RAYUS QUALITY INSTITUTE

ADVANCED IMAGING GUIDE FOR REFERRING PROVIDERS

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INTRODUCTION

The material in this ordering guide was developed by the RAYUS Quality Institute's Provider Led Entity (PLE). The PLE was qualified in 2016 by the Centers for Medicare and Medicaid to develop appropriate use criteria for traditional Medicare (Part B) patients. Clinical topic areas were developed in collaboration with national subject experts and approved by the PLE's multidisciplinary committee. To the extent feasible, recommendations throughout this document are evidence-based.

Recommendations are largely for the specific use of advanced imaging. While recommendations for conventional radiography and/or ultrasound may also be appropriate, they are not always specified within this document.

Primary recommendation ●**:** Strong recommendation for imaging. There is confidence that thedesirable effects of imaging outweigh its undesirable effects.

Alternative recommendation ●**:** Conditional recommendation for imaging. The desirable effects of imaging likely outweigh its undesirable effects, although some uncertainty may exist. Alternative imaging recommendations may be indicated with a contraindication to the primary recommendation, inspecific clinical scenarios, or when the primary recommendation results are inconclusive or incongruentwith the patient's clinical diagnosis. Specific conditions are noted in brackets, where applicable.

Recommendation against imaging ●**:** The test may not be accurate, may not be reliable, or the undesirable effects of imaging outweigh any desirable effects. Additionally, the recommendation maybe impractical or not feasible in the targeted population and/or practice setting(s).

While this document is intended to be a helpful guide for referring clinicians, it does not replace clinician experience and expertise in light of the clinical presentation and specific circumstances of the patient.

If an advanced imaging modality is not listed for a given scenario, it should generally be treated as a recommendation against imaging (red).

This document provides a listing of some of the most common scenarios for a clinical topic area, but is not meant to represent a complete list.

If more than one primary or alternative recommendation is listed for a clinical topic area, clinician preference, patient safety, and feasibility should all be taken into consideration. Alternative recommendations may have bracketed language to consider for situational use.

A complete listing of appropriate use criteria, along with bibliography materials, can be found at **www.rayusradiology.com/ple**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH HEADACHE

1. Primary or chronic headache (e.g., migraine, tension-type headache, medication overuse/rebound headache) *without* a change in pattern, neurological signs/symptoms, or other red flag features:

   - 🔴 – **MRI**
   - 🔴 – **CT**
   - 🔴 – **MRA** or **CTA**
   - 🔴 – **MRV** or **CTV**
   - 🔴 – **PET**
   - 🔴 – **SPECT**

2. Headache with any of the following:
   - Atypical features,
   - Abrupt increase in frequency or severity,
   - Abrupt pattern change,
   - Neurologic signs/symptoms,
   - Seizures,
   - New onset after age 50,
   - Increased intracranial pressure.

   - 🟢 – **MRI head without IV contrast** or **MRI head without and with IV contrast**
   - 🟡 – **MRI head with IV contrast**
     [*characterize abnormalities seen on previous MRI head without IV contrast*]
   - 🟡 – **CT head without IV contrast** [*suspicion of hemorrhage; or patient unable to undergo MRI*]
   - 🟡 – **CT head with IV contrast**
     [*characterize abnormalities seen on previous CT head without IV contrast*]
   - 🟡 – **MRA head (**with or without **MRA neck) or CTA head (**with or without **CTA neck)**
     [*suspected cranial or cervical vascular disorder*]
   - 🟡 – **MRV head** or **CTV head** [*suspected cranial or cervical vascular disorder*]
   - 🔴 – **SPECT**
   - 🔴 – **PET**

3. Sudden onset of severe headache:

   - 🟢 – **CT head without IV contrast**
   - 🟢 – **CTA head (**with or without **CTA neck)** or **MRA head (**with or without **MRA neck)**
   - 🟡 – **CT head with IV contrast**
     [*characterize abnormalities detected on previous CT head without IV contrast*]
   - 🟡 – **MRI head without IV contrast** or **MRI head without and with IV contrast**
   - 🟡 – **MRI head with IV contrast**
     [*characterize abnormalities seen on previous MRI brain without IV contrast*]
   - 🟡 – **MRV head** or **CTV head** [*suspected cranial or cervical vascular disorder*]
   - 🔴 – **SPECT**
   - 🔴 – **PET**

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4. **New headache or change in headaches in a cancer patient or immunocompromised patient:**

- 🟢 – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- 🟡 – **MRI brain with IV contrast**
  [*characterize abnormalities seen on previous MRI head without IV contrast*]
- 🟡 – **CT head without IV contrast** [*suspicion of hemorrhage; or patient unable to undergo MRI*]
- 🟡 – **CT head with IV contrast** [*characterize abnormalities seen on previous CT head without IV contrast*]
- 🟡 – **MRA head (**with or without **MRA neck) or CTA head (**with or without **CTA neck)**
  [*suspected cranial or cervical vascular disorder*]
- 🟡 – **MRV head** or **CTV head** [*suspected cranial or cervical vascular disorder*]
- 🟡 – **FDG-PET** or **Thallium 201 SPECT** [*differentiate tumor from infection*]

5. **Trigeminal autonomic cephalgia (cluster headache, SUNCT/SUNA, paroxysmal hemicrania):**

- 🟢 – **MRI head without and with IV contrast**
- 🟡 – **MRI head without IV contrast**
- 🟡 – **MRI head with IV contrast**
  [*characterize abnormalities seen on previous MRI head without IV contrast*]
- 🟡 – **CT head without IV contrast** [*suspicion of hemorrhage; or patient unable to undergo MRI*]
- 🟡 – **CT head with IV contrast** [*characterize abnormalities seen on previous CT head without IV contrast*]
- 🟡 – **MRA head (**with or without **MRA neck) or CTA head (**with or without **CTA neck)**
  [*suspected cranial or cervical vascular disorder*]
- 🟡 – **MRV head** or **CTV head** [*suspected cranial or cervical vascular disorder*]
- 🔴 – **SPECT**
- 🔴 – **PET**

6. **Suspected low CSF pressure/orthostatic headache:**

- 🟢 – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- 🟡 – **MRI head with IV contrast**
  [*characterize abnormalities seen on previous MRI brain without IV contrast*]
- 🟡 – **CT head without IV contrast** [*patient unable to undergo MRI*]
- 🟡 – **CT head with IV contrast**
  [*characterize abnormalities seen on previous CT head without IV contrast*]
- 🟡 – **MRI spine with and/or without IV contrast**
- 🟡 – **MR myelography spine** or **CT myelography spine**
- 🔴 – **MRA** or **CTA**
- 🔴 – **MRV** or **CTV**
- 🔴 – **SPECT**
- 🔴 – **PET**

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7. **Headache precipitated by cough:**

- 🟢 – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- 🟡 – **MRI head with IV contrast**
  [*characterize abnormalities seen on previous MRI head without IV contrast*]
- 🟡 – **CT head without IV contrast** [*suspicion of hemorrhage; or patient unable to undergo MRI*]
- 🟡 – **CT head with IV contrast**
  [*characterize abnormalities seen on previous CT head without IV contrast*]
- 🟡 – **MRA head (**with or without **MRA neck)** or **CTA head (**with or without **CTA neck)**
  [*suspected cranial or cervical vascular disorder*]
- 🔴 – **MRV** or **CTV**
- 🔴 – **SPECT**
- 🔴 – **PET**

8. **Persistent (subacute or chronic) headache attributed to traumatic injury to the head:**

- 🟢 – **MRI head without IV contrast** or **MRI head without and with IV contrast**
- 🟢 – **CT head without IV contrast**
- 🟡 – **CT head with IV contrast**
  [*characterize abnormalities detected on previous CT head without IV contrast*]
- 🟡 – **MRI head with IV contrast**
  [*characterize abnormalities detected on previous MRI head without IV contrast*]
- 🔴 – **MRA** or **CTA**
- 🔴 – **MRV** or **CTV**
- 🔴 – **SPECT**
- 🔴 – **PET**

APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH BACK/NECK PAIN

1. **Back/neck pain and/or radiculopathy with no red flags or complicating features; patients has not completed an appropriate period (≥ 4-6 weeks) of conservative therapy:**

- 🔴 – **MRI**
- 🔴 – **CT or CT myelography**
- 🔴 – **Bone scan, SPECT, SPECT/CT**
- 🔴 – **PET or PET/CT**
- 🔴 – **Gallium scan**

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2. **Back/neck pain (without radiculopathy) with failure of conservative therapy and/or when injection therapy or surgery is planned:**

   - 🟢 – **MRI spine without IV contrast**
   - 🟢 – **MRI spine without and with IV contrast**
   - 🟡 – **MRI spine with IV contrast**
     [further evaluate abnormalities previously noted on noncontrast imaging]
   - 🟡 – **CT spine without IV contrast** or **CT myelography spine**
     [MRI contraindicated or findings non-diagnostic; intervention planning; further evaluate or characterize bone lesion or fracture)]
   - 🟡 – **Bone scan**, **SPECT**, **SPECT/CT** *[further evaluate or characterize bone lesion or fracture]*
   - 🔴 – **PET or PET/CT**
   - 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

3. **Cervical or lumbar radiculopathy with failure of conservative therapy and/or when injection therapy or surgery is planned:**

   - 🟢 – **MRI spine without IV contrast**
   - 🟢 – **MRI spine without and with IV contrast**
   - 🟡 – **MRI spine with IV contrast**
     [further evaluate abnormalities previously noted on noncontrast imaging]
   - 🟡 – **CT spine without IV contrast** or **CT myelography spine**
     [*MRI contraindicated or findings non-diagnostic; intervention planning*]
   - 🔴 – **Bone scan**, **SPECT**, **SPECT/CT**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

4. **Lumbar spinal stenosis with failure of conservative therapy and/or when injection therapy or surgery is planned:**

   - 🟢 – **MRI lumbar spine without IV contrast**
   - 🟢 – **MRI lumbar spine without and with IV contrast**
   - 🟡 – **MRI lumbar spine with IV contrast**
     [further evaluate abnormalities previously noted on noncontrast imaging]
   - 🟡 – **CT lumbar spine without IV contrast** or **CT myelography lumbar spine**
     [*MRI contraindicated or findings non-diagnostic; intervention planning*]
   - 🔴 – **Bone scan**, **SPECT**, **SPECT/CT**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

5. **Back/neck pain and/or radiculopathy with suspicion of cancer:**

   - 🟢 – **MRI spine without IV contrast**
   - 🟢 – **MRI spine without and with IV contrast**
   - 🟡 – **MRI spine with IV contrast**
     [further evaluate abnormalities previously noted on noncontrast imaging]

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- 🟡 – **CT spine without IV contrast** or **CT myelography spine** [*MRI contraindicated or findings non-diagnostic; intervention planning; further evaluate or characterize bone lesion(s)*]
- 🟡 – **Bone scan, SPECT**, **SPECT/CT** [*further evaluate or characterize bone lesion(s)*]
- 🟡 – **PET** or **PET/CT** [*further evaluate or characterize bone lesion(s)*]
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

6. **Back/neck pain and/or radiculopathy with suspicion of infection:**

- 🟢 – **MRI spine without IV contrast**
- 🟢 – **MRI spine without and with IV contrast**
- 🟡 – **MRI spine with IV contrast** *[further evaluate abnormalities previously noted on noncontrast imaging]*
- 🟡 – **CT spine without and/or with IV contrast** or **CT myelography spine** [*MRI contraindicated or findings non-diagnostic; intervention planning*]
- 🟡 – **Bone scan, SPECT, SPECT/CT** *[MRI contraindicated or findings non-diagnostic]*
- 🟡 **– Gallium scan whole body** [with or without **SPECT** or **SPECT/CT**] *[MRI contraindicated or findings non-diagnostic]*
- 🔴 – **PET** or **PET/CT**

7. **Back/neck pain with major or progressive neurologic deficits, bowel or bladder dysfunction, numbness, and/or difficulty with coordination or balance:**

- 🟢 – **MRI spine without IV contrast**
- 🟢 – **MRI spine without and with IV contrast**
- 🟡 – **MRI spine with IV contrast** *[further evaluate abnormalities previously noted on noncontrast imaging]*
- 🟡 – **CT spine without IV contrast** or **CT myelography spine** [*MRI contraindicated or findings non-diagnostic; intervention planning*]
- 🔴 – **Bone scan**, **SPECT**, **SPECT/CT**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

8. **Back/neck pain with suspected fragility or insufficiency fracture:**

- 🟢 – **MRI spine without IV contrast**
- 🟡 – **MRI spine without and with IV contrast**
- 🟡 – **CT spine without IV contrast**
- 🟡 – **MRI spine with IV contrast** *[further evaluate abnormalities previously noted on noncontrast imaging]*
- 🟡 – **Bone scan**, **SPECT**, **SPECT/CT** [*MRI contraindicated or findings non-diagnostic; further evaluate or characterize bone lesion(s)*]
- 🟡 – **PET** or **PET/CT** [*further evaluate or characterize bone lesion(s)*]
- 🔴 – **CT myelography**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

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9. **History of spinal surgery with new or progressive symptoms, suspicion of device or hardware failure, and/or when injection therapy or surgery is planned:**

- ● – **MRI spine without IV contrast**
- ● – **MRI spine without and with IV contrast**
- ● – **CT spine without IV contrast**
- ● – **MRI spine with IV contrast** *[further evaluate abnormalities previously noted on noncontrast imaging]*
- ● – **CT myelography spine** [*MRI contraindicated or findings non-diagnostic; surgical planning*]
- ● – **Bone scan, SPECT**, **SPECT/CT** [*further evaluate or characterize bone lesion(s)*]
- ● – **PET** or **PET/CT**
- ● – **CT with IV contrast** or **CT without and with IV contrast**

APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH STROKE-RELATED CONDITIONS

1. **Physical findings, radiographic signs, and/or risk factors suggestive of carotid artery stenosis in an otherwise asymptomatic patient:**

- ● – **Duplex carotid ultrasound**
- ● – **MRA neck** *[any of the following]*
  - *further characterize hemodynamically significant carotid artery stenosis detected or suspected on duplex carotid ultrasound*
  - *in patients with nondiagnostic duplex carotid ultrasound*
  - *when ultrasound is not available*
- ● – **CTA neck** *[any of the following]*
  - *further characterize hemodynamically significant carotid artery stenosis detected or suspected on duplex carotid ultrasound*
  - *in patients with nondiagnostic duplex carotid ultrasound*
  - *when ultrasound is not available*
- ● – **MRA head** *[patients with established carotid artery stenosis **and** who are being evaluated for carotid stenting]*
- ● – **CTA head** *[patients with established carotid artery stenosis **and** who are being evaluated for carotid stenting]*
- ● – **CT perfusion** or **MR perfusion**
- ● – **CT venography** or **MR venography**
- ● – **CT head** or **MRI head**

2. **Suspected transient ischemic attack (TIA):**

Carotid (extracranial) imaging:

- ● – **Duplex carotid ultrasound**
- ● – **MRA neck**
- ● – **CTA neck** *[patient unable to undergo MRI]*

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Brain (intracranial) imaging:

- 🟢 – **CT head**
- 🟢 – **MRI head (diffusion-weighted imaging and gradient recalled imaging or susceptibility-weighted imaging)**
- 🟡 – **CT perfusion head** *[patient unable to undergo MRI]*
- 🟡 – **MRA head** *[either of the following]*
  - *extracranial source of ischemia is not identified*
  - *intervention for significant carotid stenosis detected by carotid duplex ultrasound planned*
- 🟡 – **CTA head** *[either of the following]*
  - *unable to undergo MRI **and** extracranial source of ischemia is not identified, or*
  - *unable to undergo MRI **and** intervention for significant carotid stenosis detected by carotid duplex ultrasound planned*
- 🔴 – **CT venography** or **MR venography**
- 🔴 – **MR perfusion**

3. **Suspected acute stroke within the treatment window for thrombolytic or endovascular therapy:**
   - 🟢 – **CT head**
   - 🟢 – **MRI head** *(diffusion-weighted imaging and gradient recalled imaging or susceptibility-weighted imaging)*
   - 🟢 – **CTA head and/or neck**
   - 🟡 – **MRA head and/or neck**
   - 🟡 – **CT perfusion head**
   - 🟡 – **MR perfusion head**
   - 🟡 – **Duplex carotid ultrasound**
   - 🔴 – **CT venography** or **MR venography**

4. **Suspected stroke in patients who are not candidates for thrombolytic or endovascular therapy or confirmed stroked in patients after thrombolytic or endovascular therapy for risk stratification/secondary prevention:**

   Brain (intracranial) imaging:
   - 🟢 – **CT head**
   - 🟢 – **MRI head** *(diffusion-weighted imaging and gradient recalled imaging or susceptibility-weighted imaging)*
   - 🟡 – **CTA head**
   - 🟡 – **CT venography**
   - 🟡 – **MRA head**
   - 🟡 – **MR venography**
   - 🔴 – **CT perfusion** or **MR perfusion**

   Carotid (extracranial) imaging:
   - 🟢 – **CTA neck**
   - 🟢 – **MRA neck**
   - 🟡 – **Duplex carotid ultrasound**

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5. **Follow-up of extracranial carotid artery disease treated with carotid endarterectomy or stenting:**

- 🟢 – **Duplex carotid ultrasound**
- 🟡 – **MRA neck** *(either of the following)*
  - *ultrasound is not available*
  - *nondiagnostic or inconclusive ultrasound*
- 🟡 – **CTA neck** *(either of the following)*
  - *ultrasound is not available, or*
  - *nondiagnostic or inconclusive ultrasound*
- 🔴 – **CT perfusion** or **MR perfusion**
- 🔴 – **CTA head** or **MRA head**
- 🔴 – **CT venography** or **MR venography**
- 🔴 – **CT head** or **MRI head**

APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH SINUSITIS

1. **Acute uncomplicated sinusitis (typically defined as ≤ 4 weeks):**

- 🔴 – **MRI**
- 🔴 – **CT**
- 🔴 – **CTA or MRA**

2. **Recurrent acute sinusitis (i.e., ≥ 4 annual episodes of acute bacterial sinusitis):**

- 🟢 – **CT paranasal sinuses without IV contrast**
- 🟢 – **CT cone beam paranasal sinuses without IV contrast**
- 🔴 – **CT without and with IV contrast; CT with IV contrast**
- 🔴 – **MRI**
- 🔴 – **CTA or MRA**

3. **Chronic uncomplicated sinusitis (typically defined as ≥ 12 weeks):**

- 🟢 – **CT paranasal sinuses without IV contrast**
- 🟢 – **CT cone beam paranasal sinuses without IV contrast**
- 🟡 – **MRI orbit, face & neck**
- 🟡 – **CT paranasal sinuses with IV contrast**
- 🔴 – **CT without and with IV contrast**
- 🔴 – **CTA or MRA**

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4. **Pre-operative evaluation for routine functional endoscopic sinus surgery:**

- 🟢 – **CT paranasal sinuses without IV contrast**
- 🟢 – **CT cone beam paranasal sinuses without IV contrast**
- 🔴 – **CT without and with IV contrast; CT with IV contrast**
- 🔴 – **MRI**
- 🔴 – **CTA or MRA**

5. **Diagnosis of complication of sinusitis:**

- 🟢 – **CT paranasal sinuses without IV contrast**
- 🟢 – **CT orbits without IV contrast**
- 🟢 – **CT orbits with IV contrast**
- 🟢 – **MRI orbit, face & neck without and with IV contrast**
- 🟡 – **MRI orbit, face & neck without IV contrast** *[patient unable to receive IV contrast]*
- 🟡 – **MRI orbit, face & neck with IV contrast** *[patient with recent corresponding MRI without IV contrast]*
- 🟡 – **CT paranasal sinuses with IV contrast** *[patient unable to undergo MRI]*
- 🟢 – **MRI head without and with IV contrast**
- 🟡 – **MRI head without IV contrast** *[patient unable to receive IV contrast]*
- 🟡 – **MRI head with IV contrast** *[patient with recent corresponding MRI without IV contrast]*
- 🟡 – **CT head without and/or with IV contrast** *[patient unable to undergo MRI]*
- 🟡 – **CTA head or MRA head** *[evaluate for suspected vascular complications]*
- 🔴 – **CT (sinuses/orbits) without and with IV contrast**

APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH NEUROCOGNITIVE DISORDERS

4. **Mild Cognitive Impairment (MCI):**

- 🟢 – **MRI head without IV contrast**
- 🟡 – **CT head without IV contrast**
- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast**
  [characterize abnormalities seen on previous noncontrast imaging]
- 🟡 – **Amyloid PET** or **FDG-PET**
  [in atypical cases or when an Alzheimer's dementia subtype is suspected, and all of the following apply:
  - *At specialist request*
  - *All other tests (history, physical, structural imaging, lab testing) are inconclusive*
  - *Other diagnoses have bene excluded by MRI or CT*
  - *The results of testing will change management]*
- 🟡 – **MRI head without and with IV contrast** or **CT head without and with IV contrast** *[concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]*
- 🔴 – **SPECT**

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5. **Possible Alzheimer's disease (e.g., atypical course or etiologically mixed presentation) or suspected frontotemporal dementia (FTD) spectrum disorder:**

- 🟢 – **MRI head without IV contrast**
- 🟡 **– CT head without IV contrast**
- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast** *[characterize abnormalities seen on previous noncontrast imaging]*
- 🟡 **– Amyloid PET** or **FDG-PET**
  [in atypical cases or to differentiate Alzheimer's disease from frontotemporal dementia, and all of the following apply:
  - *At specialist request*
  - *All other tests (history, physical, structural imaging, lab testing) are inconclusive*
  - *Other diagnoses have bene excluded by MRI or CT*
  - *The results of testing will change management]*
- 🟡 – **Perfusion SPECT**
  [in atypical cases or to differentiate Alzheimer's disease from frontotemporal dementia, and all of the following apply:
  - *At specialist request*
  - *All other tests (history, physical, structural imaging, lab testing) are inconclusive*
  - *Other diagnoses have bene excluded by MRI or CT*
  - *The results of testing will change management*
  - *PET imaging is not available]*
- 🟡 **– MRI head without and with IV contrast** or **CT head without and with IV contrast**
  [concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]
- 🔴 – **Dopaminergic SPECT**

6. **Probable Alzheimer's disease:**

- 🟢 – **MRI head without IV contrast**
- 🟡 **– CT head without IV contrast**
- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast**
  [characterize abnormalities seen on previous noncontrast imaging]
- 🟡 **– MRI head without and with IV contrast** or **CT head without and with IV contrast**
  [concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]
- 🟡 **– Amyloid PET**
  [in cases with atypical presentation, and all of the following apply:
  - *At specialist request*
  - *All other tests (history, physical, structural imaging, lab testing) are inconclusive*
  - *Other diagnoses have bene excluded by MRI or CT*
  - *The results of testing will change management]*
- 🔴 – **FDG-PET**
- 🔴 – **SPECT**

7. **Suspected dementia with Lewy bodies:**

- 🟢 – **MRI head without IV contrast**
- 🟡 **– CT head without IV contrast**

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- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast**
  [characterize abnormalities seen on previous noncontrast imaging]
- 🟡 – **Dopaminergic SPECT**
  [distinguish dementia with Lewy bodies from (PCA variant) Alzheimer's disease when clinical criteria are non-diagnostic]
- 🟡 – **Perfusion SPECT**
  [distinguish dementia with Lewy bodies from (PCA variant) Alzheimer's disease when clinical criteria are non-diagnostic and DAT SPECT is not available or is non-diagnostic]
- 🟡 – **Cardiac scintigraphy**
  [distinguish dementia with Lewy bodies from (PCA variant) Alzheimer's disease when clinical criteria are non-diagnostic and DAT SPECT is not available or is non-diagnostic]
- 🟡 – **FDG-PET**
  [distinguish dementia with Lewy bodies from (PCA variant) Alzheimer's disease when clinical criteria are non-diagnostic and DAT SPECT is not available or is non-diagnostic]
- 🟡 **– MRI head without and with IV contrast** or **CT head without and with IV contrast**
  [concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]
- 🔴 – **Amyloid PET**

8. Suspected vascular dementia:

- 🟢 – **MRI head without IV contrast**
- 🟡 **– CT head without IV contrast**
- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast**
  [characterize abnormalities seen on previous noncontrast imaging
- 🟡 **– MRI head without and with IV contrast** or **CT head without and with IV contrast**
  [concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]
- 🔴 – **PET**
- 🔴 – **SPECT**

9. Suspected normal pressure hydrocephalus:

- 🟢 – **MRI head without IV contrast**
- 🟡 **– CT head without IV contrast**
- 🟡 – **MRI head with IV contrast** or **CT head with IV contrast**
  [characterize abnormalities seen on previous noncontrast imaging]
- 🟡 **– MRI head without and with IV contrast** or **CT head without and with IV contrast**
  [concern for intracranial neoplasm, infection, or inflammatory disease, or when there is rapid neurological decline]
- 🟡 **– DTPA cisternography with SPECT/CT**
  [at specialist request when all other tests are inconclusive and results will change management]
- 🟡 **– Perfusion SPECT**
  [at specialist request when all other tests are inconclusive and results will change management]
- 🟡 **– Dopaminergic SPECT**
  [at specialist request when all other tests are inconclusive and results will change management]
- 🔴 – **Amyloid PET**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH ANKLE/HINDFOOT PAIN

1. **Acute ankle and/or hindfoot injury with suspected structural derangement, no fracture or alignment abnormality on radiographs, and either of the following:**
   - **Significant pain with disability or deformity**
   - **Pre-surgical planning**

   🟡 **– MRI without IV contrast**
   🟡 – **CT without IV contrast**
   🔴 – **MRI without and with IV contrast**
   🔴 – **CT with IV contrast** or **CT without and with IV contrast**
   🔴 – **MR arthrography** or **CT arthrography**
   🔴 – **Bone scan**
   🔴 - **SPECT**

2. **Acute ankle and/or hindfoot injury with fracture or alignment abnormality on radiographs, and either of the following:**
   - **Further assessment of fracture and/or associated abnormalities**
   - **Pre-surgical planning**

   🟢 – **CT without IV contrast**
   🟢 **– MRI without IV contrast**
   🔴 – **MRI without and with IV contrast**
   🔴 – **CT with IV contrast** or **CT without and with IV contrast**
   🔴 – **MR arthrography** or **CT arthrography**
   🔴 – **Bone scan**
   🔴 – **SPECT**

3. **Acute ankle and/or hindfoot pain with suspicion for stress, insufficiency, or occult fracture, and non-diagnostic radiographs:**

   🟢 **– MRI without IV contrast**
   🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
   [previous findings on MRI are non-diagnostic; patient unable to undergo MRI – not recommended for use in the acute phase for diagnosis of occult fracture]
   🟡 – **CT without IV contrast**
   [previous findings on MRI are non-diagnostic; patient unable to undergo MRI]
   🔴 – **MRI without and with IV contrast**
   🔴 – **CT with IV contrast** or **CT without and with IV contrast**
   🔴 – **MR arthrography** or **CT arthrography**

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4. **Nontraumatic ankle and/or hindfoot pain persisting after an appropriate trial (> 4-6 weeks) of conservative care, and no osteoarthritis or major abnormalities on radiographs:**

- 🟢 **– MRI without IV contrast**
- 🟡 – **CT without IV contrast** *[patient unable to undergo MRI]*
- 🟡 – **MR arthrography** or **CT arthrography**
  [assess for instability, cartilage abnormality, intra-articular bodies, or impingement]
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
  [previous findings on MRI are non-diagnostic; patient unable to undergo MRI]
- 🔴 – **MRI without and with IV contrast**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**
- 🔴 – **MR arthrography** or **CT arthrography**

5. **Osteoarthritis of the ankle and/or hindfoot on conventional radiography with any of the following:**
   - **New-onset severe pain**
   - **Significant worsening of symptoms**
   - **Pain that is disproportionate to findings on repeat radiography**
   - **Pre-surgical planning**

- 🟢 **– MRI without IV contrast**
- 🟢 – **CT without IV contrast**
- 🟡 – **MR arthrography** or **CT arthrography** *[pre-surgical planning]*
- 🔴 – **MRI without and with IV contrast**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

6. **Ankle and/or hindfoot pain with suspicion for osteochondral defect of subchondral osteonecrosis (avascular necrosis) following radiographs:**

- 🟢 **– MRI without IV contrast**
- 🟡 – **MRI without and with IV contrast**
- 🟡 – **CT without IV contrast** *[patient unable to undergo MRI]*
- 🟡 – **MR arthrography** or **CT arthrography** *[assess for instability, cartilage abnormality, or intra-articular bodies]*
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**] *[previous findings on MRI are non-diagnostic; patient unable to undergo MRI]*
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

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7. **Suspicion for ankle and/or hindfoot septic arthritis, osteomyelitis, or Charcot arthropathy and non-diagnostic radiographs:**

- 🟢 – **MRI without and with IV contrast**
- 🟢 – **MRI without IV contrast**
- 🟡 – **CT with IV contrast**
- 🟡 – **CT without IV contrast**
- 🟡 – **Bone scan** [with or without **sulfur colloid marrow scan** and/or **SPECT** or **SPECT/CT**]
  [previous findings on MRI are non-diagnostic; patient unable to undergo MRI]
- 🟡 – **FDG-PET** or **PDG-PET/CT**
  [patient unable to undergo MRI; findings on previous MRI are non-diagnostic]
- 🔴 – **CT without and with IV contrast**
- 🔴 – **MR arthrography** or **CT arthrography**

8. **Ankle and/or hindfoot pain with suspicion for foreign body; radiographs and/or ultrasound are non-diagnostic:**

- 🟢 – **CT without IV contrast**
- 🟡 – **MRI without IV contrast**
- 🟡 – **MRI without and with IV contrast**
- 🟡 – **CT with IV contrast** or **CT without and with IV contrast** *[patient unable to undergo MRI]*
- 🔴 – **Bone scan**
- 🔴 – **SPECT**
- 🔴 – **MR arthrography** or **CT arthrography**

APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH HIP PAIN

1. **Hip, buttock, or thigh pain with suspected stress, fragility, or occult fracture of the hip; radiographs normal or non-diagnostic:**

- 🟢 – **MRI hip without IV contrast**
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
  [further evaluate non-diagnostic findings on recent MRI; patient unable to undergo MRI]
- 🟡 – **CT hip without IV contrast**
  [further evaluate non-diagnostic findings on recent MRI; patient unable to undergo MRI; patient has increased or equivocal uptake on previous bone scan; evaluation of healing is necessary]
- 🔴 – **MRI hip without and with IV contrast**
- 🔴 – **CT hip without and with IV contrast** or **CT hip with IV contrast**
- 🔴 – **MR arthrography** or **CT arthrography**

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2. **Hip pain with suspected labral tear:**

- 🟢 – **MRI hip without IV contrast**
- 🟢 – **MR arthrography hip**
- 🟡 – **CT arthrography hip** *[patient unable to undergo MRI]*
- 🟡 – **CT bilateral hips without IV contrast** (with 3D reformations) *[pre-surgical planning is necessary]*
- 🔴 – **MRI hip without and with IV contrast**
- 🔴 – **CT hip without and with IV contrast** or **CT hip with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

3. **Hip pain with suspected periarticular tendinopathy, tendon tear, and/or bursitis:**

- 🟢 – **MRI hip without IV contrast**
- 🟢 – **Ultrasound hip**
- 🟡 – **CT hip without IV contrast**
  [patient unable to undergo MRI and ultrasound expertise is not available]
- 🔴 – **MRI hip without and with IV contrast**
- 🔴 – **CT hip without and with IV contrast** or **CT hip with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

4. **Osteoarthritis of the hip on conventional radiography with any of the following:**
   - **New-onset severe pain**
   - **Significant worsening of symptoms**
   - **Pain that is disproportionate to findings on repeat radiography**
   - **Pre-surgical planning**

- 🟢 **– MRI hip without IV contrast**
- 🟡 – **CT hip without IV contrast** *[unable to undergo MRI]]*
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**] *[unable to undergo MRI]*
- 🟡 – **CT arthrography** *[pre-surgical planning]]*
- 🔴 – **MR arthrography**
- 🔴 – **MRI without and with IV contrast**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

5. **Unexplained pain (hip, groin, buttock, thigh, knee) of suspected hip etiology that is unresponsive to 4-6 weeks of conservative therapy; radiographs normal or nondiagnostic:**

- 🟢 – **MRI hip without IV contrast**
- 🟡 – **MR arthrography hip**
- 🟡 – **CT arthrography hip** *[patient unable to undergo MRI]*

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- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
  [further evaluate non-diagnostic findings on recent noncontrast MRI; or patient unable to undergo MRI]
- 🟡 – **CT hip without IV contrast** *[unable to undergo MRI; or pre-surgical planning is necessary; or increased or equivocal uptake on previous bone scan]*
- 🔴 – **MRI without and with IV contrast**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

Hip pain with suspected avascular necrosis (osteonecrosis):

- 🟢 – **MRI hip without IV contrast**
- 🟡 – **MRI hip with IV contrast** or **MRI hip without and with IV contrast**
  [further evaluate non-diagnostic findings on recent MRI without IV contrast]
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**] *[patient unable to undergo MRI]*
- 🟡 – **CT bilateral hips without IV contrast**
  [patient unable to undergo MRI; or pre-surgical planning is necessary]
- 🔴 – **MR arthrography** or **CT arthrography**
- 🔴 – **CT with IV contrast** or **CT without and with IV contrast**

6. **Hip pain clinical and/or radiological suspicion for septic arthritis, osteomyelitis, and/or periarticular abscess:**

- 🟢 – **MRI hip without IV contrast** or **MRI hip without and with IV contrast**
- 🟡 – **MRI hip with IV contrast**
  [further evaluate non-diagnostic findings on recent MRI without IV contrast]
- 🟡 – **CT hip** *[patient unable to undergo MRI]*
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**] *[patient unable to undergo MRI]*
- 🟡 – **White Blood Cell (WBC) scan** [with or without **SPECT** or **SPECT/CT**] *[patient unable to undergo MRI]*
- 🔴 – **MR arthrography** or **CT arthrography**

7. **Hip pain with an indeterminate or aggressive bone lesion noted on radiographs:**

- 🟢 – **MRI hip without IV contrast** or **MRI hip without and with IV contrast**
- 🟡 – **MRI hip with IV contrast**
  [further evaluate non-diagnostic findings on recent MRI without IV contrast]
- 🟡 – **CT hip without IV contrast** or **CT hip without and with IV contrast**
  [patient unable to undergo MRI; pre-surgical planning is necessary]
- 🟡 – **Whole-body bone scan** [with or without **SPECT** or **SPECT/CT**]
  [further evaluate possible metastatic lesion(s)]
- 🟡 – **PET or PET/CT** *[further evaluate possible metastatic lesion(s)]*
- 🔴 – **MR arthrography** or **CT arthrography**
- 🔴 – **CT hip with IV contrast**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH KNEE PAIN

1. **Knee pain with suspected structural derangement after an acute injury:**

   - 🟢 – **MRI knee without IV contrast**
   - 🟡 – **CT arthrography knee** *[unable to undergo MRI]*
   - 🟡 – **CT knee without IV contrast** *[further characterize or evaluate healing of known fracture]*
   - 🟡 – **MR arthrography knee**
     [previous meniscal repair and/or ACL reconstruction]
   - 🟡 – **CT angiography** or **MR angiography of the lower extremities**
     [evaluate for vascular injury or dislocation]
   - 🔴 – **MRI knee without and with IV contrast**
   - 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

2. **Nontraumatic knee pain persisting after an appropriate trial (> 4-6 weeks) of conservative therapy and no osteoarthritis or major abnormalities on radiographs:**

   - 🟢 – **MRI knee without IV contrast**
   - 🟡 – **CT arthrography knee** *[unable to undergo MRI]*
   - 🟡 – **CT knee without IV contrast** *[assess patellofemoral morphology for purposes of surgical planning]*
   - 🟡 – **MR arthrography knee**
     [previous meniscal repair and/or ACL reconstruction]
   - 🔴 – **MRI knee without and with IV contrast**
   - 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

3. **Osteoarthritis of the knee on conventional radiography with any of the following:**
   - **New-onset severe pain**
   - **Significant worsening of symptoms**
   - **Pain that is disproportionate to findings on repeat radiography**
   - **Pre-surgical planning**

   - 🟢 – **MRI knee without IV contrast**
   - 🟡 – **CT arthrography knee** *[unable to undergo MRI]*
   - 🟡 – **CT knee without IV contrast** *[evaluate for purposes of surgical planning]*
   - 🟡 – **MR arthrography knee**
     [previous meniscal repair and/or ACL reconstruction]
   - 🔴 – **MRI knee without and with IV contrast**
   - 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

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4. **Clinical or radiological suspicion for avascular necrosis (osteonecrosis):**

- 🟢 – **MRI knee without IV contrast**
- 🟡 – **MRI knee with IV contrast** *[previous findings on noncontrast MRI are non-diagnostic]*
- 🟡 – **CT knee without IV contrast** *[unable to undergo MRI]*
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
  [unable to undergo MRI; previous findings on noncontrast MRI are non-diagnostic]
- 🔴 – **MRI knee without and with IV contrast**
- 🔴 – **MR arthrography knee** or **CT arthrography knee**
- 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**

5. **Suspected stress or insufficiency reaction/fracture and negative or non-diagnostic radiographs:**

- 🟢 – **MRI knee without IV contrast**
- 🟡 – **CT knee without IV contrast**
  [unable to undergo MRI; previous findings on noncontrast MRI are non-diagnostic; further characterize or evaluate healing of known fracture]
- 🟡 – **Bone scan** [with or without **SPECT** or **SPECT/CT**]
  [unable to undergo MRI; previous findings on noncontrast MRI are non-diagnostic]
- 🔴 – **MRI knee without and with IV contrast**
- 🔴 – **MR arthrography knee** or **CT arthrography knee**
- 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**

6. **Clinical or radiological suspicion for septic arthritis, osteomyelitis, and/or periarticular abscess:**

- 🟢 – **MRI knee without IV contrast** or **MRI knee without and with IV contrast**
- 🟡 – **CT knee without IV contrast** or **CT knee with IV contrast**
  [evaluate for soft tissue gas, foreign body, or chronic osteomyelitis; unable to undergo MRI]
- 🟡 – **Multiphase bone scan** [with or without **SPECT** or **SPECT/CT**]
  [unable to undergo MRI; previous findings on noncontrast MRI are non-diagnostic]
- 🔴 – **MRI knee without and with IV contrast**
- 🔴 – **MR arthrography knee** or **CT arthrography knee**
- 🔴 – **CT knee with IV contrast** or **CT knee without and with IV contrast**

7. **Suspected intraarticular pathology associated with a Baker's (popliteal) cyst:**

- 🟢 – **Ultrasound knee**
- 🟢 – **MRI knee without IV contrast**
- 🟡 – **CT arthrography knee** *[unable to undergo MRI]*
- 🟡 – **MR arthrography knee** *[previous meniscal repair and/or ACL reconstruction]*
- 🔴 – **MRI knee without and with IV contrast**
- 🔴 – **CT knee**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH SHOULDER PAIN

1. **Shoulder pain with either of the following rotator cuff scenarios:**
   - **Suspected full-thickness rotator cuff tear in patients who are candidates for early surgical repair**
   - **Suspected rotator cuff tear and failure of conservative therapy (> 4-6 weeks)**

   - 🟢 – **MRI shoulder without IV contrast**
   - 🟢 – **Ultrasound shoulder**
   - 🟡 – **CT arthrography shoulder** *[unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]*
   - 🟡 – **MR arthrography shoulder** *[previous noncontrast MRI findings are non-diagnostic]*
   - 🟡 – **CT shoulder without IV contrast** *[further evaluation or surgical planning of bone abnormality]*
   - 🔴 – **MRI shoulder without and with IV contrast**
   - 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

2. **Suspected rotator cuff re-tear (following previous rotator cuff repair):**

   - 🟢 – **MRI shoulder without IV contrast**
   - 🟢 – **MR arthrography shoulder**
   - 🟢 – **Ultrasound shoulder**
   - 🟡 – **CT arthrography shoulder** *[unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]*
   - 🟡 – **CT shoulder without IV contrast** *[further evaluation or surgical planning of bone abnormality]*
   - 🔴 – **MRI shoulder without and with IV contrast**
   - 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

3. **Shoulder pain any of the following scenarios:**
   - **Suspected labral tear following acute trauma**
   - **Suspected labral tear and failure of conservative therapy (> 4-6 weeks)**
   - **Instability (e.g., from dislocation event(s)) and non-diagnostic radiographs**

   - 🟢 – **MRI shoulder without IV contrast**
   - 🟢 – **MR arthrography shoulder**
   - 🟡 – **CT arthrography shoulder** *[unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]*
   - 🟡 – **CT shoulder without IV contrast** *[further evaluation or surgical planning of bone abnormality]*

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- 🔴 – **MRI shoulder without and with IV contrast**
- 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

4. **Suspected biceps tendon tear, or suspected biceps tendinopathy with symptoms that persist following conservative therapy (> 4-6 weeks):**

- 🟢 – **MRI shoulder without IV contrast**
- 🟢 – **MR arthrography shoulder**
- 🟢 – **Ultrasound shoulder**
- 🟡 – **CT arthrography shoulder**
  [unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]
- 🟡 – **CT shoulder without IV contrast**
  [further evaluation or surgical planning of bone abnormality]
- 🔴 – **MRI shoulder without and with IV contrast**
- 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

5. **Suspected adhesive capsulitis:**

- 🟢 – **MRI shoulder without IV contrast**
- 🟡 – **MRI shoulder without and with IV contrast** or **MRI shoulder with IV contrast**
- 🟡 – **MR arthrography shoulder**
  [previous noncontrast MRI findings are non-diagnostic]
- 🟡 – **CT arthrography shoulder**
  [unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]
- 🔴 – **CT shoulder**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

6. **Osteoarthritis of the shoulder on conventional radiography with any of the following:**
   - **New-onset severe pain**
   - **Significant worsening of symptoms**
   - **Pain that is disproportionate to findings on repeat radiography**
   - **Pre-surgical planning**

- 🟢 – **MRI shoulder without IV contrast**
- 🟢 – **MR arthrography shoulder**
- 🟢 – **CT shoulder without IV contrast**
- 🟡 – **CT arthrography shoulder**
  [unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]
- 🔴 – **MRI shoulder without and with IV contrast**
- 🔴 – **CT shoulder with IV contrast** or **CT shoulder without and with IV contrast**
- 🔴 – **Bone scan**
- 🔴 – **SPECT**

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7. **Further evaluation/surgical planning of suspected or known acute fracture following radiographs:**

   - 🟢 – **CT shoulder without IV contrast**
   - 🟢 – **MRI shoulder without IV contrast**
   - 🔴 – **MRI shoulder without and with IV contrast**
   - 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
   - 🔴 – **MR arthrography shoulder** or **CT arthrography shoulder**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

8. **Suspicion for septic arthritis, osteomyelitis, or periarticular abscess, and non-diagnostic radiographs:**

   - 🟢 – **MRI shoulder without IV contrast** or **MRI shoulder without and with IV contrast**
   - 🟡 – **CT shoulder with IV contrast** or **CT shoulder without IV contrast**
   - 🟡 – **Bone scan** and/or **WBC scan**
     (with or without **sulfur colloid marrow scan** and/or **SPECT** or **SPECT/CT)**
     [unable to undergo MRI; findings on previous MRI are non-diagnostic]
   - 🟡 – **FDG-PET** or **FDG-PET/CT** *[unable to undergo MRI; findings on previous MRI are non-diagnostic]*
   - 🔴 – **CT shoulder without and with IV contrast**
   - 🔴 – **MR arthrography shoulder** or **CT arthrography shoulder**

9. **Shoulder pain persisting after failure of 4-6 weeks of conservative therapy, and radiographs are non-diagnostic or noncontributory:**

   - 🟢 – **MRI shoulder without IV contrast**
   - 🟡 – **MR arthrography shoulder**
     [previous noncontrast MRI findings are non-diagnostic]
   - 🟡 – **CT arthrography shoulder**
     [unable to undergo MRI; prior shoulder arthroplasty/significant metal artifact]
   - 🟡 – **CT shoulder without IV contrast**
     [further evaluation or surgical planning of bone abnormality]
   - 🔴 – **MRI shoulder without and with IV contrast**
   - 🔴 – **CT shoulder without and with IV contrast** or **CT shoulder with IV contrast**
   - 🔴 – **Bone scan**
   - 🔴 – **SPECT**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH ABDOMINAL PAIN

1. **Acute, diffuse (poorly localized) abdominal pain – including suspected abscess, incarcerated hernia, post-surgical complication, etc.:**

   - 🟢 – **CT abdomen and pelvis with IV contrast**
   - 🟡 – **MRI abdomen and/or pelvis without and with IV contrast**
   - 🟡 – **Ultrasound abdomen** and/or **ultrasound pelvis**
   - 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
   - 🟡 – **MRI abdomen and/or pelvis without IV contrast** *[unable to receive IV contrast]*
   - 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
   - 🔴 – **MRCP**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **SPECT**
   - 🔴 – **Scintigraphy**
   - 🔴 – **MR or CT enterography; MR or CT enteroclysis**
   - 🔴 – **MR angiography** or **CT angiography**

2. **Right upper quadrant pain with suspected hepatobiliary disease:**

   - 🟢 – **Ultrasound abdomen**
   - 🟡 – **Cholescintigraphy**
   - 🟡 – **MRI abdomen without and with IV contrast with MRCP**
   - 🟡 – **MRI abdomen without IV contrast with MRCP**
   - 🟡 – **CT abdomen with IV contrast**
   - 🟡 – **CT abdomen without IV contrast** *[unable to receive IV contrast]*
   - 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **SPECT**
   - 🔴 – **Scintigraphy**
   - 🔴 – **MR or CT enterography; MR or CT enteroclysis**
   - 🔴 – **MR angiography** or **CT angiography**

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3. **Abdominal pain with suspected or known acute pancreatitis, and any of the following:**
   - **Amylase and lipase levels are equivocal**
   - **Severe or atypical pain**
   - **Further assessment > 48 hours after symptom onset is necessary**

- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟢 – **MRI abdomen without and with IV contrast with MRCP**
- 🟡 – **Ultrasound abdomen**
- 🟡 – **MRI abdomen without IV contrast with MRCP** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**
- 🔴 – **MR angiography** or **CT angiography**

4. **Abdominal pain with suspected (i.e., previously undiagnosed) chronic pancreatitis:**

- 🟢 – **CT abdomen and pelvis**
- 🟡 – **MRI abdomen without and with IV contrast with MRCP**
- 🟡 – **Ultrasound abdomen**
- 🟡 – **MRI abdomen without IV contrast with MRCP** *[unable to receive IV contrast]*
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**
- 🔴 – **MR angiography** or **CT angiography**

5. **Right lower quadrant pain with suspected acute appendicitis:**

- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟡 – **Ultrasound abdomen** and/or **ultrasound pelvis**
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
- 🟡 – **MRI abdomen and/or pelvis without and with IV contrast**
- 🟡 – **MRI abdomen without IV contrast without IV contrast** *[unable to receive IV contrast]*
- 🔴 – **MRCP**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**
- 🔴 – **MR angiography** or **CT angiography**

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6. **Left lower quadrant pain with suspected acute diverticulitis:**

- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
- 🟡 – **MRI abdomen and/or pelvis without and with IV contrast**
- 🟡 – **MRI abdomen without IV contrast without IV contrast**
- 🟡 – **Ultrasound abdomen** and/or **ultrasound pelvis**
- 🔴 – **MRCP**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**
- 🔴 – **MR angiography** or **CT angiography**

7. **Abdominal pain with suspected bowel obstruction:**

- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
- 🟡 – **MRI abdomen and/or pelvis without and with IV contrast**
- 🟡 – **MRI abdomen without IV contrast without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT enterography** or **CT enteroclysis** *[intermittent, recurrent, or low-grade small bowel obstruction]*
- 🟡 – **MR enterography** or **MR enteroclysis** *[intermittent, recurrent, or low-grade small bowel obstruction]*
- 🔴 – **Ultrasound**
- 🔴 – **MRCP**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR angiography** or **CT angiography**

8. **Abdominal pain with suspected inflammatory bowel disease:**

- 🟢 – **MRI abdomen and/or pelvis without and with IV contrast**
- 🟢 – **MR enterography** or **CT enterography**
- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟡 – **MRI abdomen and/or pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast and unable to undergo MRI]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast** *[known cancer or liver disease]*
- 🟡 – **MR enteroclysis** or **CT enteroclysis** *[suspected acute exacerbation of known Crohn's disease]*
- 🟡 – **Ultrasound abdomen and pelvis**
- 🔴 – **MRCP**

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- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR angiography** or **CT angiography**

9. **Abdominal pain with suspected bowel ischemia or infarction:**

- 🟢 – **CT angiography abdomen and pelvis**
- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟡 – **MR angiography abdomen and pelvis**
- 🟡 – **CT abdomen and pelvis without and with IV contrast**
  [angiography expertise not available; known cancer or liver disease]
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **Ultrasound abdomen** and/or **ultrasound pelvis**
- 🔴 – **MRCP**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**

10. **Abdominal pain with suspected symptomatic abdominal aortic aneurysm (AAA):**

- 🟢 – **CT angiography abdomen and pelvis**
- 🟢 – **MR angiography abdomen and pelvis**
- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟢 – **Ultrasound aorta abdomen**
- 🟡 – **MRI abdomen and/or pelvis without and with IV contrast**
- 🟡 – **MRI abdomen and/or pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without IV contrast** *[unable to receive IV contrast]*
- 🟡 – **CT abdomen and pelvis without and with IV contrast**
  [angiography expertise not available; known cancer or liver disease]
- 🔴 – **MRCP**
- 🔴 – **PET** or **PET/CT**
- 🔴 – **SPECT**
- 🔴 – **Scintigraphy**
- 🔴 – **MR or CT enterography; MR or CT enteroclysis**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH COUGH AND/OR DYSPNEA

1. **Cough and/or dyspnea presenting with a high clinical suspicion for pneumonia and negative/non-diagnostic chest radiographs:**

   - 🟢 – **CT chest without IV contrast**
   - 🟡 – **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **CT angiography chest or CT pulmonary angiography (CTPA)** *[evaluate hemoptysis or suspected vascular involvement]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **MR angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

2. **Cough and/or dyspnea presenting with pneumonia that is not responding to treatment and/or with suspected complications:**

   - 🟢 – **CT chest without IV contrast** or **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **CT angiography chest or CT pulmonary angiography (CTPA)** *[evaluate hemoptysis or suspected vascular involvement]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **MR angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

3. **Cough and/or dyspnea in an immunocompromised patient:**

   - 🟢 – **CT chest without IV contrast**
   - 🟡 – **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **CT angiography chest or CT pulmonary angiography (CTPA)** *[evaluate hemoptysis or suspected vascular involvement]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **MR angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

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4. **Cough and/or dyspnea in patients with suspected active tuberculosis and non-diagnostic chest radiographs:**

   - 🟢 – **CT chest without IV contrast**
   - 🟡 – **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **CT angiography chest or CT pulmonary angiography (CTPA)** *[evaluate hemoptysis or suspected vascular involvement]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **MR angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

5. **Chronic cough and/or dyspnea with a restrictive ventilatory pattern and/or suspicion of interstitial lung disease or pleural disease AND common etiologies of cough have been ruled out:**

   - 🟢 – **CT chest without IV contrast**
   - 🟡 – **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **FDG-PET** *[evaluate patients with asbestos exposure]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET/CT**
   - 🔴 – **MR angiography** or **CT angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

6. **Chronic cough and/or dyspnea with suspicion of an obstructive lung disease (e.g., severe asthma, COPD, or bronchiectasis) AND common etiologies of cough have been ruled out:**

   - 🟢 – **CT chest without IV contrast**
   - 🟡 – **CT chest with IV contrast**
   - 🟡 – **MRI chest** *[detect or characterize suspected pleural involvement]*
   - 🟡 – **CT angiography chest or CT pulmonary angiography (CTPA)** *[evaluate hemoptysis or suspected vascular involvement]*
   - 🔴 – **Scintigraphy**
   - 🔴 – **PET** or **PET/CT**
   - 🔴 – **MR angiography**
   - 🔴 – **CT chest without and with IV contrast**
   - 🔴 – **SPECT**

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APPROPRIATENESS OF ADVANCED IMAGING IN PATIENTS WITH RENAL, ADRENAL, & URINARY TRACT CONDITIONS

1. Hematuria:

Low-Risk Patient

- 🟡 – **Renal and bladder ultrasound**
- 🔴 – **CT**
- 🔴 – **MRI**
- 🔴 – **Scintigraphy**
- 🔴 – **PET** or **PET/CT**

Intermediate-Risk Patient

- 🟢 – **Renal and bladder ultrasound**
- 🟢 – **CT abdomen/pelvis without and with IV contrast [urography protocols preferred]**
- 🟡 – **MRI abdomen or abdomen/pelvis without and with IV contrast [urography protocols preferred]** *[unable to receive CT contrast]*
- 🟡 – **MRI abdomen or abdomen/pelvis without IV contrast [urography protocols preferred]** *[unable to receive CT contrast and also unable to receive MRI contrast]*
- 🟡 – **CT abdomen/pelvis without IV contrast** *[unable to receive CT contrast and also unable to undergo MRI]*
- 🔴 – **CT with IV contrast**
- 🔴 – **Scintigraphy**
- 🔴 – **PET** or **PET/CT**

High-Risk Patient

- 🟢 – **CT abdomen/pelvis without and with IV contrast [urography protocols preferred]**
- 🟡 – **MRI abdomen or abdomen/pelvis without and with IV contrast [urography protocols preferred]** *[unable to receive CT contrast]*
- 🟡 – **MRI abdomen or abdomen/pelvis without IV contrast [urography protocols preferred]** *[unable to receive CT contrast and also unable to receive MRI contrast]*
- 🟡 – **CT abdomen/pelvis without IV contrast** *[unable to receive CT contrast and also unable to undergo MRI]*
- 🟡 – **Renal and bladder ultrasound**
- 🔴 – **CT with IV contrast**
- 🔴 – **Scintigraphy**
- 🔴 – **PET** or **PET/CT**

2. Suspected renal or ureteral calculus:

- 🟢 – **CT KUB without IV contrast**
- 🟡 – **Renal and bladder ultrasound**
- 🟡 – **CT abdomen/pelvis with IV contrast** or **CT abdomen/pelvis without and with IV contrast** *[further evaluate abnormalities, obstruction, or non-diagnostic findings on recent ultrasound or noncontrast imaging]*

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- 🟡 – **MRI abdomen** or **MRI abdomen/pelvis [urography protocols preferred]** *[further evaluate abnormalities, obstruction, or non-diagnostic findings on recent ultrasound or noncontrast imaging]*
- 🟡 – **Renal scintigraphy** *[further evaluate obstruction on recent ultrasound or noncontrast imaging]*
- 🔴 – **PET** or **PET/CT**

3. Preoperative planning for known renal or ureteral calculus:

- 🟢 – **CT KUB without IV contrast**
- 🟢 – **CT abdomen/pelvis with IV contrast [urography protocols preferred]**
- 🟡 – **CT abdomen/pelvis without and with IV contrast [urography protocols preferred]** *[further evaluate abnormalities, obstruction, or non-diagnostic findings on recent ultrasound or noncontrast imaging]*
- 🟡 – **MRI abdomen** or **MRI abdomen/pelvis [urography protocols preferred]** *[further evaluate abnormalities, obstruction, or non-diagnostic findings on recent ultrasound or noncontrast imaging]*
- 🟡 – **Renal scintigraphy** *[evaluate suspected loss of renal function]*
- 🔴 – **Renal and bladder ultrasound**
- 🔴 – **PET** or **PET/CT**

4. Follow-up imaging during or after treatment of renal or ureteral calculus:

- 🟢 – **Renal and bladder ultrasound** [with or without **KUB radiography**]
- 🟡 – **CT KUB without IV contrast**
- 🟡 – **CT abdomen/pelvis without and with IV contrast** or **CT abdomen/pelvis with IV contrast** *[further evaluate abnormalities, obstruction, or non-diagnostic findings on recent ultrasound or noncontrast imaging]*
- 🔴 – **MRI**
- 🔴 – **Renal and bladder ultrasound**
- 🔴 – **PET** or **PET/CT**

5. Suspected infection in any of the following scenarios:

- **Immunocompromised patients**
- **Patients with ≥ 72 hours of unsuccessful therapy**
- **Patients with progressive, recurrent, or atypical symptoms**

- 🟢 – **CT abdomen/pelvis**
- 🟡 – **Renal and bladder ultrasound** or **abdominal ultrasound**
- 🟡 – **MRI abdomen** or **MRI abdomen/pelvis without and with IV contrast [urography protocols preferred]** *[unable to receive CT contrast]*
- 🟡 – **MRI abdomen or MRI abdomen/pelvis without Iv contrast [urography protocols preferred]** *[unable to receive CT contrast and also unable to receive MRI contrast]*
- 🔴 – **Scintigraphy**
- 🔴 – **PET** or **PET/CT**

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6. **Evaluation of incidental/indeterminate renal mass or complex cyst [following Bosniak classification]:**

- ● – **CT abdomen without and with IV contrast**
- ● – **MRI abdomen without and with IV contrast**
- ● – **Renal ultrasound**
- ● – **MRI abdomen without IV contrast**
  [unable to receive CT contrast and also unable to receive MRI contrast]
- ● – **CT abdomen without IV contrast**
  [unable to receive CT contrast and also unable to undergo MRI]
- ● – **CT abdomen with IV contrast**
  [further evaluate findings on recent ultrasound or noncontrast imaging]
- ● – **Scintigraphy**
- ● – **PET** or **PET/CT**

7. **Evaluation of incidental/indeterminate adrenal mass or nodule ≥ 1 cm in size and/or with symptoms of adrenal hormone excess:**

- ● – **CT abdomen**
- ● – **MRI abdomen without IV contrast**
- ● – **MRI abdomen without and with IV contrast**
- ● – **PET** or **PET/CT** *[history of malignancy]*
- ● – **Scintigraphy**
- ● – **Ultrasound**

Appropriateness of Advanced Imaging in Patients with Suspected or Known Pulmonary Embolism

1. **Low clinical suspicion for PE, or low pretest probability for PE based on a validated clinical prediction rule AND patients meets all of the Pulmonary Embolism Rule-Out Criteria (PERC):**

- ● – **CT pulmonary angiography (CTPA)** or **CT chest**
- ● – **Ventilation-Perfusion lung scan**
- ● – **Perfusion (Q) lung scan**
- ● – **MRI chest** or **Pulmonary MR angiography**
- ● – **MR venography** or **CT venography**

2. **Low clinical suspicion for PE, or low pretest probability for PE based on a validated clinical prediction rule AND patients meets all of the Pulmonary Embolism Rule-Out Criteria (PERC):**

- ● – **CT pulmonary angiography (CTPA)** or **CT chest**
- ● – **Ventilation-Perfusion lung scan**
- ● – **Perfusion (Q) lung scan**
- ● – **MRI chest** or **Pulmonary MR angiography**
- ● – **MR venography** or **CT venography**

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3. **Elevated (positive) plasma high sensitivity D-dimer test with either:**
   - **Low clinical suspicion for PE, or low pretest probability for PE based on a validated clinical prediction rule in patients who do not meet all the PERC; or**
   - **Intermediate clinical suspicion for PE, or intermediate pretest probability for PE based on a validated clinical prediction rule**

   🟢 – **CT pulmonary angiography (CTPA)** or **CT chest with IV contrast**
   🟡 – **Ventilation-Perfusion lung scan**
   🟡 – **Perfusion (Q) lung scan**
   [unable to undergo CT and unable to undergo V/Q scan]
   🟡 – **Pulmonary MR angiography**
   [unable to undergo CT; previous CT is non-diagnostic]
   🟡 – **Ultrasound lower extremity**
   [suspect deep vein thrombosis]
   🟡 – **MR venography** or **CT venography of the lower extremities**
   [suspect deep vein thrombosis and ultrasound not available]
   🔴 – **MRI chest**
   🔴 – **CT chest without IV contrast** or **CT chest without and with IV contrast**

4. **High clinical suspicion for PE, or high pretest probability for PE based on a validated clinical prediction rule:**

   🟢 – **CT pulmonary angiography (CTPA)** or **CT chest with IV contrast**
   🟡 – **Ventilation-Perfusion lung scan**
   🟡 – **Perfusion (Q) lung scan**
   [unable to undergo CT and unable to undergo V/Q scan]
   🟡 – **Pulmonary MR angiography**
   [unable to undergo CT; previous CT is non-diagnostic]
   🟡 – **Ultrasound lower extremity**
   [suspect deep vein thrombosis]
   🟡 – **MR venography** or **CT venography of the lower extremities**
   [suspect deep vein thrombosis and ultrasound not available]
   🔴 – **MRI chest**
   🔴 – **CT chest without IV contrast** or **CT chest without and with IV contrast**

5. **Evaluation for a new or recurrent pulmonary embolism in patients on therapy for thromboembolic disease and the results are expected to modify current therapy:**

   🟢 – **CT pulmonary angiography (CTPA)** or **CT chest with IV contrast**
   🟡 – **Ventilation-Perfusion lung scan**
   🟡 – **Perfusion (Q) lung scan** *[unable to undergo CT and unable to undergo V/Q scan]*
   🟡 – **Pulmonary MR angiography**
   [unable to undergo CT; previous CT is non-diagnostic]
   🟡 – **Ultrasound lower extremity**
   [suspect deep vein thrombosis]
   🟡 – **MR venography** or **CT venography of the lower extremities**
   [suspect deep vein thrombosis and ultrasound not available]

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- 🔴 – **MRI chest**
- 🔴 – **CT chest without IV contrast** or **CT chest without and with IV contrast**

6. **Low clinical suspicion for PE, or low pretest probability for PE based on a validated clinical prediction rule AND patients meets all of the Pulmonary Embolism Rule-Out Criteria (PERC):**

- 🔴 – **CT pulmonary angiography (CTPA)** or **CT chest**
- 🔴 – **Ventilation-Perfusion lung scan**
- 🔴 – **Perfusion (Q) lung scan**
- 🔴 – **MRI chest** or **Pulmonary MR angiography**
- 🔴 – **MR venography** or **CT venography**

7. **Patients with a history of thromboembolic disease and clinical suspicion for chronic thromboembolism pulmonary hypertension (CTEPH):**

- 🟢 – **Ventilation-Perfusion lung scan**
- 🟡 – **CT pulmonary angiography (CTPA)** or **CT chest with IV contrast**
- 🟡 – **Perfusion (Q) lung scan**
  [unable to undergo V/Q scan]
- 🔴 – **MRI chest** or **Pulmonary MR angiography**
- 🔴 – **MR venography** or **CT venography**
- 🔴 – **CT chest without IV contrast** or **CT chest without and with IV contrast**

Appropriateness of Advanced Imaging in Patients with Suspected or Known Coronary Artery Disease

1. **Initial evaluation for coronary artery disease in asymptomatic patient without known coronary artery disease:**

Low global CAD risk
- 🟡 – **CT coronary artery calcium**
- 🔴 – **Stress ECG**
- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress echocardiography**
- 🔴 – **Stress cardiac MRI**
- 🔴 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**

Intermediate global CAD risk
- 🟢 – **CT coronary artery calcium**
- 🟡 – **Stress ECG**
- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress echocardiography**
- 🔴 – **Stress cardiac MRI**

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- 🔴 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**

High global CAD risk

- 🟢 – **Stress ECG**
- 🟡 – **Coronary CT angiography**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **CT coronary artery calcium**
  [if not previously assessed and the patient is not already a candidate for intensive risk reducing therapy]
- 🔴 – **Invasive coronary angiography**

2. Initial testing for symptomatic patient with no known coronary artery disease:

Low pretest probability

- 🟢 – **Stress ECG**
- 🟡 – **Stress echocardiography**
- 🟡 – **Coronary CT angiography**
- 🟡 – **CT coronary artery calcium**
- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress cardiac MRI**
- 🔴 – **Invasive coronary angiography**

Intermediate pretest probability

- 🟢 – **Stress ECG**
- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Coronary CT angiography**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **CT coronary artery calcium**
- 🔴 – **Invasive coronary angiography**

High pretest probability

- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress cardiac MRI**
- 🟢 – **Coronary CT angiography**
- 🟢 – **Invasive coronary angiography**
- 🟢 – **Stress ECG**
- 🟡 – **CT coronary artery calcium**

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History of new-onset heart failure, exercise-induced or sustained ventricular tachycardia, ventricular fibrillation, or frequent PVCs with suspected underlying CAD

- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress cardiac MRI**
- 🟢 – **Invasive coronary angiography**
- 🟢 – **Coronary CT angiography**
- 🟡 – **Stress ECG**
- 🔴 – **CT coronary artery calcium**

3. **Follow-up/sequential testing for coronary artery disease:** *[Refers to sequential testing being done as part of a continued patient evaluation or application of recent testing results in the reevaluation of a patient]*

Asymptomatic patient with low global CAD risk or last test performed > 90 days and < 2 years ago

- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress echocardiography**
- 🔴 – **Stress cardiac MRI**
- 🔴 – **Coronary CT angiography**
- 🔴 – **Stress ECG**
- 🔴 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**

Asymptomatic patient with intermediate-to-high global CAD risk and last test performed > 2 years ago

- 🟡 – **Stress ECG**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress cardiac MRI**
- 🔴 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**

Symptomatic patient with previous abnormal ECG or abnormal/equivocal stress ECG for CAD

- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress cardiac MRI**
- 🟢 – **Coronary CT angiography**
- 🟡 – **Stress ECG**
- 🟡 – **Invasive coronary angiography**
- 🟡 – **CT coronary artery calcium**

Symptomatic patient with previous coronary artery calcium (Agatston) score of < 100

- 🟡 – **Stress ECG**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**

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Symptomatic patient with previous coronary artery calcium (Agatston) score of > 100

- 🟢 – **Stress ECG**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress cardiac MRI**
- 🟡 – **Coronary CT angiography**
- 🟡 – **Invasive coronary angiography**

Symptomatic patient with normal or mild ischemia on previous stress imaging (SPECT, PET, echo, or CMR)

- 🟢 – **Coronary CT angiography**
- 🟡 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**
- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress echocardiography**
- 🔴 – **Stress cardiac MRI**
- 🔴 – **Stress ECG**

Symptomatic patient with moderate to severe ischemia on previous stress imaging (SPECT, PET, echo, or CMR)

- 🟢 – **Coronary CT angiography**
- 🟢 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**
- 🔴 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🔴 – **Stress echocardiography**
- 🔴 – **Stress cardiac MRI**
- 🔴 – **Stress ECG**

Symptomatic patient with previous CCTA that is normal or shows mild (< 49%) ischemia

- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **Stress ECG**
- 🔴 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**

Symptomatic patient with previous CCTA that is inconclusive or shows moderate (50-69%) stenosis

- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress cardiac MRI**
- 🟢 – **Invasive coronary angiography**
- 🟡 – **Stress ECG**
- 🔴 – **CT coronary artery calcium**

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Symptomatic patient with previous CCTA that shows severe stenosis

- 🟢 – **Invasive coronary angiography**
- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **Stress ECG**
- 🔴 – **CT coronary artery calcium**

4. Follow-up/sequential testing for coronary artery disease:

Symptomatic patient (anginal symptoms and/or symptoms similar to prior ischemic episode)

- 🟢 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟢 – **Stress echocardiography**
- 🟢 – **Stress cardiac MRI**
- 🟢 – **Invasive coronary angiography**
- 🟡 – **Coronary CT angiography**
- 🟡 – **Stress ECG**
- 🔴 – **CT coronary artery calcium**

Asymptomatic patient with incomplete previous revascularization; additional revascularization feasible

- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **Stress ECG**
- 🔴 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**

Asymptomatic patient with prior left main coronary stent (> 2 year interval)

- 🟡 – **Stress radionuclide myocardial perfusion imaging (PET or SPECT)**
- 🟡 – **Stress echocardiography**
- 🟡 – **Stress cardiac MRI**
- 🟡 – **Stress ECG**
- 🟡 – **Coronary CT angiography**
- 🔴 – **Invasive coronary angiography**
- 🔴 – **CT coronary artery calcium**

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Appropriateness of Advanced Imaging in Patients with Cancer of the Lung (primary or metastatic, suspected or confirmed)

Note – multidisciplinary evaluation is recommended to determine the likelihood of a cancer diagnosis and the optimal diagnostic or follow-up strategy. These recommendations are not intended to preclude either shorter- or longer-term follow-up in individual subjects when deemed clinically appropriate

1. **Evaluation of a pulmonary nodule or mass incidentally discovered on previous imaging:**
   [Excluding nodules with classically benign imaging features (e.g., diffuse, central, laminated, or popcorn calcification)]

   Solid nodule(s), low-risk (< 5% malignancy) based on standard risk assessment criteria
   Single or multiple solid nodules < 6 mm
   - 🔴 – **No routine follow-up imaging recommended**

   Single solid nodule 6-8 mm
   - 🟢 – **Follow-up low-dose CT chest without IV contrast (at 6-12 months)**
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at 18-24 months)**

   Multiple solid nodules 6-8 mm
   - 🟢 – **Follow-up low-dose CT chest without IV contrast (at 3-12 months)**
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at 18-24 months)**

   Single solid nodule > 8 mm
   - 🟢 – **Follow-up low-dose CT chest without IV contrast (at ~3 months)**
   - 🟢 – **FDG-PET/CT**

   Multiple solid nodules > 8 mm
   - 🟢 – **Follow-up low-dose CT chest without IV contrast (at 3-6 months)**
   - 🟢 – **FDG-PET/CT**
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at 18-24 months)**

   Solid nodule(s), high-risk (≥ 5% malignancy) based on standard risk assessment criteria
   Single or multiple solid nodules < 6 mm
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at ~12 months)**

   Single solid nodule 6-8 mm
   - 🟢 – **Follow-up low-dose CT chest without IV contrast (at 6-12 months)**
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at 18-24 months)**

   Multiple solid nodules 6-8 mm
   - **Green** – **Follow-up low-dose CT chest without IV contrast (at 3-12 months)**
   - 🟡 – **Follow-up low-dose CT chest without IV contrast (at 18-24 months)**

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Single or multiple solid nodule(s) > 8 mm

- 🟢 – FDG-PET/CT
- 🟢 – **Follow-up low-dose CT chest without IV contrast (at ~3 months)**
- 🟡 – **Follow-up low-dose CT chest without IV contrast (at 12-24 months)**
- 🟡 – **CT chest with IV contrast** or **CT chest without IV contrast**

Subsolid nodule(s), low-risk or high-risk based on standard risk assessment criteria

Single ground glass or part-solid nodule < 6 mm

- 🔴 – **No routine follow-up imaging recommended**

Single ground glass nodule > 6 mm

- 🟢 – **Follow-up low-dose CT chest without IV contrast (at 6-12 months)**
- 🟢 – **Follow-up low-dose CT chest without IV contrast (at ~3 years and ~5 years)**

Single part-solid nodule > 6 mm, solid component < 6 mm

- 🟡 – **Follow-up low-dose CT chest without IV contrast (at 3-6 months)**
- 🟡 – **Follow-up low-dose CT chest without IV contrast (annually for at least 5 years)**

Multiple part-solid nodules, solid component < 6 mm

- 🟢 – **Follow-up low-dose CT chest without IV contrast (at 3-6 months)**
- 🟡 – **Follow-up low-dose CT chest without IV contrast (at ~2 years and ~4 years)**

Single or multiple part-solid nodule(s), solid component > 6 mm

- 🟢 – **Follow-up low-dose CT chest without IV contrast (at 3-6 months)**
- 🟢 – **Follow-up low-dose CT chest without IV contrast (annually for at least 5 years)**
- 🟡 – **FDG-PET/CT**
- 🟡 – **CT chest with IV contrast** or **CT chest without IV contrast**

2. Screening and surveillance in an asymptomatic active smoker or former smoker that has quit within the past 15 years:

Screening of patient age > 50 years and < 77 years AND with either a 20 pack-year smoking history or established occupational-related lung disease

- 🟢 – **Low-dose CT chest without IV contrast (every 12 months)**

Screening of patients with any of the following:

- Age < 50 years or > 77 years
- < 20 pack-year smoking history
- Quit date > 15 years ago
- Health problem that limits life expectancy or unwilling to have curative surgery

- 🔴 – **No screening CT recommended**

Surveillance of “negative” or “benign” nodule(s) detected on initial screening – based on ACR Lung-RADS score:

- 🟢 – **Low-dose CT chest without IV contrast (every 12 months)**

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Surveillance of "probably benign" nodule(s) detected on initial screening – based on ACR Lung-RADS score:

- ● – **Low-dose CT chest without IV contrast (at 6 months, then continue with annual screening if no change)**

Surveillance of "suspicious" nodule(s) detected on initial screening – based on ACR Lung-RADS score:

- ● – **Low-dose CT chest without IV contrast (at 6 months, then continue with annual screening if no change)**
- ● – **FDG-PET/CT (≥ 8mm solid nodule or solid component)**

Surveillance of "very suspicious" nodule(s) detected on initial screening – based on ACR Lung-RADS score:

- ● – **CT chest with IV contrast** or **CT chest without IV contrast**
- ● – **FDG-PET/CT** *[≥ 8mm solid nodule or solid component]*
- ● – **Low-dose CT chest without IV contrast (at 6 months)** *[rule out infection or inflammation]*

3. Evaluation of patients presenting with signs or symptoms suggestive of lung cancer:

- ● – **CT chest (including adrenals) with IV contrast**
- ● – **FDG-PET/CT**
- ● – **CT chest without IV contrast**
- ● – **CT chest without and with IV contrast**
- ● – **MRI**

4. Staging, management, and surveillance of non-small cell lung cancer (NSCLC):

Staging and management/restaging

- ● – **CT chest (including adrenals) with IV contrast**
- ● – **FDG-PET/CT**
- ● – **CT chest (including adrenals) without IV contrast**
- ● – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- ● – **CT head without and with IV contrast** or **CT head with IV contrast**
- ● – **CT abdomen and pelvis with IV contrast** or **CT abdomen and pelvis without IV contrast**
- ● – **MRI chest without and with IV contrast** or **MRI chest without IV contrast**
- ● – **MRI abdomen without and with IV contrast** or **MRI abdomen without IV contrast**
- ● – **Whole body bone scan**

Surveillance (in patients without symptoms)

- ● – **CT chest (including adrenals) with IV contrast**
- ● – **Low-dose CT chest without IV contrast (annually)**
- ● – **CT chest (including adrenals) without IV contrast**
- ● – **CT abdomen and pelvis with IV contrast** or **CT abdomen and pelvis without IV contrast**
- ● – **FDG-PET/CT**
- ● – **MRI**
- ● – **Bone scan**

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5. Staging, management, and surveillance of small cell lung cancer (SCLC):

Staging and management/restaging

- 🟢 – **CT chest (including adrenals) with IV contrast**
- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟢 – **FDG-PET/CT**
- 🟢 – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- 🟡 – **CT chest (including adrenals) without IV contrast**
- 🟡 – **CT abdomen and pelvis without IV contrast**
- 🟡 – **MRI chest without and with IV contrast** or **MRI chest without IV contrast**
- 🟡 – **MRI abdomen without and with IV contrast** or **MRI abdomen without IV contrast**
- 🟡 – **CT head without and with IV contrast** or **CT head with IV contrast**
- 🟡 – **Whole body bone scan**

Surveillance (in patients without symptoms)

- 🟢 – **CT chest (including adrenals) with IV contrast**
- 🟢 – **CT abdomen and pelvis with IV contrast**
- 🟢 – **MRI head without and with IV contrast** or **MRI head without IV contrast**
- 🟢 – **Follow-up low-dose CT chest without IV contrast (annually)**
  [after two years of surveillance with no evidence of recurrent disease]
- 🟡 – **CT chest (including adrenals) without IV contrast**
- 🟡 – **CT abdomen and pelvis without IV contrast**
- 🟡 – **CT head without and with IV contrast** or **CT head with IV contrast**
- 🔴 – **FDG-PET/CT**
- 🔴 – **Bone scan**

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