

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: Pretreatment Evaluation and Follow-Up of Endometrial Cancer

Variant 1: Newly diagnosed endometrial cancer; when imaging is indicated for treatment planning.
(See narrative for clinical scenarios where imaging would be indicated.)

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis without and with IV contrast	9		O
CT chest with IV contrast	8	This procedure is for patients at high risk for metastases.	☼☼☼
MRI abdomen without and with IV contrast	7		O
CT abdomen with IV contrast	7	This procedure is used to evaluate for para-aortic lymphadenopathy.	☼☼☼
X-ray chest	7	This procedure may be appropriate if chest CT is not performed or unavailable.	☼
CT pelvis with IV contrast	5	This procedure may be appropriate if MRI cannot be obtained.	☼☼☼
MRI pelvis without IV contrast	5		O
CT chest without IV contrast	4	This procedure is for patients at high risk for metastases.	☼☼☼
MRI abdomen without IV contrast	4		O
US pelvis transvaginal	3	This procedure may be appropriate if MRI cannot be performed.	O
CT abdomen without IV contrast	1		☼☼☼
CT abdomen without and with IV contrast	1		☼☼☼☼
CT pelvis without IV contrast	1		☼☼☼
CT pelvis without and with IV contrast	1		☼☼☼☼
CT chest without and with IV contrast	1	This procedure is for patients at high risk for metastases.	☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: Pretreatment Evaluation and Follow-Up of Endometrial Cancer

Variant 2: Assessing the depth of myometrial invasion.

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis without and with IV contrast	9		O
US saline infusion sonohysterography	4	With this procedure there is very low risk of malignant cell dissemination into peritoneal cavity, which does not alter stage.	O
MRI pelvis without IV contrast	3	This procedure is useful if gadolinium is contraindicated.	O
CT pelvis with IV contrast	3		☼☼☼
US pelvis transvaginal	3	This procedure may be appropriate if MRI cannot be performed.	O
CT pelvis without IV contrast	1		☼☼☼
CT pelvis without and with IV contrast	1		☼☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 3: Lymph node evaluation.

Radiologic Procedure	Rating	Comments	RRL*
FDG-PET/CT skull base to mid-thigh	9	This procedure is appropriate for patients with high-grade tumor(s) that are likely FDG-avid.	☼☼☼☼
CT pelvis with IV contrast	8		☼☼☼
CT abdomen with IV contrast	8		☼☼☼
MRI pelvis without and with IV contrast	8		O
MRI abdomen without and with IV contrast	8		O
MRI pelvis without IV contrast	6		O
MRI abdomen without IV contrast	6		O
CT pelvis without IV contrast	5		☼☼☼
CT abdomen without IV contrast	4		☼☼☼
US pelvis transabdominal	2		O
CT pelvis without and with IV contrast	1		☼☼☼☼
CT abdomen without and with IV contrast	1		☼☼☼☼
Lymphangiogram	1		☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: Pretreatment Evaluation and Follow-Up of Endometrial Cancer

Variant 4: Assessing endocervical tumor extent.

Radiologic Procedure	Rating	Comments	RRL*
MRI pelvis without and with IV contrast	9		O
MRI pelvis without IV contrast	6		O
US pelvis transvaginal	4	This procedure is useful if MRI cannot be performed.	O
CT pelvis with IV contrast	3		☼☼☼
CT pelvis without IV contrast	1		☼☼☼
CT pelvis without and with IV contrast	1		☼☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 5: Post-therapy evaluation in patients with clinically suspected recurrence.

Radiologic Procedure	Rating	Comments	RRL*
FDG-PET/CT skull base to mid-thigh	9	This procedure is appropriate for patients with high-grade tumor(s) likely that are likely FDG-avid.	☼☼☼☼
MRI pelvis without and with IV contrast	8		O
CT pelvis with IV contrast	8	This procedure is appropriate if FDG-PET is not performed.	☼☼☼
MRI abdomen without and with IV contrast	8		O
CT abdomen with IV contrast	7	This procedure is appropriate if FDG-PET or MRI of abdomen is not performed or is unavailable.	☼☼☼
MRI pelvis without IV contrast	6		O
MRI abdomen without IV contrast	6		O
CT chest with IV contrast	6		☼☼☼
CT chest without IV contrast	4		☼☼☼
X-ray chest	4	This procedure may be appropriate if chest CT and FDG-PET are not performed or are unavailable.	☼
CT pelvis without IV contrast	2		☼☼☼
CT abdomen without IV contrast	2		☼☼☼
CT pelvis without and with IV contrast	1		☼☼☼☼
CT abdomen without and with IV contrast	1		☼☼☼☼
CT chest without and with IV contrast	1		☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

PRETREATMENT EVALUATION AND FOLLOW-UP OF ENDOMETRIAL CANCER

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Summary of Literature Review

Introduction/Background

Precise pretreatment evaluation of endometrial cancers facilitates an optimized therapeutic approach, particularly with regard to choosing type of surgery. Cross-sectional imaging techniques can play a vital role in pretreatment assessment of uterine cancers and should be viewed as complementary tools for surgical evaluation of these patients. Local-regional invasion of pelvic structures and distant metastasis can be readily detected on routine and standardized radiologic imaging. Although ultrasound (US) remains the primary imaging modality of choice for women who have suspected endometrial carcinoma (EC), state-of-the-art dynamic contrast-enhanced and diffusion-weighted magnetic resonance imaging (MRI) techniques are the primary modalities of choice for women who require preoperative staging EC or an imaging assessment of recurrence or treatment response.

Clinical Background and Prognostic Factors

EC is the most common gynecologic malignancy and the fourth most common cancer in women in the United States. About 47,130 new cases and 8,010 deaths were expected in the United States in 2012 [1].

Histopathologically, the ECs are classified as type I (>80%) and type II (<20%). Type I is typically composed of endometrioid type and estrogen-dependent cancers. They are often low grade, preceded by a premalignant endometrial hyperplasia, and demonstrate better prognosis. Type II is often made up of nonestrogen-dependent, nonendometrioid, and high-grade tumors which arise from an atrophic endometrium. They demonstrate a dismal prognosis and are responsible for almost half of the EC-related deaths [2].

The surgical and therapeutic strategy may be changed with the International Federation of Gynecology and Obstetrics (FIGO) staging system. A revised simple FIGO staging scheme was approved September 2008. Stage I is defined as a tumor confined to the corpus uteri with or without myometrial invasion. Myometrial invasion <50% is assigned to stage IA and >50% as IB. Stage II signifies tumors invading the cervical stroma (not extending beyond the uterus). Stage III includes local and regional spread of disease and is classified in 3 categories. Tumors invading the serosa or adnexa are assigned stage IIIA, whereas tumors invading the vagina or parametrium are designated with stage IIIB. Presence of positive lymph nodes is assigned with stage IIIC, which is further divided in IIIC1 (positive pelvic nodes) and IIIC2 (positive para-aortic lymph nodes) disease. A tumor invading bladder and/or bowel mucosa is categorized as stage IVA, whereas distant metastasis (eg, to lung or liver) as IVB [3].

Endometrial cancer primarily presents at stage I (80% of cases), and the recommended treatment is complete resection of disease, hysterectomy, and bilateral salpingo-oophorectomy. Depending on prognostic factors such as depth of myometrial invasion, tumor size, and tumor grade, lymphadenectomy may also be indicated, though some gynecologic oncologic surgeons believe that lymphadenectomy is indicated in all patients with EC, whereas others do not recommend routine lymphadenectomy in any patient. Once lymph node metastasis is confirmed by histology, adjuvant radiation or chemotherapy could be considered.

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The potential advantages of preoperative imaging may include:

1. Evaluation of the depth of myometrial invasion to predict the likelihood of advanced disease (ie, incidence of lymph node metastasis is <2.5% in stage IA versus 15%–45% in stage IB)
2. Diagnosis of gross cervical invasion, which requires preoperative radiation therapy or a different treatment plan (ie, radical hysterectomy instead of total abdominal hysterectomy)
3. Identification of suspicious lymph nodes to guide lymph node sampling at the time of surgery
4. Detection of advanced disease

The most important prognostic variables for carcinoma of the uterus are the histologic grade and the stage of tumor, including depth of myometrial invasion and lymph node metastasis [3,4]. In a study of 349 endometrial cancer patients correlating the incidence of pelvic lymph node metastases with histologic grade and depth of myometrial invasion, lymph node metastases were found in less than 10% of patients with grade 1 and 2 disease with no or inner half (<50%) of myometrial invasion (stage IA) versus 17% with outer half (>50%) of myometrial invasion (stage IB). In histologic grade 3 disease, lymph node metastases were identified in up to 28% of patients with any degree of myometrial invasion (stage IA and IB) [5].

In a study of 200 patients with adenocarcinoma of the uterus, the depth of myometrial invasion was found to be the single most important prognostic factor. In stage IA disease, when the tumor is confined to the endometrium or to the superficial myometrium, the incidence of para-aortic lymph node metastases was <2.5%. Conversely, in stage IB disease, when there is deep myometrial invasion, para-aortic lymph node metastases occurred in 15%–45% of patients [4,6].

The first-echelon (or efferent) lymph nodes for endometrial cancer include either pelvic or para-aortic nodal stations and are the most at risk. A study of 422 endometrial cancer patients operated on consecutively at a single center demonstrated pelvic and para-aortic metastatic lymphadenopathy in 51% of patients and para-aortic nodal involvement alone in 16% of patients at lymphadenectomy [7]. However, lymphadenectomy does not alter overall survival, especially in early-stage endometrial cancer [8,9]. Thus, pretreatment lymph node evaluation with imaging should include assessment of pelvic and para-aortic nodes to guide lymph node sampling at the time of surgery.

Because errors in clinical staging are estimated to result in understaging of about 13%–22% in patients with endometrial cancer, the FIGO has recommended routine surgical staging since 1988 [10]. Preoperative imaging of EC can define the extent of disease to tailor treatment and indicate subspecialist referral if deep myometrial invasion, cervical extension, or lymphadenopathy is suspected or if high-grade or high-risk histology (such as papillary serous or clear-cell carcinoma) is found at the time of biopsy. Diagnostic imaging may be helpful in obese, elderly patients in whom radiation therapy rather than surgery might be advocated as the primary treatment or as a preoperative adjuvant to surgery. Imaging may also benefit young women with EC who want to preserve fertility, in which case hormonal therapy would be considered as a primary treatment rather than surgery.

EC tends to recur in the pelvis, especially in the vaginal vault (42% of recurrences) and pelvic lymph nodes, followed by para-aortic lymph nodes [11]. Other common sites for extrapelvic recurrence are the abdomen (especially peritoneum) and lung. Therefore, post-therapy surveillance imaging may include evaluation of the abdomen and pelvis. Imaging of the chest may be indicated in selected high-risk, advanced-stage patients to detect lung metastasis.

Use of Imaging in Clinical Guidelines

Transabdominal and Transvaginal Ultrasound

Transabdominal US is considered unreliable in staging endometrial cancer, though its use has shown some promise in evaluating myometrial invasion. Reported accuracies in stage I cancer range from 69%–93% in differentiating deep invasion (stage IB) from absent or superficial invasion (stages IA) [12–16]. Studies using high-frequency transvaginal US showed similar accuracies ranging from 73%–84% in assessing myometrial invasion [17,18]. A study using transvaginal and Doppler US also showed an accuracy of 69% in predicting myometrial invasion [19]. However, studies directly comparing the accuracy of transvaginal US to that of contrast-enhanced MRI for staging have consistently demonstrated that the latter performs with greater accuracy [13,20].

In addition, there are insufficient reports about the value of transvaginal US in predicting cervical extension, parametrial invasion, or lymphadenopathy. In 1 study, transvaginal US showed cervical involvement in only 7 of 10 patients with cervical extension [21]. Studies have shown that contrast-enhanced US could be useful to diagnose the depth of myometrial infiltration using the arcuate vascular plexus involvement as a marker; however, this needs further validation [22].

Hysterosonography (ie, transvaginal US evaluation of the uterus after intracavitary saline infusion) has been used for evaluating deep myometrial invasion, with accuracies ranging from 84%–89% [23,24]. However, its use is controversial in determining the myometrial invasion, and several reports indicated that the procedure can disseminate malignant cells into the peritoneal cavity in 6%–7% of patients with an established diagnosis of endometrial cancer [24,25].

Computed Tomography

Computed tomography (CT) has been used for evaluating EC, with emphasis on the depth of myometrial invasion and assessing lymph node status. However, CT is insensitive for depicting endometrial cancer in the uterus and therefore its role in evaluating myometrial invasion is limited [26]. This is particularly true for small and low-risk EC (stage IA or IB). In studies comparing CT with US or MRI, the accuracy of CT for myometrial invasion is reported to be 58%–61% versus 68%–69% for US and 88%–89% for MRI [13]. The value of CT in diagnosing cervical extension is not evident because identifying the margin between the cervix and the uterine corpus is difficult on axial imaging planes. Moreover, most studies suffer from having only a few patients with stage II cancer, which may prevent the drawing of valid conclusions. A recent study in preoperative evaluation of myometrial invasion and cervical extension of endometrial cancer using multidetector CT (MDCT) showed improved diagnostic accuracies of 95% and 81%, respectively [27]. However, the role of MDCT for staging EC must be further validated. For evaluation of pelvic and para-aortic lymphadenopathy, CT is 52% sensitive and 92% specific [28].

Chest CT could be obtained as a part of post-therapy surveillance in selected high-risk groups or patients with a higher FIGO stage; however, it is not needed for low-risk groups or patients with a lower FIGO stage, since pulmonary metastasis rarely occurs in the latter group [29–31]. Performing chest CT as an alternative to radiography for the initial diagnostic workup is controversial and still under investigation. However, it may be appropriate for high-risk and high-grade tumor confirmed by biopsy.

Magnetic Resonance Imaging

MRI is preferred over US or CT for pretreatment evaluation because it allows the most accurate evaluation of the extent of pelvic tumor. Evaluation of pelvic and para-aortic lymph nodes can be performed concurrently with accuracy comparable to CT with sensitivity of 44%–66% and specificity of 73%–98% [32]. In addition, MRI is significantly superior to US in the evaluation of both tumor extension into the cervix and myometrial invasion [12,13,17,20]. One study found that high-frequency transvaginal US has similar diagnostic accuracy in the evaluation of both tumor extension into the cervix (92% for high-frequency transvaginal US versus 85% for MRI) and myometrial invasion (84% for high-frequency transvaginal US versus 82% for MRI) [18]. A meta-analysis showed that the efficacy of contrast-enhanced MRI is significantly better than that of US, CT, or noncontrast MRI in evaluating the depth of myometrial invasion in patients with endometrial cancer [33,34].

Dynamic Contrast-Enhanced Magnetic Resonance Imaging

Multiple studies have demonstrated that dynamic contrast-enhanced MRI is a preferred modality to evaluate myometrial invasion with an accuracy, sensitivity, and specificity reaching as high as 100% [35]. However, a great variation of these figures has been shown in different studies, ranging from 59%–100% for accuracy, 71%–100% for sensitivity, and 72%–100% for specificity [35].

It has been clearly defined that T2-weighted imaging sequences alone have low sensitivity, specificity, and accuracy and should be combined with contrast-enhanced images [35,36]. Dynamic contrast-enhanced MRI performs significantly better than unenhanced MRI for evaluating the depth of myometrial invasion, which is best demonstrated after 50–120s postcontrast injection [20,33].

A negative finding on dynamic contrast-enhanced MR strongly suggests the absence of deep myometrial involvement [36]. Superficial layers of the myometrium or junctional zone (JZ) typically enhance on arterial phase [35]. Demonstration of an undisrupted enhancing JZ signifies lack of myometrial involvement [37]. This is a useful sign to rule out a myometrial invasion in postmenopausal patients whose JZ is otherwise not well discernible on T2-weighted images [38].

Cervical extension can be diagnosed reliably with accuracy ranging from 86%–95% [24,39-41]. One study comparing MRI with fractional curettage and hysteroscopy showed that MRI had the highest sensitivity (91%) and specificity (96%) for diagnosing cervical involvement in endometrial cancer [40]. Normal cervical stroma appears hypointense on T2-weighted images and provides an excellent contrast to the T2-weighted hyperintensity rendered by the tumoral invasion [35]. Dynamic contrast-enhanced images (with a 180–240s delay) further enhance the detection of such invasion. Studies have demonstrated accuracy up to 98% (range 46%–98%), sensitivity up to 100% (range 33%–100%), and specificity up to 100% (range 87%–100%) [35].

The detection of pelvic lymphadenopathy according to size criteria (>10 mm in the shortest axis) has low sensitivity (17%–80%), high specificity (93%–100%), and moderate accuracy (83%–90%). Reducing the cut-off to 8 mm may further increase the sensitivity but decrease the specificity [32].

An erroneous MRI assessment of the depth of myometrial invasion can sometimes be ascribed to the presence of a large polypoid endometrial cancer, which distends the uterus so that a thin rim of myometrium is stretched over the polyp rather than cancer infiltration of the myometrium [20].

Diffusion-Weighted Imaging and Apparent Diffusion Coefficient Mapping

EC shows restricted diffusion and appears hyperintense on diffusion-weighted images (DWI) relative to surrounding myometrium. DWI has demonstrated very promising results in the assessment of deep myometrial invasion (accuracy 74%–98%, sensitivity 85%–100%, and specificity 82%–100%), especially when combined with T2-weighted imaging [35]. These results are comparable to the contrast-enhanced MRI, thus DWI can be a potential alternative to patients with compromised kidney functions, where contrast is contraindicated [30,42-44].

On the other hand, ECs appear hypointense on apparent diffusion coefficient (ADC) maps, and an obvious difference of ADC values exists between benign and malignant endometrial lesions. This phenomenon has been exploited by certain investigators [42,44,45]. With cut-off values $1.05 \times 10^{-3} \text{mm}^2/\text{s}$ to differentiate benign from malignant tumors, the study results were highly encouraging (accuracy 95%, sensitivity 96%, and specificity 95%). Additionally, raising the cut-off value to 1.15 demonstrated an increased specificity (100%) but decreased sensitivity (85%) [46,47].

DWI and ADC mapping may enhance the detection of metastatic lymph nodes in pelvic malignancies. Recently, it has been shown that metastatic nodes exhibit lower ADC values than the normal nodes, and minimum ADC region values are more reliable than the mean values to evaluate the suspicion of metastasis [42]. With a cut-off value of $0.807 \times 10^{-3} \text{mm}^2/\text{s}$, the sensitivity was 100%, specificity 98.3%, positive-predictive value 63.6%, negative-predictive value 100%, and accuracy 98.3% [39].

The role of DWI to determine tumor response to the treatment in EC is still evolving and not certain at press time.

MR perfusion and blood oxygen level dependent MRI do not have established roles in the evaluation of ECs. Certain ECs have demonstrated increased spectroscopic signals from choline, lipids, and lactates. This reaction could be exploited to determine long-term prognosis and treatment response on MR spectroscopy, but it needs validation. Magnetic iron oxide nanoparticles or ultra-small particles of iron oxides may demonstrate a potential in detecting malignant pelvic lymph nodes, but these particles are not widely available.

Studies have not shown any added advantage of using 3T versus 1.5T, and results are comparable for both 3T and 1.5T. However, 3T is more susceptible for susceptibility and chemical shift artifact, and image inhomogeneity of T2-weighted images were far inferior on 3T [48,49].

Lymphangiography

Lymphangiography is not recommended for evaluating cancer of the endometrium because 1) it is invasive, 2) few imaging centers offer this service, and 3) due to the difficulties of using it to evaluate pelvic nodes, its performance is not reproducible and is slightly inferior to that of CT and MRI [50], even when performed optimally.

Positron Emission Tomography

The role of positron emission tomography (PET) in endometrial cancer imaging is evolving. In detecting lymph node involvement by tumor, PET performs with accuracy (95%–98%) comparable to that of CT or MRI [51-53]. However, because 45% of endometrial cancers are grade I and not FDG-avid, the reported improved sensitivity of PET (60%–93%) is only true for nodes >1 cm. However, it has been shown that the sensitivity of FDG-PET alone or FDG-PET plus MRI-CT could be higher than that of MRI-CT alone in overall lesion detection. Higher FDG

uptake or maximum standardized uptake value (SUV_{max}) of the primary tumors have been correlated with the higher recurrence rates. It has been shown that patients with high SUV_{max} (≥ 12.7) values had a significantly lower disease-survival rate [54]. PET was reported to be useful in post-therapy surveillance for localizing suspected recurrences [55-58]. A study showed that in the detection of recurrence and the evaluation of treatment response, FDG-PET, implemented by CT and/or MRI, performed better (sensitivity 100%, specificity 88.2%, and accuracy 93.3%) than CT and/or MRI (sensitivity 84.6%, specificity 85.7%, and accuracy 85%) and tumor markers, ie, CA125, CA19-9, CEA, and sialyl TN antigen (sensitivity 100%, specificity 70.6%, and accuracy 83.3%). The results of FDG-PET correlated well with the clinical outcome of the patients; patients who had negative PET results tended to show disease-free courses [59].

Radiography

Chest radiography has traditionally been included as standard staging procedure after initial diagnosis of endometrial cancer [60]. For imaging of patients at high risk for recurrence (ie, high FIGO stage), radiography historically has represented an alternative to CT for chest imaging.

Summary

- Because dynamic contrast-enhanced and diffusion weighted MRI demonstrates the highest accuracy for overall staging of endometrial cancer, it should be the preferred imaging modality for treatment planning when available.
- Transvaginal US is still the screening examination of choice for the detection of EC, and it can be used to assess the depth of myometrial invasion and cervical involvement, albeit with less accuracy than MRI.
- CT and MRI perform equivalently for assessing nodal involvement. MRI might have an edge with ADC mapping.
- PET with concurrent diagnostic-quality abdominopelvic CT and/or MRI is the most accurate means of assessing adenopathy pretreatment and in the post-treatment evaluation of endometrial cancer patients with clinically suspected recurrence. However, cost-effectiveness or patient outcome analyses on the benefits of surveillance imaging have yet to be reported.
- Patients with endometrial cancer should undergo preoperative diagnostic imaging in cases where there is strong desire to preserve fertility or there are clinical staging difficulties, including medical comorbidities that preclude surgery, large tumors, high histologic tumor grade, or possible cervical involvement.
- Pretreatment imaging to determine tumor extent may be performed to plan surgery and, when necessary, triage to specialist referral for complete surgical staging with lymphadenectomy.
- If pretreatment imaging is needed, MRI is the preferred modality for overall assessment of disease extent. However, for the assessment of lymphadenopathy and distant metastasis, CT is also acceptable. However, PET/CT is more appropriate for assessing lymphadenopathy in high-grade FDG-avid tumors.
- For clinically suspected recurrence after treatment, PET/CT is the preferred imaging modality to confirm and localize the recurrent disease. There is not enough evidence to support post-therapy imaging surveillance for asymptomatic patients at this time.

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, both because of 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 to 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.

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”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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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.