American College of Radiology
ACR Appropriateness Criteria®
Pretreatment Evaluation and Follow-Up of Endometrial Cancer

Variant: 1 Initial staging of pretreatment endometrial cancer; assessment of local tumor extension for all tumor grades.

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
US pelvis transvaginal	May Be 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	☢☢☢☢

Variant: 2 Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).

Procedure	Appropriateness Category	Relative Radiation Level
US pelvis transabdominal	May Be Appropriate	O
MRI abdomen without and with IV contrast	May Be Appropriate	O
MRI pelvis without and with IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT chest abdomen pelvis with IV contrast	May Be Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	May Be Appropriate	☢☢☢☢
US abdomen	Usually Not Appropriate	O
Lymphangiography pelvis	Usually Not Appropriate	☢☢☢
MRI abdomen without IV contrast	Usually Not Appropriate	O
CT chest abdomen pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT chest abdomen pelvis without IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 3 Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).

Procedure	Appropriateness Category	Relative Radiation Level
MRI pelvis without and with IV contrast	Usually Appropriate	O
CT chest abdomen pelvis with IV contrast	Usually Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US abdomen	May Be Appropriate	O
US pelvis transabdominal	May Be Appropriate	O
MRI abdomen without and with IV contrast	May Be Appropriate	O
MRI abdomen without IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT chest abdomen pelvis without IV contrast	May Be Appropriate	☢☢☢☢
Lymphangiography pelvis	Usually Not Appropriate	☢☢☢
CT chest abdomen pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 4 Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.

Procedure	Appropriateness Category	Relative Radiation Level
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
Radiography chest	Usually Not Appropriate	☢
MRI abdomen without and with IV contrast	Usually Not Appropriate	O
MRI abdomen without IV contrast	Usually Not Appropriate	O
MRI pelvis without and with IV contrast	Usually Not Appropriate	O
MRI pelvis without IV contrast	Usually Not Appropriate	O
CT chest abdomen pelvis with IV contrast	Usually Not Appropriate	☢☢☢☢
CT chest abdomen pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢
CT chest abdomen pelvis without IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 5 Surveillance of asymptomatic patients with treated high-risk endometrial cancer.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	May Be Appropriate	☢
CT chest abdomen pelvis with IV contrast	May Be Appropriate	☢☢☢☢
CT chest abdomen pelvis without IV contrast	May Be Appropriate	☢☢☢☢
US abdomen	Usually Not Appropriate	O
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
MRI abdomen without and with IV contrast	Usually Not Appropriate	O
MRI abdomen without IV contrast	Usually Not Appropriate	O
MRI pelvis without and with IV contrast	Usually Not Appropriate	O
MRI pelvis without IV contrast	Usually Not Appropriate	O
CT chest abdomen pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

Variant: 6 Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

Procedure	Appropriateness Category	Relative Radiation Level
MRI abdomen without and with IV contrast	Usually Appropriate	O
MRI pelvis without and with IV contrast	Usually Appropriate	O
CT chest abdomen pelvis with IV contrast	Usually Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US abdomen	May Be Appropriate	O
Radiography chest	May Be Appropriate	☢
MRI abdomen without IV contrast	May Be Appropriate	O
MRI pelvis without IV contrast	May Be Appropriate	O
CT chest abdomen pelvis without IV contrast	May Be Appropriate	☢☢☢☢
US pelvis transabdominal	Usually Not Appropriate	O
US pelvis transvaginal	Usually Not Appropriate	O
CT chest abdomen pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

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Summary of Literature Review

Introduction/Background

Accurate pretreatment evaluation of endometrial carcinoma (EC) may optimize therapy, particularly with regard to choosing the type of surgery. Preoperative imaging of EC can define the extent of disease and indicate the need for subspecialist referral in the presence of deep myometrial invasion, cervical extension, suspected lymphadenopathy or if high-grade endometrioid carcinoma or high-risk histology (such as papillary serous or clear cell carcinoma) is found at the time of biopsy. Cross-sectional imaging techniques play a vital role in the pretreatment assessment of uterine cancers and should be viewed as complementary modalities for surgical evaluation of these patients. The depth of myometrial invasion, cervical stromal invasion, local regional invasion of pelvic structures, and distant metastasis can be readily detected at cross-sectional imaging. Although ultrasound (US) remains the imaging modality of choice to screen women who have suspected EC, state-of-the-art dynamic contrast-enhanced and diffusion-weighted imaging (DWI) MR techniques are better suited to preoperatively stage, identify recurrence, and assess local treatment response in women with EC.

Initial Staging

EC is the most common gynecologic malignancy in the United States, with approximately 61,880 newly diagnosed cases and 12,160 deaths expected in 2019 [1]. Histopathologically, ECs are classified as type I (>80%) and type II (<20%) [2]. Type I tumors are typically endometrioid in histology and estrogen-dependent. They are often low-grade (grade 1 and 2) preceded by a premalignant endometrial hyperplasia and are associated with a better prognosis. Type II tumors tend to be nonestrogen dependent, nonendometrioid, high-grade endometrioid tumors (grade 3), and characteristically arise from an atrophic endometrium. They demonstrate a worse prognosis and are responsible for almost half of the EC-related deaths [3].

Secondary to estimated errors in clinical staging resulting in the under staging of 13% to 22% of patients with EC, the International Federation of Gynecology and Obstetrics (FIGO) staging system has recommended routine surgical staging since 1988 [4]. EC is currently staged surgically based on the revised FIGO staging system, which was approved in September 2008 [5,6]. Stage I is defined as a tumor confined to the corpus uteri with or without myometrial invasion. Myometrial invasion <50% is assigned as stage IA and ≥50% as IB. Stage II consists of tumors invading the cervical stroma (not extending beyond the uterus). Stage III includes local and regional spread of disease and is subclassified into three categories. Tumors invading the serosa or adnexa are assigned stage IIIA, whereas tumors invading the vagina or parametrium are designated as stage IIIB. Presence of positive lymph nodes is assigned as stage IIIC, which is further subdivided into

stage IIIC1 (positive pelvic nodes) and stage IIIC2 (positive para-aortic lymph nodes) disease. A tumor invading the bladder or bowel mucosa is categorized as stage IVA, whereas distant metastasis (eg, to lung or liver) as stage IVB [6].

Patients with EC typically present with stage I disease (80% of cases), and the recommended treatment is complete resection of disease by hysterectomy and bilateral salpingo-oophorectomy. Multiple studies have demonstrated that recurrence risk after treatment is related to the depth of myometrial invasion, tumor grade, histological subtype, and lymphovascular space invasion in clinically proven stage I [7]. Risk stratification systems that aggregate these prognostic factors to define recurrence risk groups have been developed and are now used worldwide to guide decision-making and design clinical trials [2,8-10]. Results of a 2014 study of a simultaneous comparison of several proposed risk stratification systems suggested that the European Society for Medical Oncology modified system was the most accurate in the prediction of lymph node status and survival [10]. In that system, categorization of risk grouping was based on FIGO stage, tumor grade, histological subtype, and lymphovascular space invasion. Patients with disease of FIGO stage IB grade 3 endometrioid type with positive lymphovascular space invasion or nonendometrioid histology of all stages can be classified as high risk. Conversely, patients with FIGO stage IA with grade 1 to 2 EC and no lymphovascular space invasion can be classified as low risk. All other tumors can be classified as intermediate or high-intermediate risk. This risk stratification system also guides the need and extent of lymph node sampling for initial staging [9].

Nevertheless, many patients will undergo a comprehensive lymphadenectomy despite having disease confined to the uterus, resulting in prolonged operating time, additional cost, and potential side effects, such as lower extremity lymphedema. Sentinel lymph node mapping, which has been used in other cancer types, is an acceptable surgical strategy between a complete lymphadenectomy and no nodal evaluation in patients with EC [11-15]. In a multicenter prospective study of 385 patients with clinical stage I EC, sentinel lymph nodes identified with indocyanine green achieved a sensitivity to detect node-positive disease of 97.2% (95% confidence interval [CI], 85.0–100) and a negative predictive value of 99.6% (97.9–100) [15]. Consensus recommendations published by Holloway et al [13] stated that sentinel lymph node mapping by cervical tracer injection accurately predicts the presence of lymph node metastasis and has a <5% false-negative rate when the National Comprehensive Cancer Network (NCCN) surgical algorithm is closely followed.

In summary, potential advantages of preoperative imaging may include:

- Evaluation of the depth of myometrial invasion to predict the likelihood of advanced disease and guide subspecialist referral. Diagnosis of extensive cervical invasion, which requires preoperative radiation therapy or a different treatment plan (eg, radical hysterectomy instead of total abdominal hysterectomy).
- Identification of suspicious lymph nodes to guide lymph node sampling at the time of surgery.
- Detection of locoregional advanced disease and distant metastases to plan the surgical approach.
- Preoperative evaluation in elderly patients in whom radiation therapy, rather than surgery, might be advocated as the primary treatment or as neoadjuvant therapy to surgery.
- Preoperative evaluation in young women who wish to preserve fertility, in which case

hormonal therapy would be considered as a primary treatment rather than surgery in patients without myometrial invasion.

Surveillance and Posttherapy Evaluation

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 [16]. Extrapelvic recurrence commonly involves the peritoneum and lungs. Atypical metastatic sites include extra-abdominal lymph nodes, liver, adrenals, brain, bones, and soft-tissue [17]. Therefore, posttherapy 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.

Close follow-up after the completion of treatment for EC is suggested, particularly in the first 3 years after diagnosis, when the risk of recurrence is highest [18]. This usually includes a history and physical examination every 3 to 6 months for several years. Vaginal bleeding is a common symptom of local recurrence. In patients with a distant recurrence, symptoms such as coughing, pain, lethargy, weight loss, or headaches are present in up to 70% of cases [19,20]. In one study, a combination of findings at physical examination with or without patient symptomatology, resulted in a >80% recurrence detection rate [21]. Radiologic evaluation such as a CT scan or fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET/CT scan of the chest, abdomen, and pelvis should only be used to investigate suspicion of recurrent disease and not for routine surveillance after treatment [22]. Whenever feasible, pathologic diagnosis with biopsy should be done to confirm disease recurrence [23].

Special Imaging Considerations

MR perfusion and blood oxygen level dependent MRI do not have established roles in the evaluation of EC [24].

Certain ECs have demonstrated increased spectroscopic signals from choline, lipids, and lactates [24]. This reaction could be exploited to determine long-term prognosis and treatment response on MR spectroscopy but still 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 [25].

Hysterosonography (eg, transvaginal US [TVUS] evaluation of the uterus after intracavitary saline infusion) has been used for evaluating deep myometrial invasion, with accuracies ranging from 84% to 89% [26,27]. However, its use is controversial in determining the myometrial invasion; at least one study showed adding intracavitary saline infusion to 3-D TVUS did not improve the diagnostic accuracy of deep myometrial invasion or cervical involvement [28-30]. A number of studies have demonstrated that the procedure can disseminate malignant cells into the peritoneal cavity; however, there is limited evidence to suggest transtubal dissemination of viable cells occurs or that it affects prognosis in stage I EC [27]. The 2009 FIGO staging stated "positive peritoneal washing has to be reporting separately without changing the stage," indicating a lack of evidence that positive peritoneal washing will influence prognosis.

Contrast-enhanced US could be useful to diagnose the depth of myometrial invasion using the arcuate vascular plexus involvement as a marker, with the diagnostic accuracy for determining the

myometrium infiltration depth was 85.3%; however, this needs further validation [31].

FDG-PET/MRI is emerging as a hybrid imaging modality that combines the functional ability of PET with the morphological high soft-tissue contrast provided by MRI. Although there is a paucity of literature on the role of FDG-PET/MRI for the initial staging and suspected recurrence in patients with EC, studies assessing local staging, lymph node involvement, and distant metastases in gynecological malignancies have found that FDG-PET/MRI is equivalent or outperforms FDG-PET/CT. Queiroz et al [32] studied 26 patients with gynecological malignancies (including four ECs) and found that PET/MRI had improved delineation compared to PET/CT for 2 of 3 ECs and 6 of 7 cervical cancers. These authors found no difference in the detection of regional lymph node involvement and abdominal metastases between the two modalities. More recently, a meta-analysis that comprised 7 studies and 216 patients with a variety of gynecological malignancies showed excellent diagnostic performance of FDG-PET/MRI to assess the primary tumor, nodal staging, and recurrence in patients with gynecological malignancies including EC [33]. In a study of 81 patients with proven recurrence of gynecological malignancy, PET/MRI achieved a lesion-based accuracy of 94% compared to 92% for PET/CT [34]. A meta-analysis (7 studies, 257 patients, 695 lesions) that evaluated the diagnostic value of FDG-PET/MRI for restaging patients with suspected recurrence of gynecological malignancies reported the pooled sensitivity and specificity on a patient-based analysis to be 0.96 and 0.95, respectively, and on a lesion-based analysis 0.99 and 0.94, respectively [35].

Discussion of Procedures by Variant

Variant 1: Initial staging of pretreatment endometrial cancer; assessment of local tumor extension for all tumor grades.

Currently there is little consensus on the role of pelvic imaging in the preoperative staging of EC, with practices differing widely across centers [36]. However, when assessment of local tumour extent during initial staging is clinically indicated, this variant addresses the evidence regarding the appropriate use of the different imaging modalities. The NCCN 2020 guidelines advise MRI for initial workup as follows: to establish the origin of the tumor (endocervical versus endometrial), assess local disease extent, and exclude myometrial invasion for fertility sparing treatment [23]. In 2016, a European multidisciplinary expert panel consensus meeting on EC suggested that MRI may be useful to assess myometrial invasion in centers in which the need for lymph node dissection is based on the preoperative stratification into low-, intermediate-, or high-risk groups [37].

Preoperative risk stratification is important, because currently there is no imaging modality that can replace surgical staging, given the inability of preoperative imaging to identify small lymph node metastases, which if present will require adjuvant therapy. However, MRI is accurate at identifying two surrogate markers of lymph node metastases (eg, deep myometrial invasion and cervical stromal involvement) [38]. In the absence of these and with low-grade tumors, the risk of lymph node metastases is low [39]. In the presence of these surrogate markers, the likelihood of lymph node metastases is high enough for full surgical staging by gynecological surgeons even for low-grade tumors [9]. The role of sentinel lymph node sampling versus complete lymphadenectomy in this subgroup of patients requires further investigation [13].

High-grade tumors are at risk for extrauterine spread and therefore warrant full surgical staging by gynecological surgeons. The role of imaging in this subgroup may be to identify extrauterine

metastases or spread, which helps plan the surgical approach (eg, minimally invasive surgery versus laparotomy). Laparotomy is the preferred approach when involvement of pelvic or abdominal organs are suspected.

Variant 1: Initial staging of pretreatment endometrial cancer; assessment of local tumor extension for all tumor grades.
A. CT Pelvis

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 EC in the uterus, and therefore its role in evaluating myometrial invasion is limited [40,41]. This is particularly true for small and low risk EC (stage IA). In studies comparing CT with US or MRI, the accuracy of CT for myometrial invasion is reported to be 58% to 61% versus 68% to 69% for US and 88% to 89% for MRI [42]. The benefit 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 study using multidetector CT in the preoperative evaluation of myometrial invasion and cervical extension of EC showed improved diagnostic accuracies of 95% and 81%, respectively [43]. In a recent study evaluating the role of dual-energy CT in detecting deep myometrial invasion in 39 patients with EC, dual-energy CT achieved a sensitivity of 100% (95% CI: 71%–99%), specificity of 91% (75%–100%), and an overall accuracy of 94% (81%–99%) [44]. However, the role of dual-energy CT for staging EC must be further validated.

Variant 1: Initial staging of pretreatment endometrial cancer; assessment of local tumor extension for all tumor grades.
B. MRI Pelvis

Pelvic MRI has long been established as a valuable imaging method in the preoperative staging of EC [45-49]. MRI is preferred over US or CT for pretreatment evaluation because it allows the most accurate evaluation of the extent of pelvic tumor. A meta-analysis showed that the efficacy of contrast-enhanced MRI is significantly better than that of noncontrast MRI and US, and tended toward better results than CT, in evaluating the depth of myometrial invasion in patients with EC [50]. One study found that high-frequency TVUS has similar diagnostic accuracy in the evaluation of both tumor extension into the cervix (92% for high-frequency TVUS versus 85% for MRI) and myometrial invasion (84% for high-frequency TVUS versus 82% for MRI) [51]. However, in patients with an elevated body mass index, in the presence of myomas or adenomyosis, in the setting of bulky tumors, and in the presence of a vertical or retroverted uterine corpus, evaluation of the EC is difficult with TVUS [51].

Disruption of the low signal intensity junctional zone on the T2-weighted images (T2WI) indicates the presence of myometrial invasion. Deep myometrial invasion is diagnosed when the intermediate signal intensity of the tumor involves at least 50% of the myometrial thickness on the T2WI. Dynamic contrast-enhanced MRI performs significantly better than unenhanced MRI for evaluating the depth of myometrial invasion, which is best demonstrated after 50 to 120 seconds postcontrast injection [50,52]. Inner layers of the junctional zone typically enhance on arterial phase [24]. Demonstration of an undisrupted enhancing subendometrial line signifies lack of myometrial involvement [24]. This is a useful sign to rule-out myometrial invasion in postmenopausal patients whose junctional zone is otherwise not well discernible on T2WI [53]. In addition, absence of myometrial invasion as shown by an intact subendometrial line of enhancement is particularly relevant for women wishing to consider fertility-preserving treatment

options.

EC shows restricted diffusion and appears hyperintense on DWI relative to surrounding myometrium. One study showed that the apparent diffusion coefficient (ADC) value of the peritumoral tissue achieved an accuracy similar to the qualitative assessment by experienced readers, 83% versus 76%, respectively [54]. A meta-analysis revealed that the pooled sensitivity and specificity of DWI for detecting deep myometrial invasion were 80.9% and 85.9%, respectively [55]. It was also reported that the diagnostic capability of DWI for deep myometrial invasion improved when it was combined with T2WI (pooled sensitivity: 85.8%, pooled specificity: 94.7%). These results are comparable or superior to the contrast-enhanced MRI, thus DWI can be a potential alternative to patients with compromised kidney functions, in which contrast is contraindicated [46,47,56-61]. An erroneous MRI assessment in evaluating the depth of myometrial invasion can sometimes be caused by a polypoid tumor compressing the myometrium or in the presence of adenomyosis and leiomyomas.

Cervical extension can be diagnosed reliably with an accuracy ranging from 84% to 95% [62-65]. One study showed that MRI yielded significantly higher specificity (91%) and accuracy (84%) than endocervical curettage for preoperative assessment of cervical stromal invasion in EC [63]. Normal cervical stroma appears hypointense on T2WI and provides an excellent contrast to the T2-weighted hyperintensity rendered by the tumoral invasion [24]. Dynamic contrast-enhanced images (with a 180–240 s delay) further enhance the detection of such invasion. More recently, a study comparing the accuracy of DWI and dynamic contrast-enhanced MRI for diagnosing cervical stromal invasion found that DWI achieved a significantly higher area under the receiver operating characteristic curve (AUC) of 0.98 (P = .006) for Reviewer 1 and 0.97 (P = .013) for Reviewer 2 [64]. 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%) [24]. Staging errors in assessing cervical stromal invasion may be caused by edema associated with dilatation and curettage [66].

Studies have not shown any added advantage of using 3T versus 1.5T, and results are comparable for both 3T and 1.5T systems. Advantages of 3T imaging includes improved spectral separation as well as increased signal-to-noise ratios, which can be exploited to acquire images with a higher spatial resolution or decreased image acquisition times. However, 3T images typically have more susceptibility and chemical shift artifacts and greater image inhomogeneity on T2WI [67,68].

Variant 1: Initial staging of pretreatment endometrial cancer; assessment of local tumor extension for all tumor grades.

C. US Pelvis Transvaginal

In a study of 169 consecutive patients with EC, TVUS achieved a 79.5% sensitivity and a 89.6% specificity for detecting deep myometrial invasion were 82% and 81%, respectively [69]. A prospective collaborative trial comparing MRI and US, reported that the accuracy of US is comparable to that provided by MRI [51]. However, US has reported accuracies varying between 77% and 91% [50,51]. A more recent study found that MRI showed greater accuracy than 3-D TVUS or 2-D TVUS (83%, 71%, and 75%, respectively) for myometrial involvement [28]. US is limited in the setting of concomitant benign disease (eg, leiomyomas or adenomyosis) and also for large lesions because of the limited depth of penetration of TVUS. In addition, there are insufficient reports about the benefit of TVUS in predicting cervical extension, parametrical invasion, or lymphadenopathy. Studies have shown that contrast-enhanced US could be useful to diagnose the depth of myometrial invasion using the arcuate vascular plexus involvement as a marker; however,

this needs further validation [31].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).

Most patients with low-grade disease are at low risk of lymph node and distant metastases. In the largest series to date on grade 1 ECs, the incidence of pelvic lymph node involvement, pelvic metastasis, and distant metastasis specific to grade 1 tumors is estimated at 3.3%, 4.6%, and 2.4%, respectively [70].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
A. CT Chest, Abdomen, and Pelvis

Contrast-enhanced CT of the abdomen and pelvis may be employed preoperatively for the detection of lymph node metastases in EC. However, the reported sensitivity of contrast-enhanced CT for pelvic and para-aortic lymphadenopathy is only 29% to 52% [71,72]. If distant metastatic disease is clinically suspected, preoperative assessment of metastatic disease with contrast-enhanced CT is indicated. However, most patients with low-grade disease are at low risk of lymph node and distant metastases. Thus, this group does not require a routine pretreatment evaluation for distant metastases by CT imaging.

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
B. FDG-PET/CT Skull Base to Mid-Thigh

The role of PET in EC imaging is evolving. Recently, a meta-analysis reported that the overall pooled sensitivity, specificity, and accuracy of using FDG-PET/CT for detection of lymph node metastasis in EC was 72.0%, 94.0%, and 88.0%, respectively [73]. Although this meta-analysis found the overall sensitivity of FDG-PET/CT to be moderate for the detection of lymph node metastasis in EC, it compares favorably with the reported sensitivities for lymph node metastasis detection by conventional MRI and CT. However, because 45% of ECs are grade 1 and not particularly FDG-avid, the routine use of FDG-PET in preoperative staging in early stage disease is not recommended, but FDG-PET may be used in patients in which distant metastases is clinically suspected [19,74].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
C. Lymphangiography Pelvis

Lymphangiography pelvis is not helpful for evaluating cancer of the endometrium because 1) it is invasive, and 2) its performance for assessing pelvic lymph nodes is not reproducible and the accuracy is slightly inferior to that of CT and MRI [75].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
D. MRI Pelvis

Evaluation of pelvic and para-aortic lymph nodes with MRI can be performed at the time of local staging with accuracy comparable to CT with a sensitivity of 44% to 66% and a specificity of 73% to 98% [76]. The detection of pelvic lymphadenopathy according to size criteria (>10 mm in the shortest axis) has a low sensitivity (17%–80%), high specificity (93%–100%), and moderate accuracy (83%–90%) [76-78]. Reducing the cut off to 8 mm may further increase the sensitivity but at the cost of decreasing the specificity [76]. Morphological assessment has not been shown to improve prediction of nodal involvement; meanwhile, DWI and ADC mapping may enhance the detection of

metastatic lymph nodes in pelvic malignancies [78]. Recently, it has been shown that metastatic nodes exhibit lower ADC values than the normal nodes, and the average mean and minimum ADC region value (0.87 and 0.74 × 10^{-3} mm^2/s) of metastatic sites were significantly lower than those of nonmetastatic ones (1.07 and 1.02 ×10^{-3} mm^2/s) [79]. However, significant overlap remains between the ADC values of malignant and benign nodes; therefore, DWI cannot be used to reliably detect lymph node metastases, particularly in normal-sized lymph nodes [77,79].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
E. MRI Abdomen

If distant metastasis to other abdominal organs (eg, liver) is clinically suspected, abdominal MRI or CT may be performed. However, patients in this group are at low risk for distant metastases [80].

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
F. US Pelvis Transabdominal

The combination of morphological and vascular patterns of lymph nodes using transabdominal US can be used to differentiate metastatic from normal or reactive nodes [81]. However, visualization of retroperitoneal or iliac lymph nodes can be limited using US because of patient body habitus and overlying bowel gas. Suspicious inguinal lymph nodes can be readily assessed by US and biopsied as needed.

Variant 2: Pretreatment evaluation of endometrial cancer; assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1, 2).
G. US Abdomen

Transabdominal US can be used to detect abdominal organ metastasis. However, most patients with low-grade disease are at low risk of lymph node and distant metastases and thus may not require routine pretreatment evaluation by US imaging.

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).

In a recent series, nodal metastases have been depicted in up to 29% of patients in intermediate- to high-risk categories [82]. In a study of 55 patients with EC with distant metastasis, 47.2% of patients had a type II tumor [83].

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
A. CT Chest, Abdomen, and Pelvis

Contrast-enhanced CT of the abdomen and pelvis may be employed preoperatively for the detection of lymph node metastases in this group. However, the reported sensitivity of contrast-enhanced CT for pelvic and para-aortic lymphadenopathy is only 30% to 57%; meanwhile, the reported specificity of contrast-enhanced CT is 92% to 98% [41,71,72]. If distant metastatic disease is clinically suspected, preoperative assessment of metastatic disease with contrast-enhanced CT is indicated [37].

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
B. FDG-PET/CT Skull Base to Mid-Thigh

Because FDG-PET/CT has a better detectability of lymph node metastasis in EC compared to

conventional MRI and CT, this procedure may be employed preoperatively for this high-grade group [73]. A systematic review revealed the overall pooled sensitivity and specificity of FDG-PET/CT for detection of lymph node metastasis were 72% (95% CI, 0.63–0.80) and 94% (95% CI, 0.93–0.96), respectively [73]. Although surgical staging is a fundamental part of the management of EC, FDG-PET/CT may play an important role in presurgical risk stratification. In addition, it is reported that higher FDG uptake or maximum standardized uptake value (SUV_{max}) of the primary tumors have been correlated with the higher recurrence rates [84]. It has been shown that patients with high SUV_{max} (≥12.7) values had a significantly lower disease-survival rate [84]. If distant metastatic disease is clinically suspected, PET/CT may be used for the preoperative assessment of metastatic disease [18,37,74,85]. Analysis of the ACRIN 6671/GOG 0233 multicenter trial that included 203 patients with high-risk EC revealed a 11.8% prevalence of distant metastases [86]. In this trial, central reader PET/CT detection of distant metastases demonstrated a sensitivity, specificity, positive predictive value, and negative predictive value of 64.6%, 98.6%, 86.1%, and 95.4%, respectively.

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
C. Lymphangiography Pelvis

Lymphangiography pelvis is not recommended for evaluating cancer of the endometrium because 1) it is invasive, and 2) its performance for assessing pelvic lymph nodes is not reproducible and the accuracy is slightly inferior to that of CT and MRI even when performed optimally [75].

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
D. MRI Pelvis

Evaluation of pelvic and para-aortic lymph nodes with MRI can be performed at the time of local staging with accuracy comparable to CT with a sensitivity of 44% to 66% and a specificity of 73% to 98% [76]. The detection of pelvic lymphadenopathy according to size criteria (>10 mm in the shortest axis) has a low sensitivity (17%–80%), high specificity (93%–100%), and moderate accuracy (83%–90%) [76-78]. Reducing the cut off to 8 mm may further increase the sensitivity but at the cost of decreasing the specificity [76]. Morphological assessment has not been shown to improve prediction of nodal involvement; meanwhile, 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 the average mean and minimum ADC region value (0.87 and 0.74 × 10^{-3} mm^2/s) of metastatic sites were significantly lower than those of nonmetastatic ones (1.07 and 1.02 ×10^{-3} mm^2/s) [79]. However, significant overlap remains between the ADC values of malignant and benign nodes; therefore, DWI cannot be used to reliably detect lymph node metastases, particularly in normal-sized lymph nodes [77,79].

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
E. MRI Abdomen

If distant metastasis to other abdominal organs (eg, liver) is clinically suspected, abdominal MRI or CT may be performed.

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
F. US Pelvis Transabdominal

The combination of morphological and vascular patterns of lymph nodes using transabdominal US can be used to differentiate metastatic from normal or reactive nodes [81]. However, there is insufficient data to allow comparison of this procedure to CT or MRI. Nevertheless, visualization of retroperitoneal or iliac lymph nodes is frequently limited using US because of patient body habitus and overlying bowel gas. Suspicious inguinal lymph nodes can be readily assessed by US and biopsied as needed.

Variant 3: Initial staging of pretreatment endometrial cancer; assessment of lymph node and distant metastasis for high-grade tumor (Type I, grade 3 and Type II).
G. US Abdomen

If solid abdominal organ metastatic disease is clinically suspected, then transabdominal US may be used [81].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.

Recurrence rates for low- or intermediate-risk patients with EC are infrequent. Therefore, a recent review of posttreatment surveillance and diagnosis of recurrence in women with gynecologic cancers sponsored by the Society of Gynecologic Oncology recommends that radiologic evaluation be used only to investigate suspicion of recurrent disease because of symptoms or physical exam and not for routine surveillance after treatment [80].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
A. MRI Pelvis

There currently is not sufficient evidence in the literature to recommend routine surveillance by MRI for patients with low- or intermediate-risk EC [80].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
B. MRI Abdomen

MRI may also be used for assessment of metastasis of the liver, adrenals, brain, bones, and soft-tissue when metastases are clinically suspected and need further investigation. However, there is insufficient data to support the routine use of MRI for surveillance of asymptomatic patients [80].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
C. CT Chest, Abdomen, and Pelvis

A review of the literature found that only 5% to 21% of asymptomatic recurrences were detected by CT [87]. Another study reported that the role of CT scanning for asymptomatic patients is not warranted because survival of patients with disease that is detected on CT scan, compared with clinical examination, did not differ significantly [88]. Therefore, the use of routine CT scan is not useful for disease surveillance [19,89].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
D. Radiography Chest

Chest radiographs have been advocated for the detection of asymptomatic chest recurrences, often on a semi-annual or annual basis. However, the rate of detection for asymptomatic chest recurrences found on chest radiographs ranges only from 0% to 20% [87,90]. Thus, this procedure

may not be appropriate for this group.

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
E. US Pelvis Transvaginal

Because many of the recurrences are detected during the physical examination, the use of routine pelvic US is not advocated [21,87].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
F. US Pelvis Transabdominal

Because many of the recurrences are detected during the physical examination, the use of routine pelvic US is not advocated [21,87].

Variant 4: Surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
G. US Abdomen

Because many of the recurrences are detected during the physical examination the use of abdominal US is not advocated [21,87].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer.

Most patients are cured following primary treatment; however, approximately 25% to 30% of patients in this subgroup may develop recurrent disease [91]. Typical metastatic sites of recurrent EC are local pelvic recurrence, pelvic and para-aortic lymph nodes, peritoneum, and lungs [17]. Atypical metastatic sites are extra-abdominal lymph nodes, liver, adrenals, brain, bones, and soft-tissue [17]. Vaginal bleeding is a common symptom of a local recurrence. In patients diagnosed with a distant recurrence, symptoms such as coughing, pain, lethargy, weight loss, or headaches are present in up to 70% of cases [19,20]. In one reported study, the combination of physical examination alone or in combination with symptoms resulted in detection rates of recurrence that exceeded 80% [21].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer.
A. CT Chest, Abdomen, and Pelvis

The evidence supporting routine CT surveillance following EC is insufficient. Even in type II EC, CT scans detected only 15% of recurrences [92]. Chest CT with or without intravenous (IV) contrast may be obtained as a part of posttherapy surveillance in selected high-risk groups or patients with an advanced FIGO stage [81,83,84].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer.
B. MRI Pelvis

Recurrent tumor appears as a mass with high signal intensity on T2WI and intensely enhances following IV contrast administration [93]. MRI has a role in the evaluation of surgical resectability if the pelvis is the sole site of recurrence [36]. However, there is insufficient data to support the routine use of MRI for surveillance of asymptomatic patients [80].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer.
C. MRI Abdomen

MRI may also be used for assessment of metastasis of the liver, adrenals, brain, bones, and soft-tissue when metastases are clinically suspected and need further investigation. However, there is

insufficient data to support the routine use of MRI for surveillance of asymptomatic patients [80].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer. D. Radiography Chest

Chest radiographs have been advocated for the detection of asymptomatic chest recurrences, often on a semi-annual or annual basis. However, the rate of detection for asymptomatic chest recurrences found on chest radiographs ranges only from 0% to 20% [87,90]. Thus, this procedure may be useful when lung metastases are clinically suspected.

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer. E. US Pelvis Transvaginal

Because many of the recurrences are detected during physical examination, the use of routine pelvic is not advocated [21,87].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer. F. US Pelvis Transabdominal

Because many of the recurrences are detected during the physical examination, the use of routine pelvic US is not advocated [21,87].

Variant 5: Surveillance of asymptomatic patients with treated high-risk endometrial cancer. G. US Abdomen

Because many of the recurrences are detected during the physical examination, the use of abdominal US is not advocated [21,87].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

Most patients are cured following primary treatment, and approximately 25% to 30% of patients with high-risk EC may develop recurrent disease [91]. Typical metastatic sites of recurrent EC are local pelvic recurrence, pelvic and para-aortic nodes, peritoneum, and lungs [17]. Atypical metastatic sites are extra-abdominal lymph nodes, liver, adrenals, brain, bones, and soft-tissue [17]. Vaginal bleeding is a common symptom of a local recurrence. In patients diagnosed with a distant recurrence, symptoms such as coughing, pain, lethargy, weight loss, or headaches are present in up to 70% of cases [19,20]. In one reported study, the combination of physical examination alone or in combination with symptoms resulted in detection rates of recurrence that exceeded 80% [21].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.
A. MRI Pelvis

MRI may be indicated in a patient clinically suspected to have local recurrence or distant metastasis [94]. Recurrent tumor appears as a mass with high signal intensity on T2WI and enhances intensely following IV contrast administration [93]. MRI has a role in the evaluation of surgical resectability if the pelvis is the sole site of recurrence [36,95].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.
B. MRI Abdomen

MRI may be indicated in patient clinically suspected to have local recurrence or distant metastasis [94]. Recurrent tumor appears as a mass with high signal intensity on T2WI and enhances intensely following IV contrast administration [93]. MRI may be used for assessment of metastasis of the

liver, adrenals, brain, bones, and soft tissue when metastases are clinically suspected and require further investigation.

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

C. CT Chest, Abdomen, and Pelvis

CT may play a role in the evaluation of patients with symptoms suggestive of recurrence [71]. A study reported that 45 asymptomatic women had routine CT scans, and recurrence was diagnosed by CT in only 2 (4.4%); whereas, 37 symptomatic women had CT scans for suspicion of recurrence, and it was confirmed by CT in 17 (46%) [71].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

D. FDG-PET/CT Skull Base to Mid-Thigh

A recent meta-analysis with over 500 patients showed a sensitivity of 95.8% and specificity of 92.5% with FDG-PET or FDG-PET/CT in detecting recurrent EC [96]. Another study showed that in the detection of recurrence and the evaluation of treatment response, FDG-PET, implemented by CT or MRI, performed better (sensitivity 100%, specificity 88.2%, accuracy 93.3%) than CT or MRI alone (sensitivity 84.6%, specificity 85.7%, accuracy 85%) and tumor markers (eg, CA125, CA19-9, CEA, and sialyl TN antigen; sensitivity 100%, specificity 70.6%, accuracy 83.3%) [97].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

E. Radiography Chest

Chest radiographs have been advocated for the detection of asymptomatic chest recurrences, often on a semi-annual or annual basis. However, the rate of detection for asymptomatic chest recurrences found on chest radiographs ranges only from 0% to 20% [87,90]. Thus, this procedure may be useful when lung metastases are clinically suspected.

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

F. US Pelvis Transvaginal

Detection rates for local recurrence using pelvic US scans range from 4% to 31%. Many of these recurrences, however, were also detected using other diagnostic methods, including physical examination [21,80,87].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

G. US Pelvis Transabdominal

Detection rates for local recurrence using pelvic US scans range from 4% to 31%. Many of these recurrences, however, were also detected using other diagnostic methods, including physical examination [21,80,87].

Variant 6: Posttherapy evaluation of clinically suspected recurrence of known endometrial cancer.

H. US Abdomen

If abdominal organ metastatic disease is clinically suspected, then transabdominal US can be used [81].

Summary of Recommendations

- **Variant 1**: MRI pelvis without and with IV contrast is usually appropriate for the assessment of local tumor extension for all tumor grades in the initial staging of pretreatment endometrial cancer.
- **Variant 2**: MRI pelvis without and with IV contrast, CT chest abdomen pelvis with IV contrast, MRI abdomen without and with IV contrast, MRI pelvis without IV contrast, FDG-PET/CT skull base to mid-thigh and US pelvis transabdominal may be appropriate for the assessment of lymph node and distant metastasis for low-grade tumor (Type I, grade 1,2) in the pretreatment evaluation of endometrial cancer.
- **Variant 3**: CT chest abdomen pelvis with IV contrast or FDG-PET/CT skull base to mid-thigh or MRI pelvis without and with IV contrast is usually appropriate for the assessment of lymph node and distant metastasis for high-grade tumor (Type 1, grade 3 and Type II) in the initial staging of pretreatment endometrial cancer. These procedures are equivalent alternatives (eg, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).
- **Variant 4**: Imaging is not usually appropriate for the surveillance of asymptomatic patients with treated low- or intermediate-risk endometrial cancer.
- **Variant 5**: CT chest abdomen pelvis with IV contrast, CT chest abdomen pelvis without IV contrast, and radiography chest may be appropriate for the surveillance of asymptomatic patients with treated high-risk endometrial cancer.
- **Variant 6**: CT chest abdomen pelvis with IV contrast or FDG-PET/CT skull base to mid-thigh or MRI pelvis without and with IV contrast or MRI abdomen without and with IV contrast is usually appropriate for the posttherapy evaluation of clinically suspected recurrence of known endometrial cancer. These procedures are equivalent alternatives (eg, only one procedure will be ordered to provide the 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, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

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 [98].

Relative Radiation Level Designations		
Relative Radiation Level*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	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."		

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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.

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