radiol (NY)* 2017;42:1762-72.
33. Gaetke-Udager K, McLean K, Sciallis AP, et al. Diagnostic Accuracy of Ultrasound, Contrast-enhanced CT, and Conventional MRI for Differentiating Leiomyoma From Leiomyosarcoma. *Acad Radiol* 2016;23:1290-7.
34. Abdel Wahab C, Jannot AS, Bonaffini PA, et al. Diagnostic Algorithm to Differentiate Benign Atypical Leiomyomas from Malignant Uterine Sarcomas with Diffusion-weighted MRI. *Radiology* 2020;297:E347.
35. Sun S, Bonaffini PA, Nougaret S, et al. How to differentiate uterine leiomyosarcoma from leiomyoma with imaging. *Diagn Interv Imaging* 2019;100:619-34.
36. Rio G, Lima M, Gil R, Horta M, Cunha TM. T2 hyperintense myometrial tumors: can MRI features differentiate leiomyomas from leiomyosarcomas? *Abdom Radiol (NY)* 2019;44:3388-97.
37. Tong A, Kang SK, Huang C, Huang K, Slevin A, Hindman N. MRI screening for uterine leiomyosarcoma. *J Magn Reson Imaging* 2019;49:e282-e94.
38. Valdes-Devesa V, Jimenez MDM, Sanz-Rosa D, Espada Vaquero M, Alvarez Moreno E, Sainz de la Cuesta Abbad R. Preoperative diagnosis of atypical pelvic leiomyoma and sarcoma: the potential role of diffusion-weighted imaging. *J Obstet Gynaecol* 2019;39:98-104.
39. Thomassin-Naggara I, Dechoux S, Bonneau C, et al. How to differentiate benign from malignant myometrial tumours using MR imaging. *Eur Radiol* 2013;23:2306-14.
40. Lin G, Yang LY, Huang YT, et al. Comparison of the diagnostic accuracy of contrast-enhanced MRI and diffusion-weighted MRI in the differentiation between uterine leiomyosarcoma / smooth muscle tumor with uncertain malignant potential and benign leiomyoma. *J Magn Reson Imaging* 2016;43:333-42.
41. Siddiqui N, Nikolaidis P, Hammond N, Miller FH. Uterine artery embolization: pre- and post-procedural evaluation using magnetic resonance imaging. *Abdom Imaging* 2013;38:1161-77.
42. Yang Q, Zhang LH, Su J, Liu J. The utility of diffusion-weighted MR imaging in differentiation of uterine adenomyosis and leiomyoma. *Eur J Radiol* 2011;79:e47-51.
43. De La Cruz MS, Buchanan EM. Uterine Fibroids: Diagnosis and Treatment. *Am Fam Physician* 2017;95:100-07.
44. Testa AC, Di Legge A, Bonatti M, Manfredi R, Scambia G. Imaging techniques for evaluation of uterine myomas. *Best Pract Res Clin Obstet Gynaecol* 2016;34:37-53.
45. Vilos GA, Allaire C, Laberge PY, Leyland N, Special C. The management of uterine leiomyomas. *J Obstet Gynaecol Can* 2015;37:157-78.
46. Van den Bosch T, Dueholm M, Leone FP, et al. Terms, definitions and measurements to describe sonographic features of myometrium and uterine masses: a consensus opinion from the Morphological Uterus Sonographic Assessment (MUSA) group. *Ultrasound Obstet Gynecol* 2015;46:284-98.
47. Robbins JB, Sadowski EA, Maturen KE, et al. ACR Appropriateness Criteria® Abnormal Uterine Bleeding. *J Am Coll Radiol* 2020;17:S336-S45.
48. Cicinelli E, Romano F, Anastasio PS, Blasi N, Parisi C, Galantino P. Transabdominal sonohysterography, transvaginal sonography, and hysteroscopy in the evaluation of submucous myomas. *Obstet Gynecol* 1995;85:42-7.
49. Dueholm M, Lundorf E, Hansen ES, Ledertoug S, Olesen F. Accuracy of magnetic resonance imaging and transvaginal ultrasonography in the diagnosis, mapping, and measurement of uterine myomas. *Am J Obstet Gynecol* 2002;186:409-15.

50. Sharma K, Bora MK, Venkatesh BP, et al. Role of 3D Ultrasound and Doppler in Differentiating Clinically Suspected Cases of Leiomyoma and Adenomyosis of Uterus. *J Clin Diagn Res* 2015;9:QC08-12.
51. Bittencourt CA, Dos Santos Simoes R, Bernardo WM, et al. Accuracy of saline contrast sonohysterography in detection of endometrial polyps and submucosal leiomyomas in women of reproductive age with abnormal uterine bleeding: systematic review and meta-analysis. *Ultrasound Obstet Gynecol* 2017;50:32-39.
52. Idowu BM, Ibitoye BO. Doppler sonography of perifibroid and intrafibroid arteries of uterine leiomyomas. *Obstet Gynecol Sci* 2018;61:395-403.
53. Kim SH, Sim JS, Seong CK. Interface vessels on color/power Doppler US and MRI: a clue to differentiate subserosal uterine myomas from extrauterine tumors. *J Comput Assist Tomogr* 2001;25:36-42.
54. Madan R. The bridging vascular sign. *Radiology* 2006;238:371-2.
55. Kurjak A, Kupesic-Urek S, Miric D. The assessment of benign uterine tumor vascularization by transvaginal color Doppler. *Ultrasound Med Biol* 1992;18:645-9.
56. Sladkevicius P, Valentin L, Marsal K. Transvaginal Doppler examination of uteri with myomas. *J Clin Ultrasound* 1996;24:135-40.
57. Kabil Kucur S, Temizkan O, Atis A, et al. Role of endometrial power Doppler ultrasound using the international endometrial tumor analysis group classification in predicting intrauterine pathology. *Arch Gynecol Obstet* 2013;288:649-54.
58. Timmerman D, Verguts J, Konstantinovic ML, et al. The pedicle artery sign based on sonography with color Doppler imaging can replace second-stage tests in women with abnormal vaginal bleeding. *Ultrasound Obstet Gynecol* 2003;22:166-71.
59. Omary RA, Vasireddy S, Chrisman HB, et al. The effect of pelvic MR imaging on the diagnosis and treatment of women with presumed symptomatic uterine fibroids. *J Vasc Interv Radiol* 2002;13:1149-53.
60. Spielmann AL, Keogh C, Forster BB, Martin ML, Machan LS. Comparison of MRI and sonography in the preliminary evaluation for fibroid embolization. *AJR Am J Roentgenol* 2006;187:1499-504.
61. Franconeri A, Fang J, Carney B, et al. Structured vs narrative reporting of pelvic MRI for fibroids: clarity and impact on treatment planning. *Eur Radiol* 2018;28:3009-17.
62. Chung YJ, Kang SY, Chun HJ, et al. Development of a Model for the Prediction of Treatment Response of Uterine Leiomyomas after Uterine Artery Embolization. *Int J Med Sci* 2018;15:1771-77.
63. Kalina I, Toth A, Valcseva E, et al. Prognostic value of pre-embolisation MRI features of uterine fibroids in uterine artery embolisation. *Clin Radiol* 2018;73:1060 e1-60 e7.
64. Sipola P, Ruuskanen A, Yawu L, et al. Preinterventional quantitative magnetic resonance imaging predicts uterus and leiomyoma size reduction after uterine artery embolization. *J Magn Reson Imaging* 2010;31:617-24.
65. Tang Y, Chen C, Duan H, Ma B, Liu P. Low vascularity predicts favourable outcomes in leiomyoma patients treated with uterine artery embolization. *Eur Radiol* 2016;26:3571-9.
66. Dutton S, Hirst A, McPherson K, Nicholson T, Maresh M. A UK multicentre retrospective cohort study comparing hysterectomy and uterine artery embolisation for the treatment of symptomatic uterine fibroids (HOPEFUL study): main results on medium-term safety and efficacy. *BJOG* 2007;114:1340-51.
67. Keung JJ, Spies JB, Caridi TM. Uterine artery embolization: A review of current concepts. *Best Pract Res Clin Obstet Gynaecol* 2018;46:66-73.
68. Campbell J, Rajan DK, Kachura JR, et al. Efficacy of Ovarian Artery Embolization for Uterine Fibroids: Clinical and Magnetic Resonance Imaging Evaluations. *Can Assoc Radiol J* 2015;66:164-70.
69. Gupta A, Grunhagen T. Live MR angiographic roadmapping for uterine artery embolization: a feasibility study. *J Vasc Interv Radiol* 2013;24:1690-7.
70. Koesters C, Powerski MJ, Froeling V, Kroencke TJ, Scheurig-Muenkler C. Uterine artery embolization in single symptomatic leiomyoma: do anatomical imaging criteria predict clinical presentation and long-term outcome? *Acta Radiol* 2014;55:441-9.
71. Nikolaidis P, Siddiqi AJ, Carr JC, et al. Incidence of nonviable leiomyomas on contrast material-enhanced pelvic MR imaging in patients referred for uterine artery embolization. *J Vasc Interv Radiol* 2005;16:1465-71.
72. Dao D, Kang SJ, Midia M. The utility of apparent diffusion coefficients for predicting treatment response to uterine arterial embolization for uterine leiomyomas: a systematic review and meta-analysis. *Diagn Interv Radiol* 2019;25:157-65.

73. Keserci B, Duc NM. Magnetic Resonance Imaging Parameters in Predicting the Treatment Outcome of High-intensity Focused Ultrasound Ablation of Uterine Fibroids With an Immediate Nonperfused Volume Ratio of at Least 90. *Acad Radiol* 2018;25:1257-69.
74. Kim YS, Lim HK, Park MJ, et al. Screening Magnetic Resonance Imaging-Based Prediction Model for Assessing Immediate Therapeutic Response to Magnetic Resonance Imaging-Guided High-Intensity Focused Ultrasound Ablation of Uterine Fibroids. *Invest Radiol* 2016;51:15-24.
75. Mindjuk I, Trumm CG, Herzog P, Stahl R, Matzko M. MRI predictors of clinical success in MR-guided focused ultrasound (MRgFUS) treatments of uterine fibroids: results from a single centre. *Eur Radiol* 2015;25:1317-28.
76. Yeo SY, Kim YS, Lim HK, Rhim H, Jung SH, Hwang NY. Uterine fibroids: Influence of "T2-Rim sign" on immediate therapeutic responses to magnetic resonance imaging-guided high-intensity focused ultrasound ablation. *Eur J Radiol* 2017;97:21-30.
77. Ghai S, Rajan DK, Benjamin MS, Asch MR, Ghai S. Uterine artery embolization for leiomyomas: pre- and postprocedural evaluation with US. *Radiographics* 2005;25:1159-72; discussion 73-6.
78. Weintraub JL, Romano WJ, Kirsch MJ, Sampaleanu DM, Madrazo BL. Uterine artery embolization: sonographic imaging findings. *J Ultrasound Med* 2002;21:633-7; quiz 39-40.
79. Czuczwar P, Wozniak S, Szkodziak P, et al. Influence of ulipristal acetate therapy compared with uterine artery embolization on fibroid volume and vascularity indices assessed by three-dimensional ultrasound: prospective observational study. *Ultrasound Obstet Gynecol* 2015;45:744-50.
80. Tal R, Segars JH. The role of angiogenic factors in fibroid pathogenesis: potential implications for future therapy. *Hum Reprod Update* 2014;20:194-216.
81. McLucas B, Perrella R, Goodwin S, Adler L, Dalrymple J. Role of uterine artery Doppler flow in fibroid embolization. *J Ultrasound Med* 2002;21:113-20; quiz 22-3.
82. Nieuwenhuis LL, Keizer AL, Stoelinga B, et al. Fibroid vascularisation assessed with three-dimensional power Doppler ultrasound is a predictor for uterine fibroid growth: a prospective cohort study. *BJOG* 2018;125:577-84.
83. Verma SK, Gonsalves CF, Baltarowich OH, Mitchell DG, Lev-Toaff AS, Bergin D. Spectrum of imaging findings on MRI and CT after uterine artery embolization. *Abdom Imaging* 2010;35:118-28.
84. Deshmukh SP, Gonsalves CF, Guglielmo FF, Mitchell DG. Role of MR imaging of uterine leiomyomas before and after embolization. *Radiographics* 2012;32:E251-81.
85. Kim YS, Lim HK, Kim JH, et al. Dynamic contrast-enhanced magnetic resonance imaging predicts immediate therapeutic response of magnetic resonance-guided high-intensity focused ultrasound ablation of symptomatic uterine fibroids. *Invest Radiol* 2011;46:639-47.
86. Naguib NN, Mbali E, Nour-Eldin NE, et al. Leiomyoma volume changes at follow-up after uterine artery embolization: correlation with the initial leiomyoma volume and location. *J Vasc Interv Radiol* 2010;21:490-5.
87. Wei C, Fang X, Wang CB, Chen Y, Xu X, Dong JN. The predictive value of quantitative DCE metrics for immediate therapeutic response of high-intensity focused ultrasound ablation (HIFU) of symptomatic uterine fibroids. *Abdom Radiol (NY)* 2018;43:2169-75.
88. Kroencke TJ, Scheurig C, Poellinger A, Gronewold M, Hamm B. Uterine artery embolization for leiomyomas: percentage of infarction predicts clinical outcome. *Radiology* 2010;255:834-41.
89. Liao D, Xiao Z, Lv F, Chen J, Qiu L. Non-contrast enhanced MRI for assessment of uterine fibroids' early response to ultrasound-guided high-intensity focused ultrasound thermal ablation. *Eur J Radiol* 2020;122:108670.
90. Cao M, Qian L, Zhang X, et al. Monitoring Leiomyoma Response to Uterine Artery Embolization Using Diffusion and Perfusion Indices from Diffusion-Weighted Imaging. *Biomed Res Int* 2017;2017:3805073.
91. Sutter O, Soyer P, Shotar E, et al. Diffusion-weighted MR imaging of uterine leiomyomas following uterine artery embolization. *Eur Radiol* 2016;26:3558-70.
92. Kirpalani A, Chong J, Yang N, et al. Diffusion-weighted imaging properties of uterine fibroids pre- and post-uterine fibroid embolisation. *Eur J Radiol* 2014;83:1620-5.
93. Ikink ME, Voogt MJ, van den Bosch MA, et al. Diffusion-weighted magnetic resonance imaging using different b-value combinations for the evaluation of treatment results after volumetric MR-guided high-intensity focused ultrasound ablation of uterine fibroids. *Eur Radiol* 2014;24:2118-27.

94. Jacobs MA, Gultekin DH, Kim HS. Comparison between diffusion-weighted imaging, T2-weighted, and postcontrast T1-weighted imaging after MR-guided, high intensity, focused ultrasound treatment of uterine leiomyomata: preliminary results. *Med Phys* 2010;37:4768-76.
95. Li C, Jin C, Liang T, et al. Magnetic resonance-guided high-intensity focused ultrasound of uterine fibroids: whole-tumor quantitative perfusion for prediction of immediate ablation response. *Acta Radiol* 2020;61:1125-33.
96. Munro MG, Storz K, Abbott JA, et al. AAGL Practice Report: Practice Guidelines for the Management of Hysteroscopic Distending Media: (Replaces Hysteroscopic Fluid Monitoring Guidelines. *J Am Assoc Gynecol Laparosc.* 2000;7:167-168.). *J Minim Invasive Gynecol* 2013;20:137-48.
97. Walker WJ, Pelage JP. Uterine artery embolisation for symptomatic fibroids: clinical results in 400 women with imaging follow up. *BJOG* 2002;109:1262-72.
98. Vott S, Bonilla SM, Goodwin SC, et al. CT findings after uterine artery embolization. *J Comput Assist Tomogr* 2000;24:846-8.
99. Nicholson TA, Pelage JP, Ettles DF. Fibroid calcification after uterine artery embolization: ultrasonographic appearance and pathology. *J Vasc Interv Radiol* 2001;12:443-6.
100. Tranquart F, Brunereau L, Cottier JP, et al. Prospective sonographic assessment of uterine artery embolization for the treatment of fibroids. *Ultrasound Obstet Gynecol* 2002;19:81-7.
101. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: <https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf>. Accessed March 31, 2022.

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.