Revision Summary Crosswalk (2023)

This report includes NIA-approved changes to guidelines for January 2023 implementation.[1]

[1]Note: During the 2022 guideline review process, the in-text reference citation format for all guidelines was switched from the author's last name to an AMA format-based numerical superscript.

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Radiology (RBM)

GUIDELINES WITH NO SIGNIFICANT CHANGES (RADIOLOGY)
*Note: Guidelines may have updated references and/or background.
3D RENDERING (CT MULTIPLANAR RECONSTRUCTION)
ABDOMINAL ARTERIES CTA
BRAIN (HEAD) MRS
CHEST MRA
CHEST (THORAX) MRI
CT CORONARY ANGIOGRAPHY (CCTA)†
CT (VIRTUAL) COLONOSCOPY – DIAGNOSTIC
CT/MRI GUIDANCE FOR NEEDLE PLACEMENT (CT GUIDANCE FOR RADIATION FIELDS)
FETAL MRI
FUNCTIONAL BRAIN MRI
LOW-DOSE CT FOR LUNG CANCER SCREENING
LOW FIELD MRI
LOWER EXTREMITY CTA/CTV
MUGA (MULTIPLE GATED ACQUISITION) SCAN
SPINAL CANAL MRA

TEMPOROMANDIBULAR JOINT (TMJ) MRI

TUMOR IMAGING PET – UNLISTED

URGENT/EMERGENT CRITERIA

†Guideline had no significant changes (e.g., updated references and/or background) since off-cycle revision this past year.

GUIDELINES WITH CHANGES (RADIOLOGY)

ABDOMEN CT	
Previous (red indicates deleted text)	New (blue indicates new text)
Follow-up of known cancer (Bourgioti, 2016; NCCN, 2019) • Follow-up of known cancer of patient undergoing active treatment within the past year --- [Within **PANCREAS** section, the following changes were made:] • Pancreatic cystic lesion found on initial imaging • Intraductal papillary mucinous neoplasm (IPMN) and mucinous cystic neoplasm (MCN) require surveillance imaging as follows (if MRI/MRCP is contraindicated) if indeterminate on initial imaging and duct communication is present and there are no high-risk characteristics (see Background section) (Elta, 2018): ○ For incidental and asymptomatic cysts <5 mm, one follow-up at three years (Pandey, 2019) ○ For cysts 5 mm-1 cm image every 2 years for 4 years, and if stable can lengthen intervals ○ For cysts 1-2 cm image every year for 2 years and if stable every 2 years for 4 years, and if stable can lengthen intervals ○ Cysts that are 2-3 cm every 6-12 months for 3 years and if stable then yearly for 4 years and if stable can lengthen intervals (can also use EUS) ○ For lesions > 3 cm MRI/CT or EUS every 6 months for 3 years, then imaging alternating with EUS every year for 4 years and if stable can lengthen intervals	**Follow-up of known cancer[6, 7]** • In patient undergoing active treatment within the past year or per surveillance imaging tip sheet that summarizes NCCN recommendations --- [Within **PANCREAS** section, the following changes were made:] • Pancreatic cystic lesion found on initial imaging • Intraductal papillary mucinous neoplasm (IPMN) and mucinous cystic neoplasm (MCN) require surveillance imaging as follows (if MRI/MRCP is contraindicated) if indeterminate on initial imaging (if there are no high-risk characteristics, see Background section)[31]: ○ For incidental and asymptomatic cysts <5 mm, one follow-up at three years[32] ○ For cysts 5 mm-1 cm image every 2 years for 4 years, and if stable can lengthen intervals ○ For cysts 1-2 cm image every year for 2 years and if stable every 2 years for 4 years, and if stable can lengthen intervals ○ Cysts that are 2-3 cm every 6-12 months for 3 years and if stable then yearly for 4 years and if stable can lengthen intervals (can also use EUS) ○ For lesions > 3 cm MRI/CT or EUS every 6 months for 3 years, then imaging alternating with EUS every year for 4 years and if stable can lengthen intervals

----- [In **Suspected Hernia**, the previous version read as:] • Abdominal/pelvic pain suspected to be due to an occult, umbilical, Spigelian, or incisional hernia when physical exam and prior imaging is non-diagnostic or equivocal or if requested as a preoperative study and limited to the abdomen	----- [In **RENAL** section, added the following:] • For evaluation of total kidney volume in polycystic kidney disease when MRI is contraindicated[44] ----- [In **Suspected Hernia**, the following changes were made:] • Abdominal/pelvic pain suspected to be due to an occult, umbilical, Spigelian, or incisional hernia when physical exam and/or prior imaging (such as ultrasound) is non-diagnostic or equivocal or if requested as a preoperative study and limited to the abdomen

ABDOMEN CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
Arterial Disease • Evaluation of known or suspected aortic aneurysm‡ (also approve MRA pelvis) (Chaikof, 2018; Khosa, 2013; Kumar, 2017) ○ For screening, US is initial study ○ Known or suspected aneurysm > 2.5 cm AND equivocal or indeterminate ultrasound results ○ Prior imaging (e.g., ultrasound) demonstrating aneurysm >2.5 cm in diameter ○ Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain ○ Surveillance imaging every three years for diameter 2.0-2.9 cm and annually for 3.0-3.4 cm if doppler ultrasound is inconclusive. If > 3.5 cm, < 6 month follow-up (and consider intervention) (Wainhainen, 2019) ‡NOTE: For known or suspected abdominal aneurysm, CT/MRI should not be approvable without a contraindication to CTA/MRA (such as severe renal dysfunction, contrast allergy, or another specific reason CT/MRI is preferred). --- • For May-Thurner syndrome (include pelvic CTV) (Ibrahim 2012; Wan-Ling, 2012) ---	**Arterial Disease** • Evaluation of known or suspected aortic aneurysm‡ (or can approve CTA abdomen and pelvis if concern extends into pelvis)[1-3] ○ For screening, US is initial study ○ Known or suspected aneurysm > 2.5 cm AND equivocal or indeterminate ultrasound results ○ Suspected complications of known aneurysm as evidenced by signs/symptoms such as new onset of abdominal or pelvic pain ○ Surveillance imaging every three years for diameter 2.0-2.9 cm and annually for 3.0-3.4 cm if doppler ultrasound is inconclusive. If > 3.5 cm, < 6 month follow-up (and consider intervention)[4] ‡NOTE: For known or suspected abdominal aneurysm, CT/MRI should not be approvable without a contraindication to CTA/MRA (such as severe renal dysfunction, contrast allergy, or another specific reason CT/MRI is preferred). --- • For known/suspected May-Thurner syndrome (include pelvic CTV)[22, 23] --- [Within the section **Pre-operative evaluation**, added:] • For surgical planning for UPJ (ureteropelvic junction) obstruction to look for a lower pole crossing vessel

[Within the section **Post-operative or post-procedural evaluation**, the following changes were made:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (CTA abdomen and pelvis should be approved) (ACR 2018; Chaikof, 2018; Uberoi, 2011) ○ If asymptomatic at six (6)-month intervals for one (1) year, then annually ○ If symptomatic/complications related to stent graft – more frequent imaging may be needed ○ Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.	--- [Within the section **Post-operative or post-procedural evaluation**, the following changes were made:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms typically needs to include pelvic imaging, therefore Abdomen Pelvis CTA would usually be the appropriate study.

ABDOMEN MRA	
Previous (red indicates deleted text)	New (blue indicates new text)
	[Within the section **Pre-operative evaluation**, added:] • For surgical planning for UPJ (ureteropelvic junction) obstruction to look for a lower pole crossing vessel --- [Within the section **Pre-operative evaluation**, added:]
• Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months (abdomen and pelvis MRA when CTA is inconclusive) (Chaikof, 2018; Uberoi, 2011)	• Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months (abdomen and pelvis MRA when CTA is inconclusive or cannot be performed)[1, 22]

ABDOMEN MRI/MRCP	
Previous (red indicates deleted text)	New (blue indicates new text)
IMPORTANT NOTE: A single authorization for CPT code 74181, 74182, 74183, S8037 includes imaging of the biliary tree and liver. Multiple authorizations are not required. When a separate MRCP and MRI abdomen exam is requested, documentation requires a medical reason that clearly indicates why additional MRI imaging of the abdomen is needed.	**IMPORTANT NOTE: A single authorization for CPT codes 74181, 74182, 74183, S8037 covers imaging of the biliary tree and its attached organs, i.e., the liver, gallbladder (GB), and pancreas. These same codes also cover MRI abdomen, MRE (Enterography), and MRU (Urography). Multiple authorizations are not typically required. When both MRCP and MRI abdomen are requested, documentation requires a medical reason clearly indicating why both are needed, i.e., that meets guidelines for imaging of bowel, kidneys, or areas other than liver, pancreas, GB, and biliary tree as well.**
Note: There is **no** MRI Abdomen/Pelvis combo (comparable to a CT Abdomen/Pelvis) such that if imaging of both the abdomen and pelvis are indicated, two separate exams (and authorization) are required (i.e., MRI Abdomen and MRI Pelvis)	Note: There is **no** MRI Abdomen/Pelvis combo (comparable to a CT Abdomen/Pelvis) such that if imaging of both the abdomen and pelvis are indicated, two separate exams (and authorization) are required (i.e., MRI Abdomen and MRI Pelvis)
This study includes MRU (MR urography) and MRE (MR enterography).	
INDICATIONS FOR ABDOMEN MRI	**INDICATIONS FOR ABDOMEN MRI**
Evaluation of suspicious known mass/tumors for further evaluation of indeterminate or questionable findings • Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study, such as ultrasound (US), or CT (ACR, 2019).	**Evaluation of suspicious known mass/tumors for further evaluation of indeterminate or questionable findings** • Initial evaluation of suspicious abdomen masses/tumors found only in the abdomen by physical exam or imaging study, such as ultrasound (US), or CT.[1] • Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance MR unless tumor(s) is/are specified as highly

	suspicious or change was found on exam or last follow-up imaging. **Initial staging of known cancer**
• Follow-up of known cancer (Bourgioti, 2016; NCCN, 2019): ○ Follow-up of known cancer of patient undergoing active treatment within the past year ○ Known cancer with suspected abdominal/pelvic metastasis based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation) ○ For known prostate cancer abdomen MRI can be approved when requested in combination with pelvis MRI when meets GL for pelvis MRI	**Follow-up of known cancer[2, 3]:** • In patient undergoing active treatment within the past year or per surveillance imaging tip sheet that summarizes NCCN recommendations[3] • With suspected pelvic metastasis based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation) • For abnormal incidental abdominal lymph nodes when follow-up is recommended based on prior imaging (initial 3-month follow-up)[4] • For known prostate cancer abdomen MRI can be approved when requested in combination with pelvis MRI when meets GL for pelvis MRI
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[Within the section on **LIVER**, the following changes:]	[Within the section on **LIVER**, the following changes:]
• For elastography in chronic liver disease to stage hepatic fibrosis (ACR, 2019) • In patients with Beckwith-Wiedemann syndrome and abnormal ultrasound or rising AFP (Kalish, 2017)	• For elastography in chronic liver disease to stage hepatic fibrosis[15] when transient elastography with ultrasound is insufficient • In patients with Beckwith-Wiedemann syndrome and abnormal ultrasound or rising AFP[20] • In Gaucher Disease when ultrasound (including Doppler assessment of portal blood flow) is insufficient[21] ○ For initial evaluation ○ To evaluate gross scarring and/or portal hypertension

	○ To monitor hepatic volume/hepatomegaly annually
Evaluation of iron overload in the following settings • Initial evaluation of liver iron in Hemochromatosis diagnosed in lieu of liver biopsy (Labranche, 2018) • Annual evaluation for high-risk patients: transfusion-dependent thalassemia major, sickle cell disease and other congenital anemias (Wood, 2014)	**Evaluation of iron overload in the following settings** • Initial evaluation of liver iron in Hemochromatosis diagnosed in lieu of liver biopsy[22] • Annual evaluation for high-risk patients: transfusion-dependent thalassemia major, sickle cell disease, Gaucher Disease, and other congenital anemias[23] when ultrasound is insufficient
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	[The following was added to the **RENAL** section:] • Polycysytic Kidney Disease ○ Total kidney volume (TKV) is an important measure for assessing disease progression as it can determine prognosis through its ability to predict decline in renal function ▪ Abdomen MRI is approvable prior to treatment (an ultrasound is not required prior to MR) ▪ If MR is contraindicated or cannot be performed, Abdomen CT is approvable
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	[The following was added to the **SPLEEN** section:] • In Gaucher Disease when ultrasound is insufficient[21] ○ For initial evaluation ○ To evaluate splenic fibrosis or the presence of focal splenic lesions ○ To monitor splenic volume/splenomegaly annually
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• Suspected incarceration or strangulation based on physical exam or prior imaging (CT preferred) (Halligan, 2018)	[The following was changed in **Suspected Hernia** section:] • Suspected incarceration or strangulation based on physical exam (guarding, rebound) or prior imaging (CT preferred)[39]
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[The following changes were made in the section **For evaluation of suspected infection or for follow-up known infection (may approve in conjunction with Pelvis MRI when indicated)**:]
 	
• Suspected peritonitis (from any cause)(would typically need to include MRI Pelvis) abdominal pain and tenderness to palpation is present, and **at LEAST one** of the following:
  ○ Rebound, guarding or rigid abdomen, **OR**
  ○ Severe tenderness to palpation over the entire abdomen
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[Within the section, **For evaluation of suspected inflammatory bowel disease or follow-up known disease (includes MR enterography and can also approve Pelvis MRI/MRE)**, the following was deleted:]
 	
• For MR enterography (MRE) if CT or MRI of the abdomen and pelvis are inconclusive
 	
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[Within the section **Other indications for abdominal MRI (and pelvis where appropriate) when CT is inconclusive or cannot be completed**, the following changes were made:]
 	
• For B symptoms of fevers more than 101 F, drenching night sweats, and unexplained weight loss of more than 10% of body weight over 6 months, if CXR labs and an ultrasound of the abdomen and pelvis have been completed (Cheson, 2014)
	[The following changes were made in the section **For evaluation of suspected infection or for follow-up known infection (may approve in conjunction with Pelvis MRI when indicated)**:]
	
	• Suspected peritonitis (would typically need to include MRI Pelvis) when abdominal pain and tenderness to palpation are present, and **at LEAST one** of the following:
	  ○ Rebound, guarding or rigid abdomen, **OR**
	  ○ Severe tenderness to palpation over the entire abdomen
	
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	[Within the section **Other indications for abdominal MRI (and pelvis where appropriate) when CT is inconclusive or cannot be completed**, the following changes were made:]
	
	• For B symptoms of fevers more than 101 F, drenching night sweats, or unexplained weight loss of more than 10% of body weight over 6 months

ABDOMEN/PELVIS CT COMBO	
Previous (red indicates deleted text)	New (blue indicates new text)
Evaluation of suspicious or known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings • Initial evaluation of suspicious masses/tumors found by physical exam or imaging study, such as ultrasound (US), and both the abdomen and pelvis are likely affected (ACR, 2013, 2014) • New evidence of an unknown primary (Greco, 2012) • Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen and pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious or a change was found on the last follow-up CT, new/changing sign/symptoms, or abnormal lab values • For abnormal incidental abdominopelvic lymph nodes when follow-up is recommended based on prior imaging (initial 3-month FU) (Smereka, 2017) • For follow-up of mesenteric panniculitis (Kaya, 2018; Mclaughlin, 2013; van Putte-Katier, 2014) or lymphadenitis (Helbling, 2017) when another diagnosis is suspected after initial imaging or there is a failure of symptom resolution **Evaluation of known cancer (Bourgioti, 2016; NCCN, 2019b) (see exception for prostate cancer*)** • **Initial staging of known cancer** ○ **Follow-up of known cancer of patient undergoing active treatment within the past year**	**Evaluation of suspicious or known mass/tumors (unconfirmed diagnosis of cancer) for further evaluation of indeterminate or questionable findings** • Initial evaluation of suspicious masses/tumors found by physical exam or imaging study, such as ultrasound (US), and both the abdomen and pelvis are likely affected[3, 4] • Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the abdomen and pelvis. No further surveillance CT unless tumor(s) are specified as highly suspicious or a change was found on the last follow-up CT, new/changing sign/symptoms, or abnormal lab values • For abnormal incidental abdominopelvic lymph nodes when follow-up is recommended based on prior imaging (initial 3-month FU)[5] • For follow-up of mesenteric panniculitis[6-8] or lymphadenitis[9] when another diagnosis is suspected after initial imaging or there is a failure of symptom resolution **Evaluation of known cancer[10, 11] (see exception for prostate cancer*)** • **Initial staging of known cancer** ○ **Follow-up of known cancer of patient undergoing active treatment within the past year or as per surveillance imaging guidance (Surveillance Imaging for Cancer Patients from NCCN)[11]** ○ **New evidence of an unknown primary[12]**

○ **Known cancer with suspected abdominal/pelvic metastasis** based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation)	○ **Known cancer with suspected abdominal/pelvic metastasis** based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation)
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For evaluation of suspected infection or inflammatory disease (ACR, 2013; Cartwright, 2015) • Suspected diverticulitis or acute appendicitis for initial imaging with at least **ONE** of the following (Linzay, 2018): ○ WBC Elevated ○ Fever ○ Anorexia ○ Nausea and vomiting	**For evaluation of suspected infection or inflammatory disease[14, 15]** • Suspected diverticulitis or acute appendicitis* for initial imaging with at least **ONE** of the following[16]: ○ WBC Elevated ○ Fever ○ Anorexia ○ Nausea and vomiting *Use ultrasound or MRI in pregnant women with suspected appendicitis[17] • Suspected diverticulitis[18] when ○ Pain is present in the LLQ (<3 months duration), medical records note suspicion for diverticulitis, the patient has no prior history of diverticulitis, AND LLQ tenderness is present on exam; OR ○ Patient is immunocompromised; OR ○ Patient has a history of diverticulitis, symptoms are similar to prior episodes, AND patient has failed treatment currently (treatment could be liquid diet/anti-inflammatories or antibiotic)
• Suspected appendicitis in a child (< age 18) (AAP, 2019; ACR, 2018; ACS, 2013; Baker, 2020; Sanchez, 2016) when ultrasound is inconclusive or cannot be completed due to body habitus or inability to cooperate	• Suspected appendicitis in a child (< age 18)[19-23] when ultrasound is inconclusive or cannot be completed due to body habitus or inability to cooperate OR when peritoneal signs are present (guarding, rebound) or other red flags

• Use ultrasound or MRI in pregnant women with suspected appendicitis (ACR, 2018) • For acute non-localized abdominal pain and fever, no recent surgery (ACR, 2018) • For suspected retroperitoneal fibrosis after labs and inconclusive ultrasound (Runowska, 2016) --- **Suspected inflammatory bowel disease (includes CT enterography)** • For suspected inflammatory bowel disease (Crohn's disease or ulcerative colitis) with abdominal pain **AND** one of the following (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018): ○ Chronic diarrhea ○ Bloody diarrhea Note: For patients under 35 years old, consider MRE • High clinical suspicion after complete work up including physical exam, labs, endoscopy with biopsy (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018; Rubin, 2019) • For CT enterography (CTE) if a CT scan is inconclusive **For evaluation of hematuria when stone is NOT suspected (includes CT urography (CTU))** (ACR, 2019; Davis, 2012; Sharp, 2013) • For painless, microscopic hematuria (should be documented by greater than 3 red blood cells (RBC) per high-power field on urinalysis and not based on a dipstick test) (Davis, 2012)	• For acute non-localized abdominal pain and fever, no recent surgery[24] • For suspected retroperitoneal fibrosis after labs and inconclusive ultrasound[25] --- **Suspected inflammatory bowel disease (includes CT enterography)** • For suspected inflammatory bowel disease (Crohn's disease or ulcerative colitis) with abdominal pain **AND** one of the following[29-31]: ○ Chronic diarrhea ○ Bloody diarrhea Note: For patients under 35 years old, consider MRE due to concern for likelihood of the need for repeat imaging in order to reduce potential radiation dose[32] • High clinical suspicion after complete work up including physical exam, labs, endoscopy with biopsy[29-31, 33] **For evaluation of hematuria when stone is NOT suspected (includes CT urography (CTU))[34-36]** • Documented by greater than 3 red blood cells (RBC) per high-power field on urinalysis and not based on a dipstick test[34] AND ONE or more of the following: ○ Age > 60; ○ 30+ pack year smoking history; or ○ > 25 RBC/hpf (i.e., high risk) • If not high risk (as above), need equivocal or abnormal renal ultrasound prior to CT

• For non-infectious macroscopic or gross hematuria (UA must be negative for infection, however, UA can be negative for blood, if hematuria is witnessed by patient or provider)
 	
NOTE: If a previous "routine" CT abdomen/pelvis has been done (with or with/without contrast), and a CTU is later requested, the previous CT must show a clear reason that additional delayed post-contrast images of the collecting system are needed.
 	
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[With the section **Other Indications for Abdomen/Pelvic CT Combo**, the following changes:]
• For B symptoms of fevers to more than 101° F, drenching night sweats, and unexplained weight loss of more than 10% of body weight over 6 months, if CXR, labs and an ultrasound of the abdomen and pelvis have been completed (can also approve chest CT) (Cheson, 2014)
	• Gross hematuria
	  ○ UA must be negative for infection
	  ○ UA can be negative for blood if hematuria is witnessed by patient or provider
	NOTE: If a previous "routine" CT abdomen/pelvis has been done (with or with/without contrast), and a CTU is later requested, the previous CT must show a clear reason that additional delayed post-contrast images of the collecting system are needed.
	
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	[With the section **Other Indications for Abdomen/Pelvic CT Combo**, the following changes:]
	• Concern for lymphoma/malignancy with B symptoms of fevers to more than 101° F, drenching night sweats, and/or unexplained weight loss of more than 10% of body weight over 6 months (can also approve chest CT)[53]

ABDOMEN/PELVIS CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
[Within the section **Post-operative or post-procedural evaluation**:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. Routine, baseline study (post-op/intervention) is warranted within 1-3 months (ACR, 2017; Chaikof, 2018; Uberoi, 2011). ○ If asymptomatic at 6-month intervals for one year, then annually	[Within the section **Post-operative or post-procedural evaluation**:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) or abdominal extent of iliac artery aneurysms. ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months[1, 23, 24] (abdomen and pelvis MRA when CTA is inconclusive or cannot be performed) ○ If asymptomatic at 6-month intervals for one year, then annually

BONE MARROW MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
	The following note was added: NOTE: If the request is for whole body MRI screening for a rare genetic predisposition syndrome (such as Li-Fraumeni syndrome (LFS) constitutional mismatch repair deficiency (CMMRD) syndrome, neurofibromatosis type 1 etc.) an unlisted MRI study may be more appropriate, please see NIA GL 063*.

BRAIN (HEAD) CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR BRAIN CTA Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section. Patients with claustrophobia, limited ability to cooperate, or an implanted device may be better suited for CTA; whereas those with renal disease or iodine contrast allergy should have MRA (Chen, 2018).	**INDICATIONS FOR BRAIN CTA** Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section. If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines) Patients with claustrophobia, limited ability to cooperate, an implanted device or in an urgent scenario may be better suited for CTA; whereas those with renal disease or iodine contrast allergy should have MRA.[1]
For evaluation of suspected intracranial vascular disease (Robertson, 2020; Salmela, 2017) <u>Aneurysm screening</u> • Screening for suspected intracranial aneurysm in patient with first-degree family history (parent, brother, sister, or child) of intracranial aneurysm **Note**: Repeat study is recommended every 5 years (Chalouhi, 2011)	**For evaluation of suspected intracranial vascular disease[2, 3]** <u>Aneurysm screening</u> • Screening for suspected intracranial aneurysm in patient with first-degree family history (parent, brother, sister, or child) of intracranial aneurysm **Note**: Repeat study is recommended every 5 years[4]

• Screening for aneurysm in polycystic kidney disease (after age 30), Loeys-Dietz syndrome‡, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation (Hayes, 2018; Hitchcock, 2016) ‡For Loeys-Dietz imaging should be repeated at least every two years	• Screening for aneurysm in polycystic kidney disease (after age 30), Loeys-Dietz syndrome‡, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation (after age 10)[5-9] ‡For Loeys-Dietz, imaging should be repeated at least every two years
<u>Vascular abnormalities</u> • Suspected vascular malformation (arteriovenous malformation (AVM) or dural arteriovenous fistula) in patient with previous or indeterminate imaging study • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up (Whitehead, 2019, Yeh, 2010, Yuan, 2018) ○ Negative Brain CT; AND Negative Lumbar Puncture; OR ○ Negative Brain MRI	<u>Vascular abnormalities</u> • Suspected vascular malformation (arteriovenous malformation (AVM) or dural arteriovenous fistula) in patient with previous or indeterminate imaging study • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset[10-13] **Note**: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients[13]
• Headache associated with exercise or sexual activity (ICHD-3, 2018) • Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm (Pula, 2016) • Pulsatile tinnitus to identify a vascular etiology (Hofmann, 2013; Pegge, 2017) **Note:** MRI is the study of choice for detecting cavernomas (Morrison, 2016; Zyck, 2021)	• Headache associated with exercise or sexual activity[14] • Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm[15] • Pulsatile tinnitus to identify a suspected arterial vascular etiology[16, 17] **Note:** MRI is the study of choice for detecting low flow malformations (see background) [18-20]
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Sickle cells disease (ischemic and/or hemorrhagic) and MRV is contraindicated or cannot be performed (Thust, 2014) • Neurological signs or symptoms in sickle cell disease	***Sickle cells disease (ischemic and/or hemorrhagic) and MRA is contraindicated or cannot be performed[31]*** • Neurological signs or symptoms in sickle cell disease

• Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 --- **For evaluation of known intracranial vascular disease** (Robertson, 2020; Salmela, 2017) • Known intracranial aneurysm or vascular malformation (i.e., AVM or dural arteriovenous fistula) --- **Indications for Brain CTA/Neck CTA combination studies** • Recent ischemic stroke or transient ischemic attack (Sanelli, 2014) • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Searls, 2012) • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall (Franz, 2012; Shakir, 2016) • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010) • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (AAN, 2010; Brott, 2011; Rerkasem, 2011)	• Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 --- **For evaluation of known intracranial vascular disease[2, 3]** • Known intracranial aneurysm, treated aneurysm, or known vascular malformation (i.e., AVM or dural arteriovenous fistula) --- **Indications for Brain CTA/Neck CTA combination studies** • Recent ischemic stroke or transient ischemic attack[21] • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[23, 24] • Suspected carotid or vertebral artery dissection; secondary to trauma or spontaneous due to weakness of vessel wall[41, 42] • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[43-45] • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[43, 46]

• Pulsatile tinnitus to identify vascular etiology (Hofmann, 2013; Pegge, 2017) **Indications for Brain CT/Brain CTA combination studies** (Robertson, 2020; Salmela, 2017) • Recent ischemic stroke or transient ischemic attack • Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm • Headache associated with exercise or sexual activity when MRI is contraindicated or cannot be performed (ICHD-3, 2018) • Suspected venous thrombosis (dural sinus thrombosis) – CTV and MRI are contraindicated or cannot be performed **Indications for Brain CT/Brain CTA/Neck CTA combination studies** • Recent ischemic stroke or transient ischemic attack (TIA) (Robertson, 2020; Salmela, 2017) • Approved indications as noted above and being performed in high-risk populations (in whom MRI is contraindicated or cannot be performed) and will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology	• Pulsatile tinnitus to identify a suspected arterial vascular etiology[16, 17] **Indications for Brain CT/Brain CTA combination studies[2, 3]** • Recent ischemic stroke or transient ischemic attack (TIA) when MRI is contraindicated or cannot be performed • Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm • Headache associated with exercise or sexual activity when MRI is contraindicated or cannot be performed[14] • Suspected venous thrombosis (dural sinus thrombosis) and MRI is contraindicated or cannot be performed – CT/CTV** • Neurological signs or symptoms in sickle cell patients when MRI is contraindicated or cannot be performed • High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 when MRI is contraindicated or cannot be performed **Indications for Brain CT/Brain CTA/Neck CTA combination studies** • Recent ischemic stroke or transient ischemic attack (TIA)[2, 3] when MRI is contraindicated or cannot be performed • Approved indications as noted above and being performed in high-risk populations (in whom MRI is contraindicated or cannot be performed) and will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology

BRAIN (HEAD) CT	
Previous (red indicates deleted text)	New (blue indicates new text)
REDUCING RADIATION EXPOSURE Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section.	**REDUCING RADIATION EXPOSURE** Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section. If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)
Important Note: Brain MRI is preferred to Brain CT in most circumstances where the patient can tolerate MRI and sufficient time is available to schedule the MRI examination. Assessment of subarachnoid hemorrhage, acute trauma, or bone abnormalities of the calvarium (fracture, etc.) may be better imaged with CT. CT is also appropriate in an urgent situation where MRI is not readily available (stroke, increased ICP, CNS infection).	**Important Note:** Brain MRI is preferred to Brain CT in most circumstances where the patient can tolerate MRI and sufficient time is available to schedule the MRI examination. Assessment of subarachnoid hemorrhage, acute trauma, or bone abnormalities of the calvarium (fracture, etc.) may be better imaged with CT. CT is also appropriate in an urgent situation where MRI is not readily available (stroke, increased ICP, CNS infection).
‡ Designates when CT is indicated only when MRI is contraindicated or cannot be performed	***‡‡ — Designates CT is indicated only when MRI is contraindicated or cannot be performed***
INDICATIONS FOR BRAIN CT	**INDICATIONS FOR BRAIN CT**

For evaluation of headache (ACR, 2019c; Holle, 2013; Quinones-Hinojosa, 2003; Schaefer, 2007; Wilbrink, 2009) • Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration) ‡ • Cluster headaches or other trigeminal-autonomic cephalgias, i.e., paroxysmal hemicrania, hemicrania continua, short-lasting unilateral neuralgiform headache attacks (SUNCT/SUNA) imaging is indicated once to eliminate secondary causes (IHS, 2018) ‡ • New acute headache, sudden onset: o With a personal or family history (brother, sister, parent, or child) of brain aneurysm or AVM (arteriovenous malformation) o < 48 hours of "worst headache in my life" or "thunderclap" headache ▪ Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes. o Prior history of stroke or intracranial bleed o Known coagulopathy or on anticoagulation • New onset of headache with any of the following (ACR, 2019c; Micieli, 2020; Mitsikostas, 2016): o Acute, new, or fluctuating neurologic deficits, such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes or with signs of increased intracranial pressure (papilledema). ‡ * Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration o History of cancer or significantly immunocompromised ‡	**For evaluation of headache[1-5]** • Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration) ‡‡ • Cluster headaches or other trigeminal-autonomic cephalgias, i.e., paroxysmal hemicrania, hemicrania continua, short-lasting unilateral neuralgiform headache attacks (SUNCT/SUNA) imaging is indicated once to eliminate secondary causes[6] ‡‡ • Acute headache, sudden onset: o With a personal or family history (brother, sister, parent, or child) of brain aneurysm or AVM (arteriovenous malformation) o < 48 hours of "worst headache in my life" or "thunderclap" headache ▪ Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes. o Prior history of stroke or intracranial bleed o Known coagulopathy or on anticoagulation • New onset of headache with any of the following[1, 7, 8]: o Acute, new, or fluctuating neurologic deficits, such as sensory deficits, limb weakness, abnormal reflexes, speech difficulties, visual loss, lack of coordination, or mental status changes or with signs of increased intracranial pressure (papilledema). See background ‡‡ o History of cancer or significantly immunocompromised ‡‡

○ Fever ○ Subacute head trauma ○ Age ≥ 50 ‡ ○ New severe unilateral headache with radiation to or from the neck, associated with suspicion of carotid or vertebral artery dissection ‡ ○ Related to activity or event (sexual activity, exertion, position) (new or progressively worsening) ‡ ○ Persistent or worsening during a course of physician-directed treatment (ACR, 2019c; Kuruvilla, 2015; Martin, 2011) ‡ **Note**: Neuroimaging warranted for atypical/complex migraine aura, but not for a typical migraine aura (see background) • Special considerations in the pediatric population with persistent headache (Trofimova, 2018): ○ Occipital location ‡ ○ Age < 6 years ‡ ○ Symptoms indicative of increased intracranial pressure, such as recurring headaches after waking with or without associated nausea/vomiting ‡ ○ Documented absence of family history of headache ‡ ○ Severe headache in a child with an underlying disease that predisposes to intracranial pathology (e.g., immune deficiency, sickle cell disease, neurofibromatosis, history of neoplasm, coagulopathy, hypertension, congenital heart disease) **For evaluation of neurologic symptoms or deficits** (ACR, 2012a) • Acute, new, or fluctuating neurologic symptoms or deficits, such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes	○ Fever ○ Subacute head trauma ○ Age ≥ 50 ‡‡ ○ New severe unilateral headache with radiation to or from the neck, associated with suspicion of carotid or vertebral artery dissection ‡‡ ○ Related to activity or event (sexual activity, exertion, position) and (new or progressively worsening ‡‡ ○ Persistent or worsening during a course of physician-directed treatment[1, 9, 10] ‡‡ **Note**: Neuroimaging warranted for atypical/complex migraine aura, but not for a typical migraine aura (see background) • Special considerations in the pediatric population with persistent headache[11]: ○ Occipital location ‡‡ ○ Age < 6 years ‡‡ ○ Symptoms indicative of increased intracranial pressure, such as recurring headaches after waking with or without associated nausea/vomiting ‡‡ ○ Documented absence of family history of headache ‡‡ ○ Severe headache in a child with an underlying disease that predisposes to intracranial pathology (e.g., immune deficiency, sickle cell disease, neurofibromatosis, history of neoplasm, coagulopathy, hypertension, congenital heart disease) **For evaluation of neurologic symptoms or deficits[12]** • Acute, new, or fluctuating neurologic symptoms or deficits, such as sensory deficits, limb weakness, abnormal reflexes,

* Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration **For evaluation of known or suspected stroke or vascular disease** (ACR 2017a, 2019a; Jauch, 2013) • Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes * Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration • Suspected stroke with first-degree family history of aneurysm (brother, sister, parent, or child) or known coagulopathy or on anticoagulation • Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes) ‡ • Suspected acute subarachnoid hemorrhage (SAH) • Follow-up for known hemorrhage, hematoma, or vascular abnormalities • Suspected central venous thrombosis - see background (ACR, 2017a; Bushnell, 2014) ‡ • Evaluation of neurological signs or symptoms in sickle cell disease (Arkuszewski, 2010; Mackin, 2014; Thust, 2014) --- **For evaluation of suspected brain tumor, mass, or metastasis** (ACR, 2018; Kerjnick, 2008; NCCN, 2020) • Suspected brain tumor with any acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, limb	speech difficulties, visual loss, lack of coordination, or mental status changes (see background) **For evaluation of known or suspected stroke or vascular disease[13-15]** • Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes (see background) • Suspected stroke with first-degree family history of aneurysm (brother, sister, parent, or child) or known coagulopathy or on anticoagulation • Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes) ‡‡ • Suspected acute subarachnoid hemorrhage (SAH) • Follow-up for known hemorrhage, hematoma, or vascular abnormalities • Suspected central venous thrombosis - see background[14-16] ‡‡ • Evaluation of neurological signs or symptoms in sickle cell disease[17-19] ‡‡ • High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity >200 ‡‡[19] --- **For evaluation of suspected brain tumor, mass, or metastasis[25-27]** • Suspected brain tumor with any acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, abnormal reflexes, limb weakness, speech difficulties, visual

weakness, speech difficulties, visual loss*, lack of coordination or mental status changes ‡
* Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration
• Suspected brain metastasis or intracranial involvement in patients with a history of cancer based on symptoms or examination findings (may include new or changing lymph nodes) ‡
• Langerhans cell histiocytosis with visual, neurological, or endocrine abnormality; polyuria or polydipsia; suspected craniofacial bone lesions, aural discharge, or suspected hearing impairment/mastoid involvement (Haupt, 2013, NCCN, 2020)
	loss, lack of coordination or mental status changes ‡‡ (see background)
	• Suspected brain metastasis or intracranial involvement in patients with a history of cancer based on symptoms or examination findings (may include new or changing lymph nodes) ‡‡
	• Histiocytic Neoplasms for screening and/or with neurological signs or symptoms[28, 29]
	  ○ Erdheim-Chester Disease
	  ○ Langerhans Cell Histiocytosis
	  ○ Rosai-Dorfman Disease
	• Suspected Pituitary Tumors (**Brain MRI** is the study of choice if indicated) or Sella CT if MRI is contraindicated or cannot be performed
	• Screening for known non-CNS Cancer and for screening of hereditary cancers syndromes **(Brain MRI** is the study of choice if indicated)

For evaluation of known brain tumor, mass, or metastasis • Follow-up of known malignant brain tumor ‡ • Suspected recurrence with prior history of CNS cancer (either primary or secondary) based on neurological symptoms or examination findings ‡ • Patient with history of CNS cancer (either primary or secondary) and a recent course of chemotherapy, radiation therapy (to the brain), or surgical treatment within the last two (2) years (NCCN, 2020) ‡	**For evaluation of known brain tumor, mass, or metastasis** • Follow-up of known CNS cancer (either primary malignant brain tumor or secondary brain metastasis) as per NCCN[27] ‡‡ • Suspected recurrence with prior history of CNS cancer (either primary or secondary) based on neurological symptoms or examination findings ‡‡ • Follow-up of known low grade tumor (WHO I-II) (i.e., meningioma, glioma, astrocytoma, oligodendroglioma) ‡‡ ○ For surveillance as per NCCN[27]

• Follow-up of known non-malignant tumor/lesion if symptomatic, new/changing signs or symptoms or complicating factors
• Follow-up of known meningioma (NHS, 2018) ‡
  ○ If <2cm or heavily calcified at 2 years and 5 years
  ○ > 2cm annually for 3 years and then scans at 5 years and 10 years
  ○ Multiple meningiomas, annually
  ○ After treatment (surgery or radiotherapy), post-operative if concern for residual tumor, every 6-12 months, then annually for 3-5 years based on WHO Grade (see background)
	○ If symptomatic, new/changing signs or symptoms or complicating factors

• Bone tumor or abnormality of the skull (Gomez, 2018)
• Langerhans cell histiocytosis (Haupt, 2013, NCCN, 2020)
  ○ To assess treatment response and surveillance of known brain/skull lesions
	• Known pituitary tumors (**Brain MRI** is the study of choice if indicated) or Sella CT if MRI is contraindicated or cannot be performed
	• Tumor monitoring in neurocutaneous syndromes as per tumor type ‡‡
	• Bone tumor or abnormality of the skull[30]
	• Histiocytic Neoplasms to assess treatment response and surveillance of known brain/skull lesions[28, 29]
	  ○ Erdheim-Chester Disease
	  ○ Langerhans Cell Histiocytosis
	  ○ Rosai-Dorfman Disease [31]

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases ‡ (NCCN, 2020) • ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine	**Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated, OR evaluation of suspected metastases[27] ‡‡** • ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine

For evaluation of known or suspected seizure disorder (Cendes, 2013; Gaillard, 2009; Krumholz, 2007; Ramli, 2015) • New onset of seizures or newly identified change in seizure activity/pattern ‡	**For evaluation of known or suspected seizure disorder**[32-35] • New onset of seizures or newly identified change in seizure activity/pattern ‡‡ **(Brain MRI** is the study of choice if indicated)
For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess) (Lummel, 2016; Tunkel, 2008) ‡ • Suspected intracranial abscess or brain infection with acute altered mental status OR positive lab findings (such as elevated WBCs) OR follow-up assessment during or after treatment completed • Meningitis with positive signs and symptoms (such as fever, headache, mental status changes, stiff neck) OR positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam) • Suspected encephalitis with headache and altered mental status OR follow-up as clinically warranted • Endocarditis with suspected septic emboli • Central Nervous System (CNS) involvement in patients with known or suspected vasculitis or autoimmune disease with abnormal inflammatory markers or autoimmune antibodies • Suspected primary CNS vasculitis based on neurological signs and symptoms with completed infectious/inflammatory lab work-up (Godasi, 2019; Zuccoli, 2011) • Immunocompromised patient (e.g., transplant recipients, HIV with CD4 < 200, primary immunodeficiency syndromes, hematologic malignancies) with focal neurologic-symptoms, headaches, behavioral, cognitive, or personality changes (Graham, 2000)	**For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess)**[36, 37] ‡‡ • Suspected intracranial abscess or brain infection with acute altered mental status OR positive lab findings (such as elevated WBCs) OR follow-up assessment during or after treatment completed ‡‡ • Meningitis with positive signs and symptoms (such as fever, headache, mental status changes, stiff neck) OR positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam) ‡‡ • Suspected encephalitis with headache and altered mental status OR follow-up as clinically warranted ‡‡ • Endocarditis with suspected septic emboli ‡‡ • Central Nervous System (CNS) involvement in patients with known or suspected vasculitis or autoimmune disease with abnormal inflammatory markers or autoimmune antibodies ‡‡ • Suspected primary CNS vasculitis based on neurological signs and symptoms with completed infectious/inflammatory lab work-up ‡‡ [38, 39] • Immunocompromised patient (e.g., transplant recipients, HIV with CD4 < 200, primary immunodeficiency syndromes, hematologic malignancies) with focal neurologic-symptoms, headaches, behavioral, cognitive, or personality changes ‡‡ [40]

For evaluation of clinical assessment documenting cognitive impairment of unclear cause (AAN, 2017; Harvey, 2012; HQO, 2014; Narayanan, 2016) • Change in mental status with a mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments */formal neuropsychological testing showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12) ‡ *Other examples include: Ottawa 3DY (O3DY), Brief Alzheimer's Screen (BAS), Blessed Dementia Scale (BDS), caregiver-completed AD8 (cAD8), Brief Cognitive Rating Scale (BCRS), Clinical Dementia Rating (CDR) (Carpenter, 2011; McDougall, 1990) **For evaluation of movement disorders** (Mascalchi, 2012) • Acute onset of a movement disorder with concern for stroke or hemorrhage ‡ • For evaluation of Parkinson's disease with atypical feature or other movement disorder (i.e., suspected Huntington disease, chorea, parkinsonian syndromes, hemiballismus, atypical dystonia) to exclude an underlying structural lesion ‡ **Note**: CT has limited utility in the chronic phases of disease. Imaging is not indicated in essential tremor or isolated focal dystonia (e.g., blepharospasm, cervical dystonia, laryngeal dystonia, oromandibular dystonia, writer's dystonia) (Albanese, 2011; Comella, 2019; Sharifi, 2014) **For evaluation of cranial nerve and visual abnormalities**	**For evaluation of clinical assessment documenting cognitive impairment of unclear cause[41-44]** • Change in mental status with a mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments */formal neuropsychological testing showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12) ‡‡ * Other examples include: Mini-Cog, Memory Impairment Screen, Saint Louis University Mental Status Examination (SLUMS), Brief Alzheimer's Screen (BAS), Blessed Dementia Scale (BDS), Clinical Dementia Rating (CDR)[45, 46] **For evaluation of movement disorders[47]** • Acute onset of a movement disorder with concern for stroke or hemorrhage ‡‡ • For evaluation of Parkinson's disease with atypical feature or other movement disorder (i.e., suspected Huntington disease, chorea, parkinsonian syndromes, hemiballismus, atypical dystonia) to exclude an underlying structural lesion ‡‡ **Note**: CT has limited utility in the chronic phases of disease. **Brain MRI** is the study of choice if indicated. Imaging is not indicated in essential tremor, Tourette' syndrome or isolated focal dystonia (e.g., blepharospasm, cervical dystonia, laryngeal dystonia, oromandibular dystonia, writer's dystonia).[48-50] **For evaluation of cranial nerve and visual abnormalities (Brain MRI is the study of choice if indicated)**

• Anosmia (loss of smell) or dysosmia (documented by objective testing) that is persistent and of unknown origin (Policeni, 2017; Rouby, 2011) ‡ • Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, new onset anisocoria, visual field deficit, etc.) (Chang, 2019) ‡ **Note**: Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration • Binocular diplopia with concern for intracranial pathology (Iliescu, 2017) ‡ • Childhood strabismus with development delay or abnormal fundoscopic exam to rule out intracranial abnormalities (Kadom, 2008; Yoon, 2019) ‡ • Horner's syndrome with symptoms localizing the lesion to the central nervous system (Lee, 2007) ‡ • Evaluation of cranial neuropathy when thought to be due to tumor, stroke, or bony abnormalities of the skull base or when MRI is contraindicated or cannot be performed (ACR, 2017b) **For evaluation of known or suspected congenital abnormality (such as craniosynostosis, neural tube defects**) (Ashwal, 2009; Marchese, 2017; Vinocur, 2010) • Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes	• Anosmia (loss of smell) or dysosmia (documented by objective testing) that is persistent and of unknown origin[51, 52] ‡‡ • Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, new onset anisocoria, visual field deficit, etc.)[53] ‡‡ **Note**: See background • Binocular diplopia with concern for intracranial pathology[54] after comprehensive eye evaluation ‡‡ • Childhood strabismus with development delay or abnormal fundoscopic exam to rule out intracranial abnormalities[55, 56] ‡‡ • Horner's syndrome with symptoms localizing the lesion to the central nervous system[57] ‡‡ • Evaluation of cranial nerve palsy/neuropathy/neuralgia when thought to be due to tumor, stroke, or bony abnormalities of the skull base or when MRI is contraindicated or cannot be performed[51] • Bulbar or pseudobulbar symptoms ‡‡ **For evaluation of known or suspected congenital abnormality (such as craniosynostosis, neural tube defects**)[58-60] • Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes • For initial evaluation of a suspected Arnold Chiari malformation ‡‡ • Follow-up imaging of a known type II or type III Arnold Chiari malformation ‡‡. For Arnold Chiari type I, follow-up imaging only if new or changing signs/symptoms[61, 62]

• Evaluation of macrocephaly in an infant/child <18 with previously abnormal US, abnormal neurodevelopmental examination (Tan, 2018), signs of increased ICP or closed anterior fontanelle ‡ • Microcephaly in an infant/child < 18 ‡ • Evaluation of the corticomedullary junction in Achondroplasia (Dougherty,2018; Kubota, 2021) ‡ • Craniosynostosis and other head deformities • • • • • • Prior treatment or planned treatment for congenital abnormality **Note**: For evaluation of known or suspected hydrocephalus please see section on CSF abnormalities. --- **Other Indications** (DeFoer, 2006; Kattah, 2009; Tarrant, 2008; Thust, 2014) • Vertigo associated with any of the following: ‡ ○ Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation) (Welgampola, 2019; Yamada, 2019) ○ Progressive unilateral hearing loss ○ Risk factors for cerebrovascular disease with concern for stroke ○ After full neurologic examination and vestibular testing with concern for central vertigo (i.e., skew deviation, vertical nystagmus, head thrust test,	• Evaluation of macrocephaly in an infant/child <18 with previously abnormal US, abnormal neurodevelopmental examination,[63] signs of increased ICP or closed anterior fontanelle ‡‡ • Microcephaly in an infant/child < 18 ‡‡ • Craniosynostosis and other head deformities • Evaluation of the corticomedullary junction in Achondroplasia[64, 65] ‡‡ • Cerebral palsy if etiology has not been established in the neonatal period, there is change in the expected clinical or developmental profile or concern for progressive neurological disorder[66, 67] • Prior treatment or planned treatment for congenital abnormality **Note**: For evaluation of known or suspected hydrocephalus please see section on CSF abnormalities. --- **Other Indications**[19, 77-79] • Vertigo associated with any of the following: ‡‡ ○ Signs or symptoms suggestive of a CNS lesion (ataxia, visual loss, double vision, weakness or a change in sensation)[80, 81] ○ Progressive unilateral hearing loss ○ Risk factors for cerebrovascular disease with concern for stroke ○ After full neurologic examination and vestibular testing with concern for central vertigo (i.e., skew deviation, vertical nystagmus, head thrust test,

videonystagmography (VNG)/ electronystagmography (ENG))
• Diagnosis of central sleep apnea on polysomnogram ‡
  ○ Children > 1 year (Felix, 2016)
  ○ Adults in the absence of heart failure, chronic opioid use, high altitude, or treatment emergent central sleep apnea AND concern for a central neurological cause (Chiari malformation, tumor, infectious/inflammatory disease) OR with an abnormal neurological exam (Malhotra, 2010)
• Syncope with clinical concern for seizure or associated neurological signs or symptoms (ACP, 2012; AFP, 2020; Al-Nsoor, 2010; Strickberger, 2006) ‡
• Cyclical vomiting syndrome or abdominal migraine with any localizing neurological symptoms (Angus-Leppan, 2018; Li, 2018; Venkatesan, 2019) ‡
• Soft tissue mass of the head with nondiagnostic initial evaluation (ultrasound and/or radiograph) (ACR, 2017c; Kim, 2019; Zhang, 2018) ‡
• Psychological changes with neurological deficits on exam or after completion of a full neurological assessment that suggests a possible neurologic cause (ACR, 2019b) ‡
• Global developmental delay or developmental delay with abnormal neurological examination in a child < 18 years (Ali, 2015; Momen, 2011) ‡
• Cerebral palsy if etiology has not been established in the neonatal period, there is change in the expected clinical or developmental profile or concern for progressive neurological disorder (Ashwal, 2004; NICE, 2020)
• Unexplained event (BRUE) formerly apparent life-threatening event (ALTE) in infants < 1 year with concern for neurological cause based on history and exam (Tieder, 2016) ‡
Note: Imaging is not indicated in low-risk patients
	videonystagmography (VNG)/ electronystagmography (ENG))
	• Diagnosis of central sleep apnea on polysomnogram ‡‡
	  ○ Children > 1 year[82]
	  ○ Adults in the absence of heart failure, chronic opioid use, high altitude, or treatment emergent central sleep apnea AND concern for a central neurological cause (Chiari malformation, tumor, infectious/inflammatory disease) OR with an abnormal neurological exam[83]
	• Syncope with clinical concern for seizure or associated neurological signs or symptoms[84-87] ‡‡
	• Cyclical vomiting syndrome or abdominal migraine with any localizing neurological symptoms[88-90] ‡‡
	• Soft tissue mass of the head with nondiagnostic initial evaluation (ultrasound and/or radiograph)[91-93] ‡‡
	• Psychological changes with neurological deficits on exam or after completion of a full neurological assessment that suggests a possible neurologic cause[94] ‡‡
	• Global developmental delay or developmental delay with abnormal neurological examination in a child < 18 years[95, 96] ‡‡
	• Unexplained event (BRUE) formerly apparent life-threatening event (ALTE) in infants < 1 year with concern for neurological cause based on history and exam[97] ‡‡
	Note: Imaging is not indicated in low-risk patients

• Prior to lumbar puncture in patients with suspected increased intracranial pressure or at risk for herniation **Indications for Combination Studies** (ACR, 2017a, 2019a)	• Prior to lumbar puncture in patients with suspected increased intracranial pressure or at risk for herniation **Indications for Combination Studies**[13, 14] Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the neuroaxis), patient history, and other available information, including prior imaging.
• Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000) ----	Exception: Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology[98] ----
• **Brain CT/Brain CTA** ○ Recent ischemic stroke or transient ischemic attack ○ Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm ○ Headache associated with exercise or sexual activity (IHS, 2018) ‡ ○ Suspected venous thrombosis (dural sinus thrombosis) – Brain CTV (see background) ‡	• **Brain CT/Brain CTA** ○ Recent ischemic stroke or transient ischemic attack ○ Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm ○ Headache associated with exercise or sexual activity[6] ‡‡ ○ Suspected venous thrombosis (dural sinus thrombosis) – Brain CTV (see background) ‡‡ ○ Neurological signs or symptoms in sickle cell patients ‡‡ ○ High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 ‡‡ [19]
• **Brain CT/Brain CTA/Neck CTA** • Recent stroke or transient ischemic attack (TIA)	• **Brain CT/Brain CTA/Neck CTA** • Recent stroke or transient ischemic attack (TIA)

• Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits	• Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits *Note: MRA and CTA are generally comparable noninvasive imaging alternatives each with their own advantages and disadvantages. ○ Brain MRI can alternatively be combined with Brain CTA/Neck CTA.
• **Brain CT/Orbit CT** ○ Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion, or optic nerve infiltrative disorders (Behbehani, 2007) ‡ ○ Bilateral optic disk swelling (papilledema) with visual loss (Margolin, 2019) ‡	• **Brain CT/Orbit CT** ○ Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion, or optic nerve infiltrative disorders[99] ‡‡ ○ Bilateral optic disk swelling (papilledema) with visual loss[100] ‡‡ • **Brain CT/Cervical CT/Thoracic CT/Lumbar CT (any combination) ‡‡** ○ For initial evaluation of a suspected Arnold Chiari malformation ○ Follow-up imaging of a known type II or type III Arnold Chiari malformation. For Arnold Chiari type I, follow-up imaging only if new or changing signs/symptoms[61, 62] ○ Oncological Applications (e.g., primary nervous system, metastatic) ▪ Drop metastasis from brain or spine (CT spine imaging in this scenario is usually CT myelogram) see background

	▪ Suspected leptomeningeal carcinomatosis (see background)[101] ▪ Tumor evaluation and monitoring in neurocutaneous syndromes ○ CSF leak highly suspected and supported by patient history and/or physical exam findings (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula - CT spine imaging in this scenario is usually CT myelogram)[102]

BRAIN (HEAD) MRA/MRV	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR BRAIN (HEAD) MR Angiography/MR Venography Brain MRI/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MRI/Brain MRA combination studies section.	**INDICATIONS FOR BRAIN (HEAD) MR Angiography/MR Venography** Brain MRI/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MRI/Brain MRA combination studies section. If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)
For evaluation of suspected intracranial vascular disease (Robertson, 2020; Salmela, 2017) • **Aneurysm screening** ○ Screening for suspected intracranial aneurysm in patient with a first-degree familial history (parent brother, sister, or child) of intracranial aneurysm **Note**: Repeat study is recommended every 5 years (Chalouhi, 2011) ○ Screening for aneurysm in polycystic kidney disease (after age 30), Loeys-Dietz syndrome*, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation (Hayes, 2018; Hitchcock, 2017; Macaya, 2019)	**For evaluation of suspected intracranial vascular disease[1, 2]** • **Aneurysm screening** ○ Screening for suspected intracranial aneurysm in patient with a first-degree familial history (parent brother, sister, or child) of intracranial aneurysm **Note**: Repeat study is recommended every 5 years[3] ○ Screening for aneurysm in polycystic kidney disease (after age 30), Loeys-Dietz syndrome*, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation (after age 10)[4-9] *For Loeys-Dietz imaging should be repeated at least

*For Loeys-Dietz imaging should be repeated at least every two years • **Vascular abnormalities** ○ Suspected vascular malformation (arteriovenous malformation (AVM) or dural arteriovenous fistula) in patient with previous or indeterminate imaging study ○ Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up (Whitehead, 2019, Yeh, 2010, Yuan, 2005): ▪ Negative Brain CT AND Negative Lumbar Puncture OR ▪ Negative Brain MRI ○ Headache associated with exercise or sexual activity (IHS, 2018) ○ Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm (Pula, 2016). ○ Pulsatile tinnitus to identify a vascular etiology (Hofmann, 2013; Pegge, 2017). **Note:** MRI is the study of choice for detecting cavernomas (Morrison, 2016; Zyck, 2021) --- ○ Hemorrhagic ▪ Known subarachnoid hemorrhage (SAH) ▪ Known cerebral intraparenchymal hemorrhage with concern for underlying vascular abnormality --- **For evaluation of known intracranial vascular disease** (Robertson, 2020; Salmela, 2017)	every two years • **Vascular abnormalities** ○ Suspected vascular malformation (arteriovenous malformation (AVM) or dural arteriovenous fistula) in patient with previous or indeterminate imaging study ○ Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset[10] **Note**: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients[11] ○ Headache associated with exercise or sexual activity[12] ○ Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm[13] ○ Pulsatile tinnitus to identify a suspected arterial vascular etiology[14, 15] **Note:** MRI is the study of choice for detecting cavernomas, developmental venous anomalies and capillary telangiectasia (see background)[16] --- ○ Hemorrhagic ▪ Known subarachnoid hemorrhage (SAH) – CTA is favored over MRI unless there is a contradiction[11] ▪ Known cerebral intraparenchymal hemorrhage with concern for underlying vascular abnormality --- **For evaluation of known intracranial vascular disease[1, 2]**

• Known intracranial aneurysm or vascular malformation (i.e., AVM or dural arteriovenous fistula) --- **Indications for Brain MRA/Neck MRA combination studies** (Robertson, 2020; Salmela, 2017) • Recent ischemic stroke or transient ischemic attack (TIA) (Sanelli, 2014) • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Pirau, 2019; Searls, 2012) • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall (Franz, 2012; Shakir, 2016) • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010) • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; Rerkasem, 2011) • Pulsatile tinnitus to identify vascular etiology (Hofmann, 2013; Pegge, 2017) **Indications for Brain MRI/Brain MRA combination studies** (Robertson, 2020; Salmela, 2017)	• Known intracranial aneurysm, treated aneurysm, or known vascular malformation (i.e., AVM or dural arteriovenous fistula) --- **Indications for Brain MRA/Neck MRA combination studies[1, 2]** • Recent ischemic stroke or transient ischemic attack (TIA)[18] • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[19-21] • Suspected carotid or vertebral artery dissection; secondary to trauma or spontaneous due to weakness of vessel wall[42, 43] • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[44-46] • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[44, 47] • Pulsatile tinnitus to identify a suspected arterial vascular etiology[14, 15] **Indications for Brain MRI/Brain MRA combination studies[1, 2]**

• Recent ischemic stroke or transient ischemic attack
  • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up (Whitehead, 2019, Yeh, 2010, Yuan, 2005):
  ○ Negative Brain CT; AND
  ○ Negative Lumbar Puncture
• Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm
• Headache associated with exercise or sexual activity (IHS, 2018)
• Suspected venous thrombosis (dural sinus thrombosis) – MRV†
	• Recent ischemic stroke or transient ischemic attack (TIA)
	  • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset [7-9]
	Note: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients[11]
	• Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm
	• Headache associated with exercise or sexual activity[12]
	• Suspected venous thrombosis (dural sinus thrombosis) – MRI/MRV†
	• Neurological signs or symptoms in sickle cell patients
	• High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200

Indications for Brain MRI/Brain MRA/Neck MRA combination studies • Recent ischemic stroke or transient ischemic attack (TIA) (Robertson, 2020; Salmela, 2017) • Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000)	**Indications for Brain MRI/Brain MRA/Neck MRA combination studies** • Recent ischemic stroke or transient ischemic attack (TIA)[1, 2, 48] • Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology[49] **Any Combination of Brain MRA/Neck MRA/Brain MRI with IAC** • Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology[14, 48]

BRAIN (HEAD) MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR BRAIN MRI Brain MR/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MR/Brain MRA combination studies section.	**INDICATIONS FOR BRAIN MRI** Brain MR/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MR/Brain MRA combination studies section. If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)

For evaluation of headache
(ACR, 2019c; Holle, 2013; Quinones-Hinojosa, 2003; Schafer, 2007; Wilbrink, 2009)
• Chronic headache with a change in character/pattern (e.g., more frequent, increased severity, or duration)
• Cluster headaches or other trigeminal-autonomic cephalgias, i.e., paroxysmal hemicrania, hemicrania continua, short-lasting unilateral neuralgiform headache attacks (SUNCT/SUNA) imaging is indicated once to eliminate secondary causes (IHS, 2018)
• New acute headache, sudden onset:
  ○ With a personal or family history (brother, sister, parent, or child) of brain aneurysm or AVM (arteriovenous malformation) OR
	For evaluation of headache[1-5]
	• Chronic headache with a change in character/pattern (e.g., more frequent, increased severity, or duration)
	• Cluster headaches or other trigeminal-autonomic cephalgias, i.e., paroxysmal hemicrania, hemicrania continua, short-lasting unilateral neuralgiform headache attacks (SUNCT/SUNA) imaging is indicated once to eliminate secondary causes[6]
	• Acute headache, sudden onset:
	  ○ With a personal or family history (brother, sister, parent, or child) of brain aneurysm or AVM (arteriovenous malformation) OR

○ < 48 hours of "worst headache in my life" or "thunderclap" headache. ▪ Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes. ○ Prior history of stroke or intracranial bleed ○ Known coagulopathy or on anticoagulation • New onset of headache with any of the following (ACR, 2019c; Micieli, 2020; Mitsikostas, 2016): ○ Acute, new, or fluctuating neurologic deficits, such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes or with signs of increased intracranial pressure (papilledema) • * Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration ○ History of cancer or significantly immunocompromised ○ Fever ○ Subacute head trauma ○ Pregnancy or puerperium (Hamilton, 2020; Shobeiri, 2019) ○ Age ≥ 50 ○ Severe unilateral headache with radiation to or from the neck, associated with suspicion of carotid or vertebral artery dissection ○ Related to activity or event (sexual activity, exertion, position) (new or progressively worsening) ○ Persistent or progressively worsening during a course of physician-directed treatment (ACR, 2019c; Kuruvilla, 2015; Martin, 2011)	○ < 48 hours of "worst headache in my life" or "thunderclap" headache. ▪ Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes. ○ Prior history of stroke or intracranial bleed ○ Known coagulopathy or on anticoagulation • New onset of headache with any of the following[1, 7, 8]: • Acute, new, or fluctuating neurologic deficits, such as sensory deficits, limb weakness, abnormal reflexes, speech difficulties, visual loss, lack of coordination, or mental status changes or with signs of increased intracranial pressure (papilledema). (See background) ○ History of cancer or significantly immunocompromised ○ Fever ○ Subacute head trauma ○ Pregnancy or puerperium[9, 10] ○ Age ≥ 50 ○ Severe unilateral headache with radiation to or from the neck, associated with suspicion of carotid or vertebral artery dissection ○ Related to activity or event (sexual activity, exertion, position), new or progressively worsening ○ Persistent or progressively worsening during a course of physician-directed treatment[1, 11, 12]

• **Note**: Neuroimaging warranted for atypical/complex migraine aura, but not for a typical migraine aura (see background)
• Special considerations in the pediatric population with persistent headache (Trofimova, 2018):
  ○ Occipital location
  ○ Age < 6 years
  ○ Symptoms indicative of increased intracranial pressure, such as recurring headaches after waking with or without associated nausea/vomiting
  ○ Documented absence of family history of headache
  ○ Severe headache in a child with an underlying disease that predisposes to intracranial pathology (e.g., immune deficiency, sickle cell disease, neurofibromatosis, history of neoplasm, coagulopathy, hypertension, congenital heart disease)
	• **Note**: Neuroimaging warranted for atypical/complex migraine aura, but not for a typical migraine aura (see background)
	• Special considerations in the pediatric population with persistent headache[13]:
	  ○ Occipital location
	  ○ Age < 6 years
	  ○ Symptoms indicative of increased intracranial pressure, such as recurring headaches after waking with or without associated nausea/vomiting
	  ○ Documented absence of family history of headache
	  ○ Severe headache in a child with an underlying disease that predisposes to intracranial pathology (e.g., immune deficiency, sickle cell disease, neurofibromatosis, history of neoplasm, coagulopathy, hypertension, congenital heart disease)

For evaluation of neurologic symptoms or deficits (ACR, 2012a) • Acute, new, or fluctuating neurologic symptoms or deficits such as, sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes * Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration	**For evaluation of neurologic symptoms or deficits[14]** • Acute, new, or fluctuating neurologic symptoms or deficits such as, sensory deficits, limb weakness, abnormal reflexes, speech difficulties, visual loss, lack of coordination, or mental status changes (see background)
For evaluation of known or suspected stroke or vascular disease (ACR 2012a, 2017a, 2019; Jauch, 2013) • Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes *Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration	**For evaluation of known or suspected stroke or vascular disease[15-17]** • Known or suspected stroke with any acute, new, or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes (see background)

• Suspected stroke with a personal or first-degree family history (brother, sister, parent, or child) of aneurysm or known coagulopathy or on anticoagulation • Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes) • Evaluation of suspected acute subarachnoid hemorrhage (SAH) • Follow-up for known hemorrhage, hematoma, or vascular abnormalities **Note**: MRI is the study of choice for detecting cavernous malformations (CCM). Follow-up imaging of known CCM should be done only to guide treatment decisions or to investigate new symptoms. First-degree relatives of patients with more than one family member with a CCM should have a screening MRI as well as genetic counseling (Akers, 2017; Velz, 2018; Zyck, 2021) • Suspected central venous thrombosis - see background (ACR, 2017a, Bushnell, 2014) • Evaluation of neurological signs or symptoms in sickle cell disease (Mackin, 2014; Thust, 2014) --- **For evaluation of suspected brain tumor, mass, or metastasis** (Kerjnick, 2008; NCCN, 2020) • Suspected brain tumor with any acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, visual loss*, lack of coordination, or mental status changes	• Suspected stroke with a personal or first-degree family history (brother, sister, parent, or child) of aneurysm or known coagulopathy or on anticoagulation • Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms such as sensory deficits, limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes) • Evaluation of suspected acute subarachnoid hemorrhage (SAH) • Follow-up for known hemorrhage, hematoma, or vascular abnormalities **Note**: MRI is the study of choice for detecting cavernous malformations (CCM) and other low flow vascular malformations (see background). Follow-up imaging of known CCM should be done only to guide treatment decisions or to investigate new symptoms. First-degree relatives of patients with more than one family member with a CCM should have a screening MRI as well as genetic counseling[18-20] • Suspected central venous thrombosis - see background[15, 21] • 1-time screening for silent cerebral infarcts in school age children and adults with sickle cell disease[22] • Evaluation of neurological signs or symptoms in sickle cell disease[23, 24] • High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity >200[25, 26] --- **For evaluation of suspected brain tumor, mass, or metastasis[30, 31]** • Suspected brain tumor with any acute, new, or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, abnormal reflexes, speech difficulties, visual loss,

• * Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration • Suspected brain metastasis or intracranial involvement in patients with a history of cancer based on neurological symptoms or examination findings (may include new or changing lymph nodes) • Langerhans cell histiocytosis with visual, neurological, or endocrine abnormality; polyuria or polydipsia; suspected craniofacial bone lesions, aural discharge, or suspected hearing impairment/mastoid involvement (Haupt, 2013; NCCN, 2020)	lack of coordination, or mental status changes (see background) • Suspected brain metastasis or intracranial involvement in patients with a history of cancer based on neurological symptoms or examination findings (may include new or changing lymph nodes) • Histiocytic Neoplasms for screening and/or with neurological signs or symptoms[32, 33] ○ Erdheim-Chester Disease ○ Langerhans Cell Histiocytosis ○ Rosai-Dorfman Disease) • Midline dermoid cysts/sinuses with concern for intracranial extension[34-37]
Suspected Pituitary Tumors (ACR, 2018; GHRS, 2000; Kannan, 2013; Majumdar, 2013~~)~~ • With the following: ○ Neurologic findings (e.g., visual field deficit suggesting compression of the optic chiasm, diplopia, gaze palsy) ○ Suspected hypofunctioning pituitary gland based on hormonal testing, e.g., hypopituitarism, growth hormone deficiency, hypogonadotropic hypogonadism [i.e., low gonadotropins (FSH/LH) and sex hormones*] * Severe secondary hypogonadism with total testosterone persistently < 150 and low or normal LH/FSH OR * Testosterone levels below normal range with low or normal LH/FSH; **AND** ▪ Neurological signs and symptoms; OR	• Suspected Pituitary Tumors[38-41] ○ Neurologic findings (e.g., visual field deficit suggesting compression of the optic chiasm, diplopia, gaze palsy) ○ Suspected hypofunctioning pituitary gland based on hormonal testing ▪ Hypopituitarism ▪ Growth hormone deficiency ▪ Hypogonadotropic hypogonadism [low sex hormones and gonadotropins (FSH/LH)][42] • Total testosterone persistently < 150 with low or normal LH/FSH i.e., severe secondary hypogonadism **OR** • Total testosterone levels persistently borderline around the lower limits of normal range (200-400 ng/dL) with low or normal LH/FSH; **AND** ○ Neurological signs or symptoms; OR

▪ Other pituitary hormonal abnormalities; OR ▪ Consideration of reversible functional causes of gonadotropin suppression (e.g., obesity, opioid use, or comorbid illness)	○ Other pituitary hormonal abnormalities; OR ○ Low free testosterone and consideration of reversible functional causes of gonadotropin suppression (e.g., obesity, opioid use, diabetes, steroid use, or comorbid illness)
○ Suspected hyperfunctioning pituitary gland based on hormonal testing, i.e., central hyperthyroidism (high TSH), Cushing disease (high ACTH), acromegaly/gigantism (high GH/IGF-1) or elevated prolactin (≥ 250 ng/mL or persistently elevated in the absence of another cause, e.g., stress, pregnancy, hypothyroidism, medication)	○ Suspected hyperfunctioning pituitary gland based on hormonal testing ▪ Central hyperthyroidism (high TSH) ▪ Cushing disease (high ACTH) ▪ Acromegaly/gigantism (high GH/IGF-1) ▪ Elevated prolactin[43-45] • ≥ 250 ng/mL OR • In the absence of another cause, e.g., stress, pregnancy, hypothyroidism, renal insufficiency, medication ○ ≥ 100 ng/mL OR ○ Persistently elevated OR ○ Neuroendocrine signs or symptoms (i.e., headache, galactorrhea, abnormal menses, infertility, or bitemporal hemianopsia)
○ Central Diabetes Insipidus (low ADH) ○ Precocious puberty in a child (male < 9; female < 8), with hormonal studies suggesting a central cause and evidence of an accelerated bone age on x-ray (Faizah, 2012) ○ Pituitary apoplexy with sudden onset of neurological and hormonal symptoms	○ Central Diabetes Insipidus (low ADH) ○ Precocious puberty in a child (male < 9; female < 8), with hormonal studies suggesting a central cause [46] ○ Pituitary apoplexy with sudden onset of neurological and hormonal symptoms

[The following section was moved in the 2023 GL to a different location within the GL.]
 	
For evaluation of known brain tumor, mass, or metastasis
• Follow-up of known malignant brain tumor
• Suspected recurrence with prior history of CNS cancer based on neurological symptoms or examination findings
• Patient with history of CNS cancer (either primary or secondary) and a recent course of chemotherapy, radiation therapy (to the brain), or surgical treatment within the last two (2) years (NCCN, 2020)
• Follow-up of known non-malignant brain tumor/lesion if symptomatic, new/changing signs or symptoms or complicating factors
• Follow-up of known meningioma (NHS, 2018)
  ○ If <2cm or heavily calcified at 2 years and 5 years
  ○ > 2cm annually for 3 years and then scans at 5 years and 10 years
  ○ Multiple meningiomas, annually
  ○ After treatment (surgery or radiotherapy), post-operative if concern for residual tumor, every 6-12 months, then annually for 3-5 years based on WHO Grade (see background)
• Follow-up of known pituitary adenoma
  ○ New neuroendocrine signs or symptoms
  ○ Functioning adenoma - to assess response to treatment and 1-year follow-up after drug holiday (Stoller, 2015)
  ○ Asymptomatic Macroadenoma (≥ 10mm) follow-up every 6-18 months, post-surgical follow-up 1-2 years after surgery (Dekkers, 2008)
  ○ Asymptomatic, non-functioning Microadenoma < 10mm repeat in one year; if stable, repeat every 2-3 years (Lake, 2013)	

• Follow-up of known pineal cyst (≥ 5mm) if there are atypical features or symptoms (e.g., headaches, gaze paresis, ataxia, papilledema, nausea/vomiting) (Cauley, 2009; Jussila 2017)
• Follow-up of known arachnoid cyst (Al-Holou, 2010, 2013; Mustansir, 2018)
  ○ < 4 years old, serial imaging is warranted
  ○ > 4 years old, repeat imaging only if newly symptomatic, i.e., headaches, increased intracranial pressure, hydrocephalus, local mass effect, seizures, visual/endocrine dysfunction
• Tumor evaluation and monitoring in neurocutaneous syndromes – see background
• Langerhans cell histiocytosis (Haupt, 2013, NCCN, 2020)
  ○ To assess treatment response and surveillance of known brain lesions
 	
For screening for known Non-CNS Cancer - see background (NCCN, 2020)
• Default screening for
  ○ Kidney cancer
  ○ Lung cancer
  ○ Merkel cell carcinoma
  ○ Mucosal melanoma of the head and neck, especially of the oral cavity
  ○ Poorly differential neuroendocrine cancer (Large or Small cell/Unknown primary of neuroendocrine origin)
• Screening with preconditions
  ○ AML……. Suspicion of leukemic meningitis
  ○ Cutaneous melanoma……. Stage IIIC or higher
  ○ Testicular cancer-Seminoma……. High risk
	• For screening for known non-CNS Cancer[47-56] - see background
	  ○ Default screening for
	  ▪ Kidney cancer
	  ▪ Lung cancer
	  ▪ Merkel cell carcinoma
	  ▪ Mucosal melanoma of the head and neck, especially of the oral cavity
	  ▪ Poorly differential neuroendocrine cancer (Large or Small cell/Unknown primary of neuroendocrine origin)
	  ○ Screening with preconditions
	  ▪ AML……. Suspicion of leukemic meningitis
	  ▪ Cutaneous melanoma……. Stage IIIC or higher
	  ▪ Testicular cancer-Seminoma……. High risk

○ Gestational Trophoblastic Neoplasia…….. Pulmonary metastasis ○ Bladder cancer…… High risk, i.e., small cell • All other cancer if CNS symptoms present	▪ Gestational Trophoblastic Neoplasia…….. Pulmonary metastasis ▪ Bladder cancer…… High risk, i.e., small cell ○ All other cancer if CNS symptoms present
For screening of Hereditary Cancer Syndromes • Li Fraumeni syndrome- Annually (Kumar, 2018) • Von Hippel Lindau – Every 2 years, starting at age of 8 years (Rednam, 2017) • Tuberous Sclerosis – Every 1-3 years, until the age of 25 years (Krueger, 2013) • MEN1 – Every 3-5 years, starting at the age of 5 years (Brandi, 2001) • NF-2- Brain IAC: Annually starting at the age of 10 years (Evans, 2017) • Sturge Weber Syndrome: Once, after age 1 to rule out intracranial involvement; in patients <1 year, only if symptomatic (Comi, 2011)	• For screening of Hereditary Cancer Syndromes - see background ○ Li Fraumeni syndrome- Annually[57] ○ Von Hippel Lindau – Every 2 years, starting at age of 8 years[58] ○ Tuberous Sclerosis – Every 1-3 years, until the age of 25 years[59] ○ MEN1 – Every 3-5 years, starting at the age of 5 years[60] ○ NF-2- Brain IAC: Annually starting at the age of 10 years[61] ○ Sturge Weber Syndrome: Once, after age 1 to rule out intracranial involvement; in patients <1 year, only if symptomatic[62]
For evaluation of known brain tumor, mass, or metastasis • Follow-up of known malignant brain tumor • Suspected recurrence with prior history of CNS cancer based on neurological symptoms or examination findings • Patient with history of CNS cancer (either primary or secondary) and a recent course of chemotherapy, radiation therapy (to the brain), or surgical treatment within the last two (2) years (NCCN, 2020) • Follow-up of known non-malignant brain tumor/lesion if symptomatic, new/changing signs or symptoms or complicating factors • Follow-up of known meningioma (NHS, 2018)	**For evaluation of known brain tumor, mass, or metastasis** • Follow-up of known CNS cancer (either primary malignant brain tumor or secondary brain metastasis) as per NCCN[31] • Suspected recurrence with prior history of CNS cancer based on neurological symptoms or examination findings • Follow-up of known low grade tumor (WHO I-II) (i.e., meningioma, glioma, astrocytoma, oligodendroglioma) ○ For surveillance as per NCCN[31] ○ If symptomatic, new/changing signs or symptoms or complicating factors

○ If <2cm or heavily calcified at 2 years and 5 years ○ > 2cm annually for 3 years and then scans at 5 years and 10 years ○ Multiple meningiomas, annually ○ After treatment (surgery or radiotherapy), post-operative if concern for residual tumor, every 6-12 months, then annually for 3-5 years based on WHO Grade (see background) • Follow-up of known pituitary adenoma ○ New neuroendocrine signs or symptoms ○ Functioning adenoma - to assess response to treatment and 1-year follow-up after drug holiday (Stoller, 2015) ○ Asymptomatic Macroadenoma (≥ 10mm) follow-up every 6-18 months, post-surgical follow-up 1-2 years after surgery (Dekkers, 2008) ○ Asymptomatic, non-functioning Microadenoma < 10mm repeat in one year; if stable, repeat every 2-3 years (Lake, 2013) • Follow-up of known pineal cyst (≥ 5mm) if there are atypical features or symptoms (e.g., headaches, gaze paresis, ataxia, papilledema, nausea/vomiting) (Cauley, 2009; Jussila 2017) • Follow-up of known arachnoid cyst (Al-Holou, 2010, 2013; Mustansir, 2018) ○ < 4 years old, serial imaging is warranted ○ > 4 years old, repeat imaging only if newly symptomatic, i.e., headaches, increased intracranial pressure, hydrocephalus, local mass effect, seizures, visual/endocrine dysfunction • Tumor evaluation and monitoring in neurocutaneous syndromes – see background • Langerhans cell histiocytosis (Haupt, 2013, NCCN, 2020)	• Follow-up of known pituitary adenoma ○ New neuroendocrine signs or symptoms ○ Functioning adenoma - to assess response to treatment and 1-year follow-up after drug holiday[63] ○ Asymptomatic Macroadenoma (≥ 10mm) follow-up every 6-18 months, post-surgical follow-up every 1-2 years after surgery[64] ○ Asymptomatic, non-functioning Microadenoma < 10mm repeat in one year; if stable, repeat every 2-3 years[65] • Follow-up of known pineal cyst (≥ 5mm) if there are atypical features or symptoms (e.g., headaches, gaze paresis, ataxia, papilledema, nausea/vomiting)[66, 67] • Follow-up of known arachnoid cyst[68-70] ○ < 4 years old, serial imaging is warranted ○ > 4 years old, repeat imaging only if newly symptomatic, i.e., headaches, increased intracranial pressure, hydrocephalus, local mass effect, seizures, visual/endocrine dysfunction • Tumor monitoring in neurocutaneous syndromes as per tumor type • Histiocytic Neoplasms to assess treatment response and surveillance of known brain lesions[32, 33, 71] ○ Erdheim-Chester Disease

○ To assess treatment response and surveillance of known brain lesions --- **For evaluation of suspected multiple sclerosis (MS)** (CMSC, 2018; Thompson, 2017; Traboulsee, 2016) • For evaluation of patient with neurologic symptoms or deficits suspicious for MS with ○ A clinically isolated syndrome (optic neuritis, transverse myelitis, or brain stem syndrome); **OR** ○ Recurrent episodes of variable neurological signs or symptoms not attributable to another cause • To demonstrate dissemination in time for diagnosis (6-12 months for high risk, 12-24 months for low risk) **For evaluation of known multiple sclerosis (MS)** (CMSC, 2018) • To establish a new baseline (no recent imaging, postpartum, or 6-12 months after switching disease modifying therapy) • Prior to starting or switching disease-modifying therapy • Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years • New signs or symptoms suggested of an exacerbation or unexpected clinical worsening • Progressive Multifocal Leukoencephalopathy (PML) surveillance for patients on natalizumab (Tsyabri) (McGuigan, 2016) ○ 12 months after the start of treatment in all patients ○ Further surveillance MRI scanning timing is based on anti-JCV antibody status ▪ If anti-JCV antibody negative, annually	○ Langerhans Cell Histiocytosis ○ Rosai-Dorfman Disease --- **For evaluation of suspected multiple sclerosis (MS)[82-85]** • For evaluation of patient with neurologic symptoms or deficits suspicious for MS with ○ A clinically isolated syndrome (optic neuritis, transverse myelitis, or brain stem syndrome); **OR** ○ Recurrent episodes of variable neurological signs or symptoms not attributable to another cause • To demonstrate dissemination in time for diagnosis (every 6-12 months) **For evaluation of known multiple sclerosis (MS)[82, 85, 86]** • To establish a new baseline (no recent imaging, postpartum, or 3-6 months after switching disease modifying therapy) • Prior to starting or switching disease-modifying therapy • 6-month repeat scan in patients with MRI disease activity that is not associated with clinical activity on a follow-up scan • Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years • New signs or symptoms suggested of an exacerbation or unexpected clinical worsening • Progressive Multifocal Leukoencephalopathy (PML) surveillance for patients on natalizumab (Tsyabri)[87] ○ 12 months after the start of treatment in all patients ○ Further surveillance MRI scanning timing is based on risk ▪ Annually, if anti-JCV antibody negative,

▪ If anti-JCV antibody positive and antibody index < 1.5. every 6 months ▪ If anti-JCV antibody positive and antibody index > 1.5, every 3-4 months	▪ Every 3-4 months, if high risk of PML occurrence: • seropositive for JC virus and have been treated with natalizumab for ≥18 months OR • high anti-JC virus antibody index values (>0.9) OR • previously treated with immunosuppressive therapies ○ Brain MRI every 3–4 months for up to 12 months, in high-risk patients who switch from natalizumab to other therapeutics Note: In the pediatric population, use a similar scan frequency for disease and therapeutic monitoring. Increase frequency of imaging (e.g., every 6 months) in children with highly active disease or in situations where imaging will change management.
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	[New section/indications added to "For evaluation of known or suspected infectious or inflammatory disease (e.g., meningitis or abscess)":] • Neurosarcoid[97-99] ○ Initial Evaluation: ▪ Suspected based on neurological sign/symptoms and lab work (ACE, CSF analysis) OR ▪ Known history of sarcoidosis with neurological signs or symptoms ○ Follow-up of known neurosarcoidosis: ▪ To assess treatment response ▪ Worsening signs or symptoms
For evaluation of clinical assessment documenting cognitive impairment of unclear cause	**For evaluation of clinical assessment documenting cognitive impairment of unclear cause[100-102]**

(Harvey 2012; HQO, 2014; Narayanan, 2016) • Mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments*/formal neuropsychological testing showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12) *Other examples include: Ottawa 3DY (O3DY), Brief Alzheimer's Screen (BAS), Blessed Dementia Scale (BDS), caregiver-completed AD8 (cAD8), Brief Cognitive Rating Scale (BCRS), Clinical Dementia Rating (CDR) (Carpenter, 2011; McDougall, 1990) --- **For evaluation of movement disorders** (ACR, 2019e; Albanese, 2011; Mascalchi, 2012; McFarland, 2014; Pyatigorskaya, 2014; Sharifi, 2014) • For evaluation of suspected Parkinson's with atypical feature or unresponsive to levodopa • For evaluation of new non-Parkinson symptoms in known Parkinson's disease complicating the evaluation of the current condition • For the evaluation of other movement disorder to exclude a structural lesion (i.e., suspected Huntington disease, chorea, atypical parkinsonian syndromes, hemiballismus, atypical dystonia) • **Note**: MRI not indicated in essential tremor or isolated focal dystonia (e.g., blepharospasm, cervical dystonia, laryngeal dystonia, oromandibular dystonia, writer's dystonia) (Alabanese, 2011; Comella, 2019; Sharfi, 2014) **For evaluation of cranial nerve and visual abnormalities**	• Mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments*/formal neuropsychological testing showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12) *Other examples include: Mini-Cog, Memory Impairment Screen, Saint Louis University Mental Status Examination (SLUMS), Brief Alzheimer's Screen (BAS), Blessed Dementia Scale (BDS), Clinical Dementia Rating (CDR)[103, 104] --- **For evaluation of movement disorders[106-111]** • For evaluation of suspected Parkinson's with atypical feature or unresponsive to levodopa • For evaluation of new non-Parkinson neurological symptoms in known Parkinson's disease complicating the evaluation of the current condition • For the evaluation of other movement disorder to exclude a structural lesion (i.e., suspected Huntington disease, chorea, atypical parkinsonian syndromes, hemiballismus, atypical dystonia) • **Note**: MRI not indicated in essential tremor, Tourette' syndrome, or isolated focal dystonia (e.g., blepharospasm, cervical dystonia, laryngeal dystonia, oromandibular dystonia, writer's dystonia)[107, 111, 112] **For evaluation of cranial nerve and visual abnormalities** • Anosmia (loss of smell) or dysosmia documented by objective testing that is persistent and of unknown origin[113-115]

• Anosmia (loss of smell) or dysosmia documented by objective testing that is persistent and of unknown origin (Decker, 2013; Policeni, 2017; Rouby, 2011) • Optic neuritis • Abnormal eye findings on physical or neurologic examination (papilledema, pathologic nystagmus, optic atrophy, ocular nerve palsies, new onset anisocoria, visual field deficit, etc.) (Chang, 2019) **Note**: Not explained by underlying ocular diagnosis, glaucoma, or macular degeneration • Binocular diplopia with concern for intracranial pathology (Iliescu, 2017) • Childhood strabismus with development delay or abnormal fundoscopic exam to rule out intracranial abnormalities (Kadom, 2008; Yoon, 2019) • Horner's syndrome with symptoms localizing the lesion to the central nervous system (Lee, 2007) • Trigeminal neuralgia or other trigeminal autonomic cephalgias, notably in those with atypical presentation (Bendtsen, 2019; Cruccu, 2016; Wilbrink, 2009) • Bell's Palsy- if atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset (Quesnel, 2010) • Hemifacial spasm (Hermier, 2019) • Other objective cranial nerve palsy (CN IX-XII) (ACR, 2017b; Mumtaz, 2014; Policeni, 2017) • Bulbar symptoms, i.e., difficulty in chewing, weakness of the facial muscles, dysarthria, palatal weakness, dysphagia, and dysphonia and/or signs, i.e., atrophy and fasciculations of the tongue and absent gag reflex (Yedavelli, 2018) • Pseudobulbar symptoms, i.e., dysphagia, dysarthria, facial weakness, sudden, stereotyped emotional outbursts that are	• Optic neuritis • Abnormal eye findings on physical or neurologic examination (papilledema, pathologic nystagmus, optic atrophy, ocular nerve palsies, new onset anisocoria, visual field deficit, etc.)[116] **Note**: See background • Binocular diplopia with concern for intracranial pathology[117] after comprehensive eye evaluation[118] • Childhood strabismus with development delay or abnormal fundoscopic exam to rule out intracranial abnormalities[119, 120] • Horner's syndrome with symptoms localizing the lesion to the central nervous system[121] • Trigeminal neuralgia or neuropathy, notably with an atypical presentation[5, 122, 123] • Occipital Neuralgia to exclude a structural lesion, notably in atypical cases[124-126] • Bell's Palsy- if atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset[127] • Hemifacial spasm[128] • Other objective cranial nerve palsy (CN IX-XII)[114, 129] • Bulbar symptoms, i.e., difficulty in chewing, weakness of the facial muscles, dysarthria, palatal weakness, dysphagia, and dysphonia and/or signs, i.e., atrophy and fasciculations of the tongue and absent gag reflex[130] • Pseudobulbar symptoms, i.e., dysphagia, dysarthria, facial weakness, sudden, stereotyped emotional outbursts that are

not reflective of mood and/or signs, i.e., spastic tongue and exaggerated gag/jaw jerk (King, 2013)	not reflective of mood and/or signs, i.e., spastic tongue and exaggerated gag/jaw jerk[131]
For evaluation of known or suspected congenital abnormality (such as craniosynostosis, neural tube defects) (Ashwal, 2009; Vinocur, 2010)	**For evaluation of known or suspected congenital abnormality** (such as craniosynostosis, neural tube defects)[132, 133]

• Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes
• Evaluation of macrocephaly in an infant/child <18 with previously abnormal US, abnormal neurodevelopmental examination (Tan, 2018), signs of increased ICP or closed anterior fontanelle
• Evaluation of microcephaly in an infant/child < 18
• Evaluation of craniosynostosis and other skull deformities. CT is preferred imaging to assess bony structures; MRI imaging is preferred to assess intracranial soft tissue
• Evaluation of the corticomedullary junction in Achondroplasia (Dougherty,2018; Kubota, 2020))
	• Known or suspected congenital abnormality with any acute, new, or fluctuating neurologic, motor, or mental status changes
	• Evaluation of macrocephaly in an infant/child <18 with previously abnormal US, abnormal neurodevelopmental examination, signs of increased ICP or closed anterior fontanelle[134]
	• Evaluation of microcephaly in an infant/child < 18
	• Evaluation of craniosynostosis and other skull deformities. CT is preferred imaging to assess bony structures; MRI imaging is preferred to assess intracranial soft tissue
	• Evaluation of the corticomedullary junction in Achondroplasia[135, 136]
	• Cerebral palsy if etiology has not been established in the neonatal period, there is change in the expected clinical or developmental profile or concern for progressive neurological disorder[137, 138]
	• X-linked Adrenoleukodystrophy[139]
	  ○ Baseline MRI between 12 and 18 months old
	  ○ Second MRI 1 year after baseline
	  ○ MRI every 6 months between 3 and 12 years old
	  ○ Annual MRI after 12 years old

• Prior treatment OR treatment planned for congenital abnormality **Note**: For evaluation of known or suspected hydrocephalus please see section on CSF abnormalities.	• Prior treatment OR treatment planned for congenital abnormality **Note**: For evaluation of known or suspected hydrocephalus please see section on CSF abnormalities.
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[The following indication was moved from "Other Indications for a Brain MRI" to the section "For evaluation of known or suspected congenital abnormality" within Indications for the 2023 GLs] • Cerebral palsy if etiology has not been established in the neonatal period, there is change in the expected clinical or developmental profile or concern for progressive neurological disorder (Ashwal, 2004; NICE, 2020)	**[The following indication was added to the section "Indications for a Brain MRI with Internal Auditory Canal (IAC)"]:** • Congenital/childhood sensorineural hearing loss suspected to be due to a structural abnormality[171-173] (CNVIII, the brain parenchyma, or the membranous labyrinth). CT is the preferred imaging modality for the osseous anatomy and malformations of the inner ear.
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Indications for Combination Studies (ACR, 2017a, 2019a)	**Indications for Combination Studies[15, 16]** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the neuroaxis), patient history, and other available information, including prior imaging.
• For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000)	Exception: For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology[177]
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• **Brain MRI/Brain MRA**	• **Brain MRI/Brain MRA***

○ Recent ischemic stroke or transient ischemic attack ○ Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up (Whitehead, 2019, Yeh, 2010, Yuan, 2005): ▪ Negative Brain CT; **AND** ▪ Negative Lumbar Puncture ○ Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm ○ Headache associated with exercise or sexual activity (IHS, 2018) ○ Suspected venous thrombosis (dural sinus thrombosis) – Brain MRV see background	○ Recent ischemic stroke or transient ischemic attack ○ Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset[178-180] **Note**: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients[181] ○ Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm ○ Headache associated with exercise or sexual activity[6] ○ Suspected venous thrombosis (dural sinus thrombosis) – Brain MRV see background ○ Neurological signs or symptoms in sickle cell patients ○ High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 [24]
• **Brain MRI/Brain MRA/Neck MRA** ○ Recent stroke or transient ischemic attack (TIA) ○ Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits	• **Brain MRI/Brain MRA/Neck MRA*** ○ Recent stroke or transient ischemic attack (TIA) ○ Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits • **Brain MRI with IAC/ Brain MRA/Neck MRA (any combination)*** ○ Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology[182, 183] *Note: MRA and CTA are generally comparable noninvasive imaging alternatives each with their own advantages and disadvantages. Brain MRI can alternatively be combined with Brain CTA/Neck CTA.
• **Brain MRI/ Cervical MRI/Thoracic MRI (any combination)**	• **Brain MRI/Cervical MRI/Thoracic MRI (any combination)**

○ For evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis) (Wingerchuk, 2015) ○ For known MS, prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline) ○ Follow-up scans for known MS if patients have known spine disease (Kaunzner, 2017) ▪ 6-12 months after starting/changing treatment ▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years	○ Combination studies for MS: These body regions might be evaluated separately or in combination as guided by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history (e.g., symptom(s), time course, and where in the CNS the likely localization(s) is/are), and other available information, including prior imaging. ○ For evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis)[184] ○ For known MS, prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline)[185] ○ Follow-up scans, including brain and spine imaging, if patients have known spine disease: ▪ 6-12 months after starting/changing treatment ▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years
• **Brain MRI/ Cervical MRI/Thoracic MRI/Lumbar (any combination)** ○ Follow-up imaging of a known type II or type III Arnold Chiari malformation†. For Arnold Chiari type I, follow-up imaging only if new or changing signs/symptoms (Radic, 2018; Whitson, 2015)	• **Brain MRI/Cervical MRI/Thoracic MRI/Lumbar MRI (any combination)** ○ For initial evaluation of a suspected Arnold Chiari malformation ○ Follow-up imaging of a known type II or type III Arnold Chiari malformation. For Arnold Chiari type I, follow-up imaging only if new or changing signs/symptoms[140, 186] ○ Oncological Applications (e.g., primary nervous system, metastatic) ▪ Drop metastasis from brain or spine (see background)

○ Suspected Leptomeningeal carcinomatosis (see background) (Shah, 2011) ○ Tumor evaluation and monitoring in neurocutaneous syndromes - See background ○ CSF leak highly suspected and supported by patient history and/or physical exam findings (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • **Brain MRI/Orbit MRI** ○ Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion or optic nerve infitrative disorders (Behbehani, 2007) ○ Bilateral optic disk swelling (papilledema) with visual loss (Margolin, 2019) ○ Optic Neuritis ▪ If atypical presentation, severe visual impairment, or poor recovery following initial onset or treatment onset (CMSC, 2018) ▪ If needed to confirm optic neuritis and rule out compressive lesions ○ Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent, or bilateral optic neuritis (Wingerchuk, 2015) • **Brain MRI/FACE/SINUS/NECK MRI**	▪ Suspected leptomeningeal carcinomatosis (see background)[187] ▪ Tumor evaluation and monitoring in neurocutaneous syndromes - See background ○ CSF leak highly suspected and supported by patient history and/or physical exam findings (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • **Brain MRI/Orbit MRI** ○ Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion or optic nerve infitrative disorders[188] ○ Bilateral optic disk swelling (papilledema) with visual loss[189] ○ Optic Neuritis ▪ If atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence)[190, 191] ▪ If needed to confirm optic neuritis and rule out compressive lesions ○ Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent, or bilateral optic neuritis[184] • **Brain MRI/FACE/SINUS/NECK MRI**

○ Anosmia or dysosmia on objective testing that is persistent and of unknown origin (Decker, 2013; Policeni, 2017; Zaghouani, 2013) ○ Granulomatosis with polyangiitis (Wegener's granulomatosis) disease (Pakalniskis, 2015) ○ Trigeminal Neuralgia or other trigeminal autonomic cephalgias, notably in those with atypical presentation (Hughes, 2016; Policeni, 2017) ○ Bells/hemifacial spasm that meets above criteria ○ Objective cranial nerve palsy (CN IX-XII) (for evaluation of the extracranial nerve course) (Mumtaz, 2014; Policeni, 2017)	○ Anosmia or dysosmia on objective testing that is persistent and of unknown origin[113, 114, 192] ○ Granulomatosis with polyangiitis (Wegener's granulomatosis) disease[193] ○ Trigeminal neuralgia or neuropathy with an atypical presentation (for evaluation of the extracranial nerve course) [114, 194] ○ Bell's Palsy/hemifacial spasm for evaluation of the extracranial nerve course -if atypical signs, slow resolution beyond three weeks, no improvement at four months, or facial twitching/spasms prior to onset[127] ○ Objective cranial nerve palsy (CN IX-XII) (for evaluation of the extracranial nerve course)[114, 129]

BRAIN PET SCAN	
Previous (red indicates deleted text)	New (blue indicates new text)
Policy Statement INDICATIONS FOR BRAIN PET SCAN using FDG (Fluorodeoxyglucose) Known brain tumor or cancer • To differentiate radiation necrosis or post-treatment change from residual/recurrent tumor on brain MRI‡ • To differentiate low from high grade glioma when brain MRI‡ is inconclusive • For evaluation of primary brain lymphoma when brain MRI‡ is inconclusive • To guide intervention/biopsy	**Policy Statement** INDICATIONS FOR BRAIN PET SCAN Known brain tumor or cancer • To differentiate radiation necrosis or post-treatment change from residual/recurrent tumor when brain MRI‡ is inconclusive • To differentiate low from high grade glioma when brain MRI‡ is inconclusive • For evaluation of primary brain lymphoma when brain MRI‡ is inconclusive • For evaluation of meningiomas when brain MRI is inconclusive • To guide intervention/biopsy

BREAST MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
NO HISTORY OF KNOWN BREAST CANCER **For screening examination to detect breast cancer in any of the following situations** • A Breast Cancer Risk Assessment (including the Breast Cancer Consortium Risk Model (BCSC) which incorporates breast density, the International Breast Cancer Intervention Study (IBIS)/ Tyrer-Cuzick model, the Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm model (BOADICEA), the modified Gail (also known as the Breast Cancer Risk assessment tool (BCRAT)) or other validated risk assessment models) that identifies the patient as having a lifetime risk of 20% or greater of developing breast cancer ○ Approve annually beginning 10 years prior to youngest family member's age at diagnosis or at age 40, whichever comes first, but not before age 25 • Patients with lifetime risk of 20% or greater of developing breast cancer based on history of lobular neoplasia (LCIS/ALH (Lobular Carcinoma in Situ /Atypical Lobular Hyperplasia)) or ADH (atypical ductal hyperplasia) ○ Approve annually beginning at age of diagnosis of LCIS/ALH or ADH but not prior to age 25	**NO HISTORY OF KNOWN BREAST CANCER** **For screening examination to detect breast cancer in any of the following situations** • A Breast Cancer Risk Assessment (including the Breast Cancer Consortium Risk Model (BCSC) which incorporates breast density, the International Breast Cancer Intervention Study (IBIS)/ Tyrer-Cuzick model, the Breast and Ovarian Analysis of Disease Incidence and Carrier Estimation Algorithm model (BOADICEA), the modified Gail (also known as the Breast Cancer Risk assessment tool (BCRAT)) or other validated risk assessment models) that identifies the patient as having a lifetime risk of 20% or greater of developing breast cancer[1] ○ Approve annually beginning 10 years prior to youngest family member's age at diagnosis or at age 40, whichever comes first, but not before age 25[2-6] • Patients with lifetime risk of 20% or greater of developing breast cancer based on history of lobular neoplasia (LCIS/ALH (Lobular Carcinoma in Situ /Atypical Lobular Hyperplasia)) or ADH (atypical ductal hyperplasia) ○ Approve annually beginning at age of diagnosis of LCIS/ALH or ADH but not prior to age 25[2] • Patients with intermediate lifetime risk (15%-20%) of developing breast cancer based on a history lobular neoplasia (LCIS/ALH (Lobular Carcinoma in Situ /Atypical Lobular Hyperplasia)) or ADH (atypical ductal hyperplasia)) AND have dense breast tissue on mammography

• Patients with history of extensive chest irradiation (usually as treatment for Hodgkin's or other lymphoma between ages ten and thirty) ○ Begin eight years after radiation, but not prior to age 25 • Patients with known *BRCA 1/2* mutation ○ Approve annually starting at age 25 • Patients not yet tested for *BRCA* gene, but with known *BRCA* mutation in first-degree relative Approve annually starting at age 25 • Personal history of germline mutations known to predispose to a high risk of breast cancer (NCCN, 2021): ○ Li-Fraumeni syndrome (*TP53* mutation) ▪ Begin age 20-29 or age at earliest diagnosed breast cancer in family ○ Cowden syndrome (*PTEN*) or Bannayan-Riley-Ruvalcaba syndrome (BRRS) ▪ Begin 30-35 or 5-10 years before earliest breast cancer diagnosis in family ○ *ATM* ▪ Begin age 40 ○ *BARD1* ▪ Begin age 40 ○ *CDH1* ▪ Begin age 30 ○ *CHEK2* ▪ Begin age 40 ○ *NF1* ▪ Begin age 30 ○ *PALB2*	○ Approve annually beginning at age of diagnosis of LCIS/ALH or ADH but not prior to age 25[2,7,8] • Patients with history of extensive chest irradiation (usually as treatment for Hodgkin's or other lymphoma between ages ten and thirty) ○ Begin eight years after radiation, but not prior to age 25[2] • Patients with known *BRCA 1/2* mutation ○ Approve annually starting at age 25[2,3] • Patients not yet tested for *BRCA* gene, but with known *BRCA* mutation in first-degree relative Approve annually starting at age 25[2,3] • Personal history of germline mutations known to predispose to a high risk of breast cancer[1]: ○ Li-Fraumeni syndrome (*TP53* mutation) ▪ Begin age 20-29 or age at earliest diagnosed breast cancer in family, if younger than age 20 ○ Cowden syndrome (*PTEN*) or Bannayan-Riley-Ruvalcaba syndrome (BRRS) ▪ Begin age 35 or 10 years before earliest breast cancer diagnosis in family (NCCN 2022) ○ *ATM* ▪ Begin age 40 ○ *BARD1* ▪ Begin age 40 ○ *CDH1* ▪ Begin age 30 ○ *CHEK2* ▪ Begin age 40 ○ *NF1* ▪ Begin age 30, end age 50[2] ○ *PALB2*

▪ Begin age 30 ○ Peutz-Jeghers Syndrome (*STK11*) ▪ Begin age 25	▪ Begin age 30 ○ Peutz-Jeghers Syndrome (*STK11*) ▪ Begin age 25

CEREBRAL PERFUSION CT	
Previous (red indicates deleted text)	New (blue indicates new text)
Some indications in red were reorganized (moved down) • For early detection of acute cerebral ischemia and infarct to determine the appropriateness of an intervention or procedure • Differentiating post ictal paralysis or other stroke mimics from acute stroke after MRI has been completed or is contraindicated and will guide treatment • For noninvasive evaluation of vasospasm after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate • Pre-operative evaluation of cerebral blood flow in patients at high risk for developing cerebral hyperperfusion after carotid revascularization • For the assessment of cerebral blood flow after carotid revascularization in patients with severe carotid artery stenosis or signs/symptoms of cerebral hyperperfusion • For assessment of cerebrovascular reserve by using acetazolamide challenge in patients individuals with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment • For the assessment of microvascular permeability in patients with intracranial neoplasms • A follow-up study may be needed to help evaluate an patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested	• Pre-operative evaluation of cerebral blood flow in patients at high risk for developing cerebral hyperperfusion after carotid revascularization • For assessment of cerebrovascular reserve by using acetazolamide challenge in individuals with intracranial vascular stenosis who are potential candidates for bypass surgery or neuroendovascular treatment • For the assessment of microvascular individuals with intracranial neoplasms • A follow-up study may be needed to help evaluate an individual's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested • In the acute setting: • For early detection of acute cerebral ischemia and infarct to determine the appropriateness of an intervention or procedure

	• Differentiating post-ictal paralysis or other stroke mimics from acute stroke after MRI has been completed or is contraindicated and will guide treatment • For noninvasive evaluation of suspected vasospasm related cerebral ischemia/infarction and/or delayed cerebral ischemia after subarachnoid hemorrhage when transcranial Doppler cannot be done or is indeterminate • For the assessment of cerebral blood flow after carotid revascularization in individuals with severe carotid artery stenosis or signs/symptoms of cerebral hyperperfusion

CERVICAL SPINE CT	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR CERVICAL SPINE CT **(Combination requests at end of the document)** **For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate** (Acharya, 2019; ACR, 2013; NASS, 2010; Teoli, 2021) • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes ○ Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity	**INDICATIONS FOR CERVICAL SPINE CT** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months), the results of the prior study should be:** • **Inconclusive or show a need for additional or follow-up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.** **(*Unless approvable in the combination section as noted in the guidelines)** **For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate[1-3]** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy) ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes ○ Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity

○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) ○ Gait abnormalities (see Table 1 below for more details) • Suspected cord compression with any neurological deficits as listed above. **For evaluation of neck pain with any of the following when Cervical Spine MRI is contraindicated** (Allegri, 2016) • With new or worsening objective neurologic deficits on exam, as above • Failure of conservative treatment* for at least six (6) weeks within the last six (6) months (ACR, 2013; Eubanks, 2010) • With progression or worsening of symptoms during the course of conservative treatment* • With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013)) • Isolated neck pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below thoracic and lumbar spine may also be indicated) ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger	○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)- not related to an inherent bowel or bladder process ○ Gait abnormalities (see Table 1 below for more details) • Suspected cord compression with any neurological deficits as listed above **For evaluation of neck pain with any of the following when Cervical Spine MRI is contraindicated[4]** • With new or worsening objective neurologic deficits on exam, as above • Failure of conservative treatment* for at least six (6) weeks within the last six (6) months[5] • With progression or worsening of symptoms during the course of conservative treatment* • With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain)[6] • Isolated neck pain in pediatric population[7] – conservative care not required if red flags present ○ Red flags that prompt imaging should include the presence of the following: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; fever; weight loss [8, 9]

child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) ○ Neck pain associated with suspected inflammation, infection, or malignancy **As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection)** **Note: If ordered by Neurosurgeon or orthopedic surgeon for purposes of surgical planning, a contraindication to MRI is not required.** • For preoperative evaluation/planning • CT discogram • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram) (Starling, 2013) • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above.	**As part of initial pre-operative/post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[10, 11] and MRI for cord, nerve root compression, disc pathology, or post-op infection)** **Note: If ordered by Neurosurgeon or orthopedic surgeon for purposes of surgical planning, a contraindication to MRI is not required.** • For preoperative evaluation/planning • CT discogram • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))[12] • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • New or changing neurological deficits or symptoms post-operatively[10, 13] - see neurological deficit section above.

• When combo requests are submitted (i.e. MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required) (Fisher, 2013) ○ Combination requests where both cervical spine CT and MRI cervical spine are both approvable (not an all-inclusive list): ▪ OPLL (Ossification of posterior longitudinal ligament) (Choi, 2011) ▪ Pathologic or complex fractures ▪ Malignant process of spine with both bony and soft tissue involvement ▪ Unstable craniocervical junction ▪ Clearly documented indication for bony and soft tissue abnormality where assessment will change management for the patient --- **For evaluation of known fracture or known/new compression fractures** (ACR, 2018) • To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing • To determine the position of fracture fragments • With history of malignancy (if MRI is contraindicated or cannot be performed) • With an associated new focal neurologic deficit as above (Alexandru, 2012) • Prior to a planned surgery/intervention or if the results of the CT will change management	• When combo requests (see above statement+) are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required)[14] ○ Combination requests where both cervical spine CT and MRI cervical spine are both approvable (not an all-inclusive list): ▪ OPLL (Ossification of posterior longitudinal ligament)[15] ▪ Pathologic or complex fractures ▪ Malignant process of spine with both bony and soft tissue involvement ▪ Unstable craniocervical junction ▪ Clearly documented indication for bony and soft tissue abnormality where assessment will change management for the patient --- **For evaluation of known fracture or known/new compression fractures with worsening neck pain[21, 24]** • To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing • To determine the position of fracture fragments • With history of malignancy (if MRI is contraindicated or cannot be performed) • With an associated new focal neurologic deficit as above[25] • Prior to a planned surgery/intervention or if the results of the CT will change management

CT myelogram is indicated when signs and symptoms are incongruent with MRI findings or MRI cannot be performed/contraindicated/surgeon preference (Grams, 2010; Morita, 2011; Naganawa, 2011; NASS, 2012; Ozdoba; 2011; Starling, 2013) • Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac • Evaluation of suspected brachial plexus or nerve root injury in the neonate --- **Metastatic tumor** • With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam • Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine • With an associated new focal neurologic deficit (Alexandru, 2012) • Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019)	**CT myelogram: When MRI cannot be performed/contraindicated/surgeon preference**[12, 26-30] • When signs and symptoms inconsistent or not explained by the MRI findings • Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac • Evaluation of suspected brachial plexus or nerve root injury in the neonate --- **Metastatic tumor** • With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam • With an associated new focal neurologic deficit[25] • Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine[33, 35]

----- [Within section **Other Indications for a Cervical Spine CT, when MRI is contraindicated or cannot be performed**, the following changes:]	----- [Within section **Other Indications for a Cervical Spine CT, when MRI is contraindicated or cannot be performed**, the following changes:]
• Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))	• Toe walking in a child with signs/symptoms of myelopathy localized to the Cervical Spine • Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's) ○ After detailed neurological exam and basic testing completed
COMBINATION STUDIES WITH CERVICAL SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE	**COMBINATION STUDIES WITH CERVICAL SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE**
Indications for combination studies: (ACR, 2017, 2019) **- For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure**	
Brain CT/Cervical CT • For evaluation of known Arnold-Chiari Malformation	**Brain CT/Cervical CT** • For evaluation of known Arnold-Chiari Malformation
	Cervical and Thoracic CT • Initial evaluation of known syrinx or syringomyelia ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis[49]) ○ To further characterize a suspicious abnormality seen on prior imaging

	○ Known syrinx with new/worsening symptom
Any combination of Cervical and/or Thoracic and/or Lumbar CTs:	**Any combination of Cervical and/or Thoracic and/or Lumbar CTs:** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging. **Exception**- Indications for combination studies[50, 51]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure
• Any combination of these studies for: ○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015). ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) ○ Neck pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging. ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR	• Any combination of these studies for: ○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10[52-54] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[55] ○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[56]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);

▪ When office notes clearly document how imaging will change management • Arnold Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015) • Arnold Chiari II-IV ○ For initial evaluation and follow-up as appropriate • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging (Hertzler, 2010) • Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords)) • Neck pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger	▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari malformations[57, 58] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[43, 52] ○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele) • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,[43-45] when anesthesia required for imaging[59] (e.g., meningomyelocele, lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)

child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) • Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram) • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011) • Any combination of these for spinal survey in patient with metastases • Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula - preferred exam CT myelogram) (Starling, 2013) • CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT	• Oncological Applications (e.g., primary nervous system, metastatic) ○ Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram)- See Background ○ Suspected leptomeningeal carcinomatosis (LC)[60]- See Background ○ Any combination of these for spinal survey in patient with metastases ○ Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))[12] • CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT

CERVICAL SPINE MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR CERVICAL SPINE MRI **(Combination requests at end of the document)** **For evaluation of neurologic deficits** (Acharya, 2019; ACR, 2013; NASS, 2010; Stolper, 2017; Teoli, 2021) • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes ○ Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)	**INDICATIONS FOR CERVICAL SPINE MRI** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months), the results of the prior study should be:** • **Inconclusive or show a need for additional or follow-up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.** **(*Unless approvable in the combination section as noted in the guidelines)** **For evaluation of neurologic deficits[1-6]** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy) ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes ○ Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)- not related to an inherent bowel or bladder process

○ Gait abnormalities (see Table 1 for more details) • Suspected cord compression with any neurological deficits as listed above **For evaluation of neck pain with any of the following** (Allegri, 2016; AANSCNS, 2014; Jarvik, 2015) • With new or worsening objective neurologic deficits on exam • Failure of conservative treatment* for at least six (6) weeks within the last six (6) months (ACR, 2013; Eubanks, 2010) • With progression or worsening of symptoms during the course of conservative treatment* • With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain (NASS, 2013)) • Isolated neck pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below thoracic and lumbar spine may also be indicated) ○ Red flags that prompt imaging should include the presence of the following: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) ○ Neck pain associated with suspected inflammation, infection, or malignancy	○ Gait abnormalities (see Table 1 for more details) • Suspected cervical cord compression with any neurological deficits as listed above **For evaluation of neck pain with any of the following[7-9]** • With new or worsening objective neurologic deficits (as listed above) on exam • Failure of conservative treatment* for at least six (6) weeks within the last six (6) months[10] • With progression or worsening of symptoms during the course of conservative treatment* • With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain.)[11] • Isolated neck pain in pediatric population[12, 13] – conservative care not required if red flags present ○ Red flags that prompt imaging should include the presence of the following: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; fever; weight loss[14, 15]

As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology or post-op infection)** • For preoperative evaluation/planning • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula)) • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above • When combo requests are submitted (e.g., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required) (Fisher, 2013) --- • **Combination studies MS** (Barakat, 2015)	**As part of initial pre-operative / post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[12, 16] and MRI for cord, nerve root compression, disc pathology or post-op infection)** • For preoperative evaluation/planning • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula)) • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • New or changing neurological deficits or symptoms post-operatively[16, 17] - see neurological deficit section above • When combo requests (see above statement[+]) are submitted (e.g., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required)[18] --- **Combination studies MS[28]** • **These body regions might be evaluated separately or in combination as guided by physical examination findings**

○ Cervical **and/or** Thoracic MRI for evaluation of suspected multiple sclerosis (MS) when Brain MRI does not fulfill diagnostic criteria (Filippi, 2016) ○ Cervical **and/or** Thoracic MRI with suspected transverse myelitis - with appropriate clinical symptoms (e.g., bilateral weakness, sensory disturbance, and autonomic dysfunction which typically evolve over hours or days) ○ Brain MRI with Cervical **and/or** Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis) (Wingerchuk, 2015) ○ Known MS, entire CNS axis (Brain, **and/or** Cervical **and/or** Thoracic spine) is approvable prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline) ○ Follow-up scans, including brain and spine imaging if patients have known spine disease: ▪ 6-12 months after starting/changing treatment ▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years --- [Under **For evaluation of trauma or acute injury**, the following was changed:]	**(e.g., localization to a particular segment of the spinal cord), patient history (e.g., symptom(s), time course, and where in the CNS the likely localization(s) is/are), and other available information, including prior imaging.** ○ Cervical **and/or** Thoracic MRI for evaluation of highly suspected multiple sclerosis (MS) when Brain MRI has indeterminate findings and/or does not fulfill diagnostic criteria[26] ○ Cervical **and/or** Thoracic MRI with suspected transverse myelitis - with appropriate clinical symptoms (e.g., bilateral weakness, sensory disturbance, and autonomic dysfunction which typically evolve over hours or days) ○ Brain MRI with Cervical **and/or** Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis)[29] ○ Known MS, entire CNS axis (Brain, **and/or** Cervical **and/or** Thoracic spine) is approvable prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline) ○ Known MS- Follow-up scans, including brain and spine imaging, if patients have known spine disease: ▪ 6-12 months after starting/changing treatment ▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years --- [Under **For evaluation of trauma or acute injury**, the following was changed:]

• History of underlying spinal abnormalities (i.e., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis), both MRI and CT are approvable (ACR, 2021; Koivikko, 2008; Taljanovic, 2009)
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Metastatic tumor
• With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
• Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine
• With an associated new focal neurologic deficit (Alexandru, 2012)
• Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019)
 	
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[Under **Other Indications for a Cervical Spine MRI**, the following was changed:]
• Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))
	• History of underlying spinal abnormalities (i.e., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis) (Both MRI and CT would be approvable)[31-33]
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	• **Metastatic tumor**
	  ○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
	  ○ With an associated new focal neurologic deficit[34]
	  ○ Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine[12, 39]
	
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	[Under **Other Indications for a Cervical Spine MRI**, the following was changed:]
	• Toe walking in a child with signs/symptoms of myelopathy localized to the Cervical Spine

	• Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's) ○ After detailed neurological exam and basic testing completed

COMBINATION OF STUDIES WITH CERVICAL SPINE MR
 	
Indications for combination studies: (ACR, 2017, 2019) - For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure
 	
Brain MRI/Cervical MRI
• For evaluation of known Arnold-Chiari Malformation
	COMBINATION OF STUDIES WITH CERVICAL SPINE MR
	
	Brain MRI/Cervical MRI
	• For evaluation of known Arnold-Chiari Malformation
	
	Cervical and Thoracic MRI
	• Initial evaluation of known syrinx or syringomyelia
	  ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis[54])
	  ○ To further characterize a suspicious abnormality seen on prior imaging
	  ○ Known syrinx with new/worsening symptom

Any combination of Cervical and/or Thoracic and/or Lumbar MRIs	**Any combination of Cervical and/or Thoracic and/or Lumbar MRIs** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging.

	Exception- Indications for combination studies[55, 56]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure
• Any combination of these studies for: ○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015) ○ In the presence of progressive spinal deformity or for preoperative planning (Trenga, 2016) ○ Neck pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015)	• Any combination of these studies for: ○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10[57-59] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[60] ○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[61]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari malformations[62, 63] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[50, 57]

• Arnold-Chiari II-IV
  ○ For initial evaluation and follow up as appropriate
	○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate
	  ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele

• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging (Hertzler, 2010)	• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,[48-50] when anesthesia required for imaging[64] (e.g., meningomyelocele, lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)
• Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))	
• Neck pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006)	

	• Oncological applications (e.g., primary nervous system, metastatic)
	  ○ Drop metastasis from brain or spine (imaging also includes brain)- see Overview section
	  ○ Suspected leptomeningeal carcinomatosis (LC)[65] - see Overview section
	  ○ Any combination of these for spinal survey in patient with metastases

• Drop metastasis from brain or spine (imaging also includes brain) • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011) • Any combination of these for spinal survey in patient with metastases	

• Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))	○ Tumor evaluation and monitoring in neurocutaneous syndromes - See Overview section • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))

CHEST CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
Suspected Pulmonary Embolism (PE) (ACCP, 2013; ACR, 2020; Corrigan, 2016; Kirsch, 2017; Konstantinides, 2014) • High risk for PE based on shock or hypotension ○ Risk can be determined by the parameters detailed in Background section • Positive D-dimer (Corrigan, 2016; Konstantinides, 2014)	**Suspected Pulmonary Embolism (PE)[1-5]** • High risk for PE based on shock or hypotension • Intermediate or high risk as determined by the parameters detailed in Overview section • Positive D-dimer[2, 4]

CHEST (THORAX) CT	
Previous (red indicates deleted text)	New (blue indicates new text)

• **Incidental pulmonary nodules on non-chest CT**
  ○ Nodules >8mm or those with very suspicious features need further Chest CT as early as possible
  ○ Nodules ≤ 8mm should follow the Fleischner table
	• **Incidental pulmonary nodules on non-Chest CT**
	  ○ Nodules >8mm or those with very suspicious features need further Chest CT as early as possible
	  ○ Nodules ≤ 8mm should follow the Fleischner table
	
	Incidental pulmonary nodules on chest x-ray that are indeterminate (not typical of granulomatous disease) as noted by the radiologist. No time delay between the chest x-ray and the subsequent Chest CT needed).

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Pre-operative/procedural evaluation • Pre-operative evaluation for a planned surgery or procedure	**Pre-operative/procedural evaluation** • Pre-operative evaluation for a planned surgery or procedure • Pre-operative evaluation for Electromagnetic Navigation Bronchoscopy[31]
Post-operative/procedural evaluation • Post-surgical follow-up when records document medical reason requiring additional imaging • Pre-operative evaluation for Electromagnetic Navigation Bronchoscopy (Khan, 2016)	**Post-operative/procedural evaluation** • Post-surgical follow-up when records document medical reason requiring additional imaging
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• Long (Chronic) COVID:
  ○ Prior history of Covid with hypoxia or impaired lung function on follow-up (Rubin, 2020)
  ▪ Restricted diffusion on Pulmonary Function Test (would need a HRCT – High Resolution CT)
	• Long (Chronic) COVID (See Overview)
	  ○ Prior history of Covid with hypoxia or impaired lung function of follow-up[33]
	  ▪ Restricted diffusion on Pulmonary Function Test (would need a HRCT – High Resolution CT)

▪ Low oxygen saturation and a Chest x-ray was done	▪ Low oxygen saturation and a Chest x-ray was done ○ Known fibrosis with continued symptoms

CT BONE DENSITY STUDY	
Previous (red indicates deleted text)	New (blue indicates new text)
	[Added the following section:] **Indications for QCT/pQCT in pediatric and adolescent include:** • Individuals receiving (or expected to receive) glucocorticoid therapy for more than 3 months • Individuals receiving radiation or chemotherapy for malignancies • Individuals with an endocrine disorder known to adversely affect BMD (e.g., hyperparathyroidism, hyperthyroidism, growth hormone deficiency or Cushing's syndrome) • Individuals with bone dysplasias known to have excessive fracture risk (osteogenesis imperfecta, osteopetrosis) or high BMD, such as prolonged exposure to fluoride • Individuals with medical conditions that could alter bone marrow density, such as: (chronic renal failure, inflammatory arthritides, eating disorders, organ transplantation, prolonged immobilization, sprue, inflammatory bowel disease, malnutrition, cystic fibrosis, osteomalacia, acromegaly, cirrhosis, HIV infection, prolonged exposure to fluorides, and hematologic disorders (thalassemia, sickle cell disease))

CT HEART/CT HEART CONGENITAL (Not including coronary arteries)	
Previous (red indicates deleted text)	New (blue indicates new text)
	[Under indications for Congenital Heart Disease, added:] • Single-Ventricle Heart Disease (includes hypoplastic left heart syndrome, double-inlet LV, double-inlet RV, mitral atresia, tricuspid atresia, unbalanced A-V septal defect): postoperative routine surveillance (3-5 years) in an asymptomatic patient
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[Under Aortic Pathology, removed typo:] • Patient with Turner's syndrome patients should undergo initial imaging with CT, MRI, or TTE for evidence of dilatation of the ascending thoracic aorta. If imaging is normal and there are no risk factors for aortic dissection, repeat imaging should be performed every 5 - 10 years, or if otherwise indicated. If the aorta is enlarged, appropriate follow-up imaging should be done according to size, as above	[Under Aortic Pathology:] • Patient with Turner's syndrome should undergo initial imaging with CT, MRI, or TTE for evidence of dilatation of the ascending thoracic aorta. If imaging is normal and there are no risk factors for aortic dissection, repeat imaging should be performed every 5 - 10 years, or if otherwise indicated. If the aorta is enlarged, appropriate follow-up imaging should be done according to size, as above

CT (VIRTUAL) COLONOSCOPY – SCREENING	
Previous (red indicates deleted text)	New (blue indicates new text)
• CT (computer tomographic) colonography (CTC) is considered medically appropriate as an alternative to colonoscopy for screening asymptomatic individuals in the following settings: ○ For average or moderate risk individuals‡ as defined below: ▪ Age ≥ 45 years, for initial screening and every 5 years after initial negative screen (ACS, 2018) ▪ Screening to age 75 or ≤10 years of life expectancy ▪ One time screening age 76- 85 if no prior study has been completed (depending on comorbidities and life expectancy) ▪ When endoscopy is medically contraindicated or not possible (e.g., patient is unable to undergo sedation or has medical conditions such as recent myocardial infarction, recent colonic surgery, a bleeding disorder, or severe lung and/or heart disease)	• CT (computer tomographic) colonography (CTC) is considered medically appropriate as an alternative to colonoscopy for screening asymptomatic individuals in the following settings: ○ For average or moderate risk individuals‡ as defined below: ▪ Age 45-75 years, for initial screening and every 5 years after initial negative screen[1-3] ▪ Screening to age 75 or ≤10 years of life expectancy ▪ One time screening age 76- 85 if no prior study has been completed (depending on comorbidities and life expectancy) ▪ When colonoscopy is medically contraindicated or not possible (e.g., due to a known colonic lesion, structural abnormality, or technical difficulty, patient is unable to undergo sedation or has medical conditions such as recent myocardial infarction, recent colonic surgery, a bleeding disorder, or severe lung and/or heart disease)

ELECTRON-BEAM TOMOGRAPHY (EBCT)	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR CORONARY ARTERY CALCIUM (CAC) TESTING (Arnett, 2019; Blankstein, 2017; Goff, 2014; Greenland, 2018; Hecht, 2017; Mahabadi, 2017; McClelland, 2015; Nasir, 2015; Pender, 2016; Piepoli, 2016)	**INDICATIONS FOR CORONARY ARTERY CALCIUM (CAC) TESTING[1-10]**
• In the context of shared decision making for patients aged 40 to 75, (without clinical atherosclerotic cardiovascular disease), with intermediate-to-low 10-year risk (5 - 20%), with documentation that the CAC score is necessary to adjust management, such as statin therapy (Hecht, 2017; Michos, 2017; Stone, 2013; Wilkins, 2018)	CAC testing is for cardiovascular risk assessment in individuals aged 40-75 years who have an intermediate (5-19.9%) 10-year ASCVD risk based upon the ACC/AHA pooled cohort risk calculator. Documentation is required that the results of the study will affect decision making for preventative actions (i.e., statin therapy).
• Patients who are over 75 or younger than 40 years old can be considered for CAC testing when there is well-documented evidence that the results could alter management (Tota-Maharaj, 2012) ○ Patients with estimated 10-year risk of less than 5%, but are suspected to be at elevated atherosclerotic cardiovascular disease (ASCVD) risk because of a major risk factor not accounted for in the global risk equations, such as family history of premature CAD (Greenland, 2018; Hecht, 2017)	• Patients who are **over 75 or younger than 40 years old can be considered** for CAC testing when there is well-documented evidence of one of the following: [11] ○ Patients with estimated 10-year risk of less than 5%, but are suspected to be at elevated atherosclerotic cardiovascular disease (ASCVD) risk because of a major risk factor not accounted for in the global risk equations, such as: [4, 5, 12] ▪ Family history of premature ASCVD ▪ Persistently elevated LDL-C > 160mg/dl or non-HDL-C >190mg/dl ▪ Chronic kidney disease ▪ Metabolic syndrome

	▪ Conditions specific to women (e.g., pre-eclampsia, premature menopause) ▪ Inflammatory diseases (HIV, psoriasis, RA) ▪ Ethnicity (e.g., South Asian ancestry) ▪ Persistently elevated triglycerides (>175mg/dl) ▪ hsCRP >2mg/L ▪ Lp(a) levels > 50mg/dl ▪ apoB>130mg/dl ▪ ABI < 0.9

HEART MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
• Evaluation in patients with known or suspected connective tissue disease or genetic conditions that predispose to aortic aneurysm or dissection, such as Marfan's, Ehler's Danlos or Loeys-Dietz syndrome (at the time of diagnosis and 6 months thereafter), followed by annual imaging (can be done more frequently if > 4.5 cm or rate of growth > 0.5 cm/year- up to twice per year) --- • Single-Ventricle Heart Disease: ○ Postoperative routine surveillance (3–5 years) in an asymptomatic patient ○ Routine surveillance (1–2 years) in an asymptomatic adult postoperative Stage 2 palliation (CMR only) --- **Coronary Artery Disease Evaluation** **(CMR as an alternative to pharmacologic MPI)** • CMR, which is done pharmacologically, is used for the assessment of coronary artery disease when a stress echocardiogram (SE) cannot be performed ○ If the patient cannot walk and would otherwise be a candidate for a pharmacologic MPI, a CMR can be performed	• Evaluation in patients with known or suspected connective tissue disease or genetic condition that predispose to aortic aneurysm or dissection, such as Marfan's, Ehler's Danlos or Loeys-Dietz syndrome (at the time of diagnosis and 6 months thereafter), followed by annual imaging (can be done more frequently if > 4.5 cm or rate of growth > 0.5 cm/year- up to twice per year) --- • Single-Ventricle Heart Disease: • Postoperative routine surveillance (1–2 years) in an asymptomatic patient • Routine surveillance (1–2 years) in an asymptomatic adult postoperative Stage 2 palliation (CMR only) --- **Coronary Artery Disease Evaluation (CMR as an alternative to pharmacologic MPI)** CMR, which is done pharmacologically, is used for the assessment of coronary artery disease, and can be performed if the patient would otherwise be a candidate for a pharmacologic MPI.

○ If the patient can walk and is having an MPI for another reason (LBBB, CABG, etc.), MPI is chosen over CMR • Assessment of LV wall motion to identify patients with akinetic segments that would benefit from coronary revascularization • To identify the extent and location of myocardial necrosis in patients with chronic or acute ischemic heart disease	• If the patient can walk and is having an MPI for another reason (LBBB, CABG, etc.), MPI is chosen over CMR • Assessment of LV wall motion to identify patients with akinetic segments that would benefit from coronary revascularization • To identify the extent and location of myocardial necrosis in patients with chronic or acute ischemic heart disease

HEART (CARDIAC) PET	
Previous (red indicates deleted text)	New (blue indicates new text)
GENERAL INFORMATION It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted. **INDICATIONS FOR HEART PET**	**GENERAL INFORMATION** It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted. **This guideline is for stress imaging, specifically Heart (Cardiac) PET imaging, with appropriate preference for suitable alternatives, such as stress echocardiography (SE) or myocardial perfusion imaging (MPI), when more suitable, unless otherwise stated (refer to Background section).** **INDICATIONS FOR HEART PET**

SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)
 	
Symptomatic patients without known CAD (use Diamond Forrester Table)
• Low or intermediate pretest probability and unable to exercise
• High pretest probability
• Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago **AND** meets one of the criteria above
Asymptomatic patients without known CAD
• Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities
• Previously unevaluated pathologic Q waves
• Unevaluated complete left bundle branch block
• History of diabetes mellitus, > 40 years old, with calcium score >400
 	
INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither
	SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)
	
	• **Symptomatic patients without known CAD (use Diamond Forrester Table)**
	  ○ Low or intermediate pretest probability and unable to exercise *(SE diversion not required)*
	  ○ High pretest probability *(SE diversion not required)*
	  ○ Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago **AND** meets one of the criteria above
	• **Asymptomatic patients without known CAD** *(SE diversion not required)*
	  ○ Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities (see section in Background)
	  ○ Previously unevaluated pathologic Q waves (see section in Background)
	  ○ Unevaluated complete left bundle branch block
	
	ABNORMAL CALCIUM SCORES (CAC)[1-5] (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)
	
	• ASYMPTOMATIC patient with a calcium score >400, not previously evaluated
	• SYMPTOMATIC patient with prior CAC ≥100
	
	INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither

SE nor MPI have provided or are expected to provide optimal imaging) • Exercise stress ECG with low risk Duke treadmill score (≥5), but patient's current symptoms indicate an intermediate or high pretest probability • Exercise stress ECG with an intermediate Duke treadmill score • Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions) • Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR) • An intermediate evaluation by prior stress imaging (within the past 2 years) **FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) when LVEF is ≤ 40% and revascularization is under consideration** • **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent **OR** • For patients with high occupational risk (e.g., associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters)	**SE nor MPI have provided, or are expected to provide, optimal imaging)** • Exercise stress ECG with low-risk Duke treadmill score (≥5) (see section in Background) but patient's current symptoms indicate an intermediate or high pretest probability *(SE diversion not required* for high pretest probability) • Exercise stress ECG with an intermediate Duke treadmill score • Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions) • Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR) *(SE diversion not required)* • An intermediate evaluation by prior stress imaging (within the past 2 years) *(SE diversion not required)* **FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)** • **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent **OR** • For patients with high occupational risk (e.g., associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters)

• **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging, if it will alter management	• **New, recurrent, or worsening symptoms post coronary revascularization** are an indication for stress imaging, if it will alter management
FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)	**FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)**
• For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine a patient's potential benefit from coronary revascularization (Patel, 2013; Tsai, 2014; Yancy, 2013) • **Routine follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management	• **Follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management
SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided or are expected to provide optimal imaging)	**SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)**
• Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation • Newly diagnosed systolic heart failure (EF < 50%), especially with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (Fihn, 2012; Patel, 2013; Yancy, 2013) • Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary	• Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation • Newly diagnosed systolic heart failure or diastolic heart failure, *with reasonable suspicion of cardiac ischemia (prior events, risk factors),* unless invasive coronary angiography is immediately planned[6-8] • Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary

revascularization. (Diversion from PET not required when LVEF less than or equal to 40%) (Patel, 2013; Tsai, 2014; Yancy, 2013)
• Ventricular arrhythmias
  ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not the immediately planned test (Al-Khatib, 2018)
  ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed
• Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), as well as annually in intermediate and high global risk patients (SE diversion not required) (Reiffel, 2015)
• Assessment of hemodynamic significance of one of the following documented conditions (Anagnostopoulos, 2004):
  ○ Anomalous coronary arteries (Grani, 2017)
  ○ Muscle bridging of coronary artery (perform with exercise stress) (Sorajja, 2021)
• Coronary aneurysms in Kawasaki's disease (McCrindle, 2017) or due to atherosclerosis
• Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti, 2013)
 	
• **Cardiac Sarcoidosis** (Birnie, 2016; Blankstein, 2016; Vita, 2018)
  ○ Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of
	revascularization. (Diversion from PET not required when LVEF less than or equal to 40%)[6, 7, 9]
	• Ventricular arrhythmias
	  ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not the immediately planned test[10]
	  ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed
	• Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), as well as annually in intermediate and high global risk patients (SE diversion not required)[11]
	• Assessment of hemodynamic significance of one of the following documented conditions[12]:
	  ○ Anomalous coronary arteries[13]
	  ○ Muscle bridging of coronary artery [3, 14]
	
	• Coronary aneurysms in Kawasaki's disease[15] or due to atherosclerosis
	• Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter[16]
	
	• **Cardiac Sarcoidosis**[17-19]
	  ○ Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed

suspected cardiac involvement by echo or ECG, when CMR has not been performed ○ Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion (Vita, 2018) ○ Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy (Vita, 2018) ○ Initial and follow-up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years • **Infective Endocarditis** ○ In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications (Doherty, 2017; Habib, 2016; Wang, 2018) • **Aortitis** ○ For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging (Bhave, 2018) ‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required. **PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)**	○ Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion[19] ○ Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy[19] ○ Initial and follow-up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years • **Infective Endocarditis** ○ In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications[20, 21] • **Aortitis** ○ For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging[22] ‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required. **PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)**

• Patients who have no other indication for a non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met: ○ Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal; **AND** ○ The patient has **at least one** of the additional cardiac complication risk factors: ▪ Ischemic Heart Disease ▪ History of stroke or TIA ▪ History of congestive heart failure or ejection fraction ≤ 35% ▪ Insulin-requiring diabetes mellitus ▪ Creatinine ≥ 2.0 mg/dl **AND** ○ The patient has limited functional capacity (< 4 METS), such as one of the following: ▪ Unable to take care of their activities of daily living (ADLs) or ambulate ▪ Unable to walk 2 blocks on level ground ▪ Unable to climb 1 flight of stairs **AND** ○ There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery	• An intermediate or high risk surgery with of one or more risk factors (see below), AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year[23-25] ○ **Risk factors:** history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin, and preoperative serum creatinine >2.0 mg/dL. ○ **Surgical Risk:** ▪ **High risk surgery:** Aortic and other major vascular surgery, peripheral vascular surgery, anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss ▪ **Intermediate risk surgery:** Carotid endarterectomy, head and neck surgery, intraperitoneal and intrathoracic surgery, orthopedic surgery, prostate surgery ▪ **Low risk surgery**: Endoscopic procedures, superficial procedure, cataract surgery, breast surgery
• Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the	• Planning for any organ or stem cell transplantation is an indication for preoperative stress imaging, if there has not been a conclusive stress evaluation, CTA, or heart

past year with ≥ 3 of the following risk factors (SE diversion not required) (Lentine, 2012): • Age > 60 • Smoking • Hypertension • Dyslipidemia • Left ventricular hypertrophy • 1 year on dialysis (for renal transplant patients) • Diabetes mellitus • Prior ischemic heart disease **POST CARDIAC TRANSPLANT** (SE diversion not required) (McArdle, 2012) • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography • After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually if invasive coronary arteriography is not planned	catheterization within the past year, at the discretion of the transplant service[26] **POST CARDIAC TRANSPLANT** (SE diversion not required)[27] • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography • After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually if invasive coronary arteriography is not planned

HEART (CARDIAC) PET WITH CT FOR ATTENUATION	
Previous (red indicates deleted text)	New (blue indicates new text)
GENERAL INFORMATION It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.	**GENERAL INFORMATION** It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted. **This guideline is for stress imaging, specifically Heart (Cardiac) PET imaging, with appropriate preference for suitable alternatives, such as stress echocardiography (SE) or myocardial perfusion imaging (MPI), when more suitable, unless otherwise stated (refer to Background section).**
INDICATIONS FOR HEART PET **SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)** **Symptomatic patients without known CAD (use Diamond Forrester Table)** • Low pretest probability and unable to exercise • Intermediate pre-test probability with an uninterpretable electrocardiogram (ECG) or unable to exercise (Wolk, 2014) • High pretest probability	**INDICATIONS FOR HEART PET WITH CT FOR ATTENUATION** **SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)** • **Symptomatic patients without known CAD (use Diamond Forrester Table)** ○ Low or intermediate pretest probability and unable to exercise *(SE diversion not required)* ○ High pretest probability *(SE diversion not required)*

• Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago **AND** meets one of the criteria above **Asymptomatic patients without known CAD** • Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities • Previously unevaluated pathologic Q waves • Unevaluated complete left bundle branch block • History of diabetes mellitus, > 40 years old, with calcium score >400 **INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither SE nor MPI have provided or are expected to provide optimal imaging)** • Exercise stress ECG with low risk Duke treadmill score (≥5), but patient's current symptoms indicate an intermediate or high pretest probability • Exercise stress ECG with an intermediate Duke treadmill score	○ Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago **AND** meets one of the criteria above • **Asymptomatic patients without known CAD** *(SE diversion not required)* ○ Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities (see section in Background) ○ Previously unevaluated pathologic Q waves (see section in Background) ○ Unevaluated complete left bundle branch block **ABNORMAL CALCIUM SCORES (CAC)[1-5] (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)** • ASYMPTOMATIC patient with a calcium score >400, not previously evaluated • SYMPTOMATIC patient with prior CAC ≥100 **INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)** • Exercise stress ECG with low-risk Duke treadmill score (≥5) (see section in Overview) but patient's current symptoms indicate an intermediate or high pretest probability *(SE diversion not required* for high pretest probability)

• Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions) • Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR) • An intermediate evaluation by prior stress imaging (within the past 2 years)	• Exercise stress ECG with an intermediate Duke treadmill score • Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions) • Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR) *(SE diversion not required)* • An intermediate evaluation by prior stress imaging (within the past 2 years) *(SE diversion not required)*
FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) when LVEF is ≤ 40% and revascularization is under consideration • **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent **OR** • For patients with high occupational risk (e.g., associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) • **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging, if it will alter management	**FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)** • **Asymptomatic, follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), (whichever is later), is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent **OR** • For patients with high occupational risk (e.g., associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers, and firefighters) • **New, recurrent, or worsening symptoms post coronary revascularization** are an indication for stress imaging, if it will alter management
FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging) • For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine	**FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)**

a patient's potential benefit from coronary revascularization (Patel, 2013; Tsai, 2014; Yancy, 2013) • **Routine follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management	• **Follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis greater than or equal to 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging in patients if it will alter management
SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided or are expected to provide optimal imaging) • Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation • Newly diagnosed systolic heart failure (EF < 50%), especially with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (Fihn, 2012; Patel, 2013; Yancy, 2013) • Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary revascularization. (Diversion from PET not required when LVEF less than or equal to 40%) (Patel, 2013; Tsai, 2014; Yancy, 2013) • Ventricular arrhythmias ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not the immediately planned test (Al-Khatib, 2018) ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as	**SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided, or are expected to provide, optimal imaging)** • Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation • Newly diagnosed systolic heart failure or diastolic heart failure, *with reasonable suspicion of cardiac ischemia (prior events, risk factors),* unless invasive coronary angiography is immediately planned[6-8] • Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary revascularization. (Diversion from PET not required when LVEF less than or equal to 40%)[6, 7, 9] • Ventricular arrhythmias ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not the immediately planned test[10] ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour on remote

greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed • Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), as well as annually in intermediate and high global risk patients (SE diversion not required) (Reiffel, 2015) • Assessment of hemodynamic significance of one of the following documented conditions (Anagnostopoulos, 2004): ○ Anomalous coronary arteries (Grani, 2017) ○ Muscle bridging of coronary artery (perform with exercise stress) (Sorajja, 2021) • Coronary aneurysms in Kawasaki's disease (McCrindle, 2017) or due to atherosclerosis • Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti, 2013) • **Cardiac Sarcoidosis** (Birnie, 2016; Blankstein, 2016; Vita, 2018) ○ Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed ○ Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion (Vita, 2018) ○ Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy (Vita, 2018)	monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed • Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), as well as annually in intermediate and high global risk patients (SE diversion not required)[11] • Assessment of hemodynamic significance of one of the following documented conditions[12]: ○ Anomalous coronary arteries[13] ○ Muscle bridging of coronary artery [3, 14] • Coronary aneurysms in Kawasaki's disease[15] or due to atherosclerosis • Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter[16] • **Cardiac Sarcoidosis[17-19]** ○ Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed ○ Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion[19] ○ Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy[19]

○ Initial and follow-up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years	○ Initial and follow-up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years
• **Infective Endocarditis** ○ In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications (Doherty, 2017; Habib, 2016; Wang, 2018)	• **Infective Endocarditis** ○ In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications[20, 21]
• **Aortitis** ○ For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging (Bhave, 2018) ‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required.	• **Aortitis** ○ For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging[22] ‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required.
PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging) • Patients who have no other indication for a non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met: ○ Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal; **AND** ○ The patient has **at least one** of the additional cardiac complication risk factors: ▪ Ischemic Heart Disease	**PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)** • An intermediate or high risk surgery with of one or more risk factors (see below), AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year[23-25] ○ **Risk factors:** history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment

▪ History of stroke or TIA ▪ History of congestive heart failure or ejection fraction ≤ 35% ▪ Insulin-requiring diabetes mellitus ▪ Creatinine ≥ 2.0 mg/dl **AND** ○ The patient has limited functional capacity (< 4 METS), such as one of the following: ▪ Unable to take care of their activities of daily living (ADLs) or ambulate ▪ Unable to walk 2 blocks on level ground ▪ Unable to climb 1 flight of stairs **AND** ○ There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery	with insulin, and preoperative serum creatinine >2.0 mg/dL. ○ **Surgical Risk:** ▪ **High risk surgery:** Aortic and other major vascular surgery, peripheral vascular surgery, anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss ▪ **Intermediate risk surgery:** Carotid endarterectomy, head and neck surgery, intraperitoneal and intrathoracic surgery, orthopedic surgery, prostate surgery ▪ **Low risk surgery**: Endoscopic procedures, superficial procedure, cataract surgery, breast surgery
• Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year with ≥ 3 of the following risk factors (SE diversion not required) (Lentine, 2012): • Age > 60 • Smoking • Hypertension • Dyslipidemia • Left ventricular hypertrophy • 1 year on dialysis (for renal transplant patients) • Diabetes mellitus	• Planning for any organ or stem cell transplantation is an indication for preoperative stress imaging, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, at the discretion of the transplant service[26]

• Prior ischemic heart disease **POST CARDIAC TRANSPLANT** (SE diversion not required) (McArdle, 2012) • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography • After the first five years post cardiac transplantation: ○ Patients with documented transplant coronary vasculopathy, can be screened annually if invasive coronary arteriography is not planned	**POST CARDIAC TRANSPLANT** (SE diversion not required)[27] • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography [Note: The wording was not changed in bullet below, but the sub-bullet was combined into bullet for clarity.] • After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually if invasive coronary arteriography is not planned

LOWER EXTREMITY CT	
Previous (red indicates deleted text)	New (blue indicates new text)

• Knee (Doral, 2018; Katz, 2013; Mohankumar, 2014; Slaughter, 2014; Smith, 2015; Taljanovic, 2019)
  ○ Joint instability or meniscal injury on exam, demonstrated with a positive
  ▪ McMurray's
  ▪ Thessaly
  ▪ Apley's
  ▪ Lachman's
  ▪ Anterior or Posterior Drawer sign
  ▪ Varus or valgus stress
  ▪ Acute mechanical locking of the knee not due to guarding (Hussin, 2014)
 	
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Trauma
Bone Fracture
• Suspected stress or insufficiency fracture with a negative initial x-ray (Bencardino, 2017; Patel, 2011; Sadineni, 2015):
  ○ If hips and MRI cannot be done
  ○ If other parts of the extremities and repeat x-rays in 10-14 days are negative or nondiagnostic
 	
  ○ If at high risk for a complete fracture with conservative therapy (e.g., navicular bone) and MRI cannot be performed (Kellar, 2020)
	• Knee[2-7]
	
	  ○ Joint instability or meniscal injury on exam, demonstrated with a positive
	  ▪ McMurray's
	
	  ▪ Apley's
	  ▪ Lachman's
	  ▪ Anterior or Posterior Drawer sign
	  ▪ Varus or valgus stress
	  ▪ Acute mechanical locking of the knee not due to guarding[8]
	
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	Trauma
	Bone Fracture
	• Suspected stress or insufficiency fracture with a negative initial x-ray[39-41]:
	  ○ If hips and MRI cannot be done
	  ○ Non-hip extremities: if x-rays, taken 10-14 days after the injury or clinical assessment, are negative or nondiagnostic[42]
	  ○ If at high risk for a complete fracture with conservative therapy (e.g., navicular bone) and MRI cannot be performed[43]

LOWER EXTREMITY MRA/MRV	
Previous (red indicates deleted text)	New (blue indicates new text)

• Renal impairment
  ○ Not on dialysis
  ▪ Mild to moderate, GFR 30-89 ml/min MRA can be done
  ▪ Severe, GFR < 30 ml/min MRA without contrast
	• Renal impairment
	  ○ Not on dialysis
	  ▪ Mild to moderate, GFR 30-45 ml/min MRA with contrast can be performed
	  ▪ Severe, GFR < 30 ml/min MRA without contrast

LOWER EXTREMITY MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
• Knee (Doral, 2018; Katz, 2013; Mohankumar, 2014; Slaughter, 2014; Smith, 2015; Taljanovic, 2019) ○ Joint instability or meniscal injury on exam, demonstrated with a positive ▪ McMurray's ▪ Thessaly ▪ Apley's ▪ Lachman's ▪ Anterior or Posterior Drawer sign ▪ Varus or valgus stress ▪ Acute mechanical locking of the knee not due to guarding (Hussin, 2014) --- **Trauma** **Bone Fracture** • Suspected stress or insufficiency fracture with a negative initial x-ray (Bencardino, 2017; Sadineni, 2015): ○ If hips, then approve an immediate MRI ○ Suspicion of a hip fracture in a pregnant patient does not require an initial x-ray ○ If other parts of the extremities and repeat x-rays in 10-14 days are negative or nondiagnostic ○ If at high risk for a complete fracture with conservative therapy (e.g., navicular bone), then immediate MRI is warranted (Kellar, 2020)	• Knee[2-7] ○ Joint instability or meniscal injury on exam, demonstrated with a positive ▪ McMurray's ▪ Apley's ▪ Lachman's ▪ Anterior or Posterior Drawer sign ▪ Varus or valgus stress ▪ Acute mechanical locking of the knee not due to guarding[8] --- **Trauma** **Bone Fracture** • Suspected stress or insufficiency fracture with a negative initial x-ray[35, 36]: ○ If hips, then approve an immediate MRI ○ Suspicion of a hip fracture in a pregnant patient does not require an initial x-ray ○ Non-hip extremities: if x-rays, taken 10-14 days after the injury or clinical assessment, are negative or nondiagnostic[37] ○ If at high risk for a complete fracture with conservative therapy (e.g., navicular bone), then immediate MRI is warranted[38]

LUMBAR SPINE CT	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR LUMBAR SPINE CT **(Combination requests at end of the document)**	**INDICATIONS FOR LUMBAR SPINE CT** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:** • **Inconclusive or show a need for additional or follow up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.** **(*Unless approvable in the combination section as noted in the guidelines)**
For evaluation of neurologic deficits when Lumbar Spine MRI is contraindicated or inappropriate • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic or abnormal reflexes ○ Absent/decreased sensory changes along a particular lumbar dermatome (nerve distribution): pin prick, touch, vibration, proprioception or temperature ○ Lower extremity increased muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) ○ Gait abnormalities (see Table 1 below for more details)	**For evaluation of neurologic deficits when Lumbar Spine MRI is contraindicated or inappropriate** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy)[1, 2] ○ Pathologic or abnormal reflexes ○ Absent/decreased sensory changes along a particular lumbar dermatome (nerve distribution): pin prick, touch, vibration, proprioception or temperature ○ Lower extremity increased muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)- not related to an inherent bowel or bladder process ○ Gait abnormalities (see Table 1 below for more details)

○ New onset foot drop • Cauda Equina Syndrome as evidence by severe back pain/sciatica along with one of the defined symptoms (see Background section) [Within section **For evaluation of back pain with any of the following when Lumbar Spine MRI is contraindicated**, the following changes were made:] • Isolated back pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below cervical and thoracic spine may also be indicated) ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) ○ Back pain associated with suspected inflammation, infection, or malignancy [Within **As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** section, the following changes were made:] **As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) and MRI for cord, nerve root compression, disc pathology, or post-op infection)**	○ New onset foot drop (Not related to a peripheral nerve injury e.g., peroneal nerve) • Cauda Equina Syndrome as evidence by severe back pain/sciatica along with one of the defined symptoms (see Overview) [Within section **For evaluation of back pain with any of the following when Lumbar Spine MRI is contraindicated**, the following changes were made:] • Isolated low back pain in pediatric population[13] – conservative care not required if red flags present ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed[14, 15] [Within **As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** section, the following changes were made:] **As part of initial pre-operative/post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[11, 16] and MRI for cord, nerve root compression, disc pathology, or post-op infection)**

• Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above • When combo requests are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required (Fisher, 2013)	• Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • New or changing neurological deficits or symptoms post-operatively[16, 18] - see neurological deficit section above • When combo requests are submitted (see above statement[+]) (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required[19]
[Within section **For evaluation of trauma or acute injury**, the following changes were made:]	[Within section **For evaluation of trauma or acute injury**, the following changes were made:]
• History of underlying spinal abnormalities (i.e., ankylosing spondylitis or diffuse idiopathic skeletal hyperostosis) both MRI and CT are approvable (Koivikko, 2008)	• History of underlying spinal abnormalities (i.e., ankylosing spondylitis or diffuse idiopathic skeletal hyperostosis) (Both MRI and CT would be approvable)[21]
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CT myelogram is indicated when signs and symptoms are incongruent with MRI findings or MRI cannot be performed/contraindicated /surgeon preference	**CT myelogram: When MRI cannot be performed/contraindicated/surgeon preference**
• Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac	• When signs and symptoms are inconsistent or not explained by the MRI findings[24-28] • Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac

[Within section **Pars defect (spondylolysis) or spondylolisthesis**, the following changes were made:]
• Clinically suspected Pars defect (spondylolysis) which is not seen on plain films in pediatric population (<18 yr) (flexion extension instability not required) and imaging would change treatment (Cohen, 2005; Kobayashi, 2013; Rush, 2015) when MRI is contraindicated
 	
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Metastatic tumor
• With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
• Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine
• With an associated new focal neurologic deficit (Alexandru, 2012)
• Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2020)
 	
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For evaluation of known or suspected inflammatory disease when MRI is contraindicated or cannot be performed
(ACR, 2021)
• For known or suspected Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup
	[Within section **Pars defect (spondylolysis) or spondylolisthesis**, the following changes were made:]
	• Clinically suspected Pars defect (spondylolysis) which is not seen on plain films in pediatric population (<18 yr) (flexion extension instability not required) and imaging would change treatment[29-31] when MRI is contraindicated/cannot be performed or surgeon preference
	
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	• **Metastatic tumor**
	  ○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
	  ○ With an associated new focal neurologic deficit[23]
	  ○ Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine[36, 37]
	
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	For evaluation of known or suspected inflammatory disease when MRI is contraindicated or cannot be performed[42]
	
	• Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup

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COMBINATION STUDIES WITH LUMBAR SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE	**COMBINATION STUDIES WITH LUMBAR SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE**
Indications for combination studies: (ACR, 2017, 2019) - For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure	
Any combination of Cervical and/or Thoracic and/or Lumbar CTs	**Any combination of Cervical and/or Thoracic and/or Lumbar CTs** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging. **Exception**- Indications for combination studies[49, 50]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure
• Any combination of these studies for:	• Any combination of these studies for: ○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic

○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) ○ Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015) • Arnold Chiari II-IV ○ For initial evaluation and follow-up as appropriate • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or	scoliosis under the age of 10[51-53] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[54] ○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[55]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari malformations[56, 57] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[45, 51] ○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele) • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or

high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia is required for imaging (Hertzler, 2012) • Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords)) • Back pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) • Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram) • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011) • Any combination of these for spinal survey in patient with metastases • Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache,	high-risk cutaneous stigmata,[43-45] when anesthesia required for imaging[58] (e.g., meningomyelocele, lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations) • Oncological Applications (e.g., primary nervous system, metastatic) ○ Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram)- See Overview ○ Suspected leptomeningeal carcinomatosis (LC)[59]- See Overview ○ Any combination of these for spinal survey in patient with metastases ○ Tumor evaluation and monitoring in neurocutaneous syndromes • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache,

orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))(Starling, 2013) • CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT	orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))[17] • CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT

LUMBAR SPINE MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR LUMBAR SPINE MRI **(Combination requests at end of the document)** **For evaluation of neurologic deficits** (Acharya, 2019; ACR, 2013; NASS, 2010; Stolper, 2017) • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic or abnormal reflexes ○ Absent/decreased sensory changes along a particular lumbar dermatome (nerve distribution): pin prick, touch, vibration, proprioception or temperature ○ Lower extremity increased muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) ○ Gait abnormalities (see Table 1 for more details) ○ New onset foot drop	**INDICATIONS FOR LUMBAR SPINE MRI** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:** • **Inconclusive or show a need for additional or follow up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.** **(*Unless approvable in the combination section as noted in the guidelines)** **For evaluation of neurologic deficits[1-4]** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy)[5, 6] ○ Pathologic or abnormal reflexes ○ Absent/decreased sensory changes along a particular lumbar dermatome (nerve distribution): pin prick, touch, vibration, proprioception or temperature ○ Lower extremity increased muscle tone/spasticity ○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)- not related to an inherent bowel or bladder process ○ Gait abnormalities (see Table 1 for more details) ○ New onset foot drop (Not related to a peripheral nerve injury, e.g., peroneal nerve)

• Cauda Equina Syndrome as evidence by severe back pain/sciatica along with one of the defined symptoms (see Background section) [Under **For evaluation of back pain with any of the following**, the following changes were made:] • Isolated back pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below cervical and thoracic spine may also be indicated) ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) ○ Back pain associated with suspected inflammation, infection, or malignancy [Under **As part of initial post-operative / procedural evaluation**… section, the following changes were made:] **As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology or post-op infection)** • Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings	• Cauda Equina Syndrome as evidence by severe back pain/sciatica along with one of the defined symptoms (see Overview section) [Under **For evaluation of back pain with any of the following**, the following changes were made:] • Isolated back pain in pediatric population[17] – conservative care not required if red flags present ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed[18, 19] [Under **As part of initial post-operative / procedural evaluation**… section, the following changes were made:] **As part of initial pre-operative / post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[16, 20] and MRI for cord, nerve root compression, disc pathology or post-op infection)** • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings

• Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above • When combo requests are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required (Fisher, 2013)	• New or changing neurological deficits or symptoms post-operatively [20, 21] - see neurological deficit section above • When combo requests (see above statement[+]) are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required[22]
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For evaluation of known or new compression fractures	**For evaluation of known or new compression fractures with worsening back pain[29]**
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Metastatic tumor • With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam • Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine • With an associated new focal neurologic deficit (Alexandru, 2012) • Initial imaging of new or increasing non-traumatic back pain or radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2020)	• **Metastatic tumor** ○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam ○ With an associated new focal neurologic deficit[34] ○ Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine[35, 36]
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	• Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's) ○ After detailed neurological exam and basic testing completed
COMBINATION OF STUDIES WITH LUMBAR SPINE MRI **Indications for combination studies: (ACR, 2017, 2019) - For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure** **Any combination of Cervical and/or Thoracic and/or Lumbar MRIs**	**COMBINATION OF STUDIES WITH LUMBAR SPINE MRI** **Any combination of Cervical and/or Thoracic and/or Lumbar MRIs** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging. **Exception**- Indications for combination studies[48, 49]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure

• Any combination of these studies for:
  ○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015)
 	
  ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)
	• Any combination of these studies for:
	  ○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10[50-52] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies)
	  ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[53]

○ Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management	○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[54]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management
• Arnold Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015).	• Arnold-Chiari malformations[55, 56] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[42, 50]
• Arnold Chiari II-IV ○ For initial evaluation and follow-up as appropriate	○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele)
• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia is required for imaging (Hertzler, 2010) • Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or	• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,[41-43] when anesthesia required for imaging[57] (e.g., meningomyelocele, lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)

orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords)) • Back pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) • Drop metastasis from brain or spine (imaging also includes brain) • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011) • Any combination of these for spinal survey in patient with metastases • Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))	• Oncological Applications (e.g., primary nervous system, metastatic) ○ Drop metastasis from brain or spine (imaging also includes brain)- see Overview ○ Suspected leptomeningeal carcinomatosis (LC)[58] -see Overview ○ Any combination of these for spinal survey in patient with metastases ○ Tumor evaluation and monitoring in neurocutaneous syndromes - See Overview • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))

MYOCARDIAL PERFUSION IMAGING (NUCLEAR CARDIAC IMAGING STUDY)	
Previous (red indicates deleted text)	New (blue indicates new text)
GENERAL INFORMATION It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results, and the reason that alternative imaging cannot be performed, must be included in the documentation submitted.	**GENERAL INFORMATION** It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results, and the reason that alternative imaging cannot be performed, must be included in the documentation submitted. **This guideline is for stress imaging, specifically myocardial perfusion imaging (MPI), with appropriate preference for suitable alternatives, such as stress echocardiography (SE), when more suitable, unless otherwise stated (refer to** Overview section**).**
INDICATIONS for MPI (Fihn 2012, Hendel 2009, Montalescot 2013, Wolk 2014)	**INDICATIONS for MPI[1-4]**
SUSPECTED Coronary Artery Disease (CAD)	**SUSPECTED CORONARY ARTERY DISEASE (CAD)**
Symptomatic patients without known CAD (use Diamond Forrester Table) • Low or intermediate pretest probability and unable to exercise • High pretest probability (Stress Echocardiogram [SE] diversion not required) • Repeat testing in a patient with new or worsening symptoms and negative result at least one year prior AND meets one of the criteria above	• **Symptomatic patients without known CAD (use Diamond Forrester Table)** ○ Low or intermediate pretest probability and unable to exercise *(SE diversion not required)* ○ High pretest probability *(SE diversion not required)* ○ Repeat testing in a patient with new or worsening symptoms and negative result at least one year prior AND meets one of the criteria above
Asymptomatic patients without known CAD (SE diversion not required)	• **Asymptomatic patients without known CAD** *(SE diversion not required)*

• Previously unevaluated ECG evidence of possible myocardial ischemia including ischemic ST segment or T wave abnormalities (See Overview section) • Previously unevaluated pathologic Q waves • Previously unevaluated complete left bundle branch block • History of diabetes mellitus, > 40 years old, with calcium score >400 (Budoff, 2016)	○ Previously unevaluated ECG evidence of possible myocardial ischemia including ischemic ST segment or T wave abnormalities (See Overview section) ○ Previously unevaluated pathologic Q waves (Overview section) ○ Previously unevaluated complete left bundle branch block **ABNORMAL CALCIUM SCORES (CAC)[4-8]** • ASYMPTOMATIC patient with a calcium score >400, not previously evaluated • SYMPTOMATIC patient with prior CAC ≥100
INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN • Exercise stress ECG with low-risk Duke treadmill score (≥5), (see Overview) but patient's current symptoms indicate an intermediate or high pretest probability (SE diversion not required for high pretest probability) • Exercise stress ECG with an intermediate Duke treadmill score • Intermediate coronary computed tomography angiography (CCTA) (e.g. 30 - 70% lesions) • Non-diagnostic exercise stress test with inability to achieve target heart rate (THR)	**INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN** • Exercise stress ECG with low-risk Duke treadmill score (≥5), (see section in Overview) but patient's current symptoms indicate an intermediate or high pretest probability *(SE diversion not required* for high pretest probability) • Exercise stress ECG with an intermediate Duke treadmill score • Intermediate coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions) • Non-diagnostic exercise stress test with inability to achieve target heart rate (THR) *(SE diversion not required)*

• An indeterminate (equivocal, borderline, or discordant) evaluation by prior stress imaging (SE or CMR) within the past 2 years	• An indeterminate (equivocal, borderline, or discordant) evaluation by prior stress imaging (SE or CMR) within the past 2 years *(SE diversion not required)*
FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) (Wolk, 2014)	**FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG)[4]**
• **Asymptomatic follow-up stress imaging (MPI or SE)** at a minimum of 2 years post coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) (whichever is later) is appropriate for patients with a history of silent ischemia or a history of a prior left main stent (Wolk, 2014) **OR** For patients with high occupational risk (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers and firefighters)	• **Asymptomatic follow-up stress imaging** at a minimum of 2 years post coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) (whichever is later) is appropriate for patients with a history of silent ischemia or a history of a prior left main stent.[4] *(SE diversion not required for CABG)* **OR** For patients with high occupational risk, associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers and firefighters *(SE diversion not required)*
• **New, recurrent, or worsening symptoms post coronary revascularization** is an indication for stress imaging (MPI or SE), if it will alter management	• **New, recurrent, or worsening symptoms post coronary revascularization** is an indication for stress imaging, if it will alter management
FOLLOW-UP OF KNOWN CAD	**FOLLOW-UP OF KNOWN CAD**
• **Follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis ≥ 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for stress imaging (MPI or SE) in patients if it will alter	• **Follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR ≤ 0.80 or stenosis ≥ 70% of a major vessel), over two years ago, without intervening coronary revascularization is an appropriate indication for

management
 	
SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION
 	
• Prior acute coronary syndrome (with documentation in MD notes), without invasive or non-invasive coronary evaluation (SE diversion not required)
• Newly diagnosed systolic heart failure (EF < 50%) with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (SE diversion not required) (Fihn, 2012; Patel, 2013; Yancy, 2013)
 	
• LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary revascularization (Patel, 2013; Yancy, 2013)
• Ventricular arrhythmias
  ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not immediately planned (Al-Khatib 2018) (SE diversion not required)
  ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, or frequent PVCs (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed (Zimetbaum 2018)
• Prior to initiation of Class IC antiarrhythmic drug initiation (Propafenone or Flecainide), as well as annually in intermediate and high global risk patients (SE diversion not required) (Reiffel, 2015)
• Assessment of hemodynamic significance of one of the following documented conditions:
	stress imaging in patients if it will alter management
	
	SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION
	
	• Prior acute coronary syndrome (with documentation in MD notes), without invasive or non-invasive coronary evaluation *(SE diversion not required)*
	• Newly diagnosed systolic heart failure or diastolic heart failure, *with reasonable suspicion of cardiac ischemia (prior events, risk factors)*, unless invasive coronary angiography is immediately planned (SE diversion not required)[1, 9-11]
	• LVEF requiring myocardial viability assessment to assist with decisions regarding coronary revascularization[9, 10]
	• Ventricular arrhythmias
	  ○ Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise-induced VT, when invasive coronary arteriography is not immediately planned[12] *(SE diversion not required)*
	
	  ○ Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, or frequent PVCs (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed[13]
	• Prior to initiation of Class IC antiarrhythmic drug initiation (Propafenone or Flecainide), as well as annually in intermediate and high global risk patients *(SE diversion not required)* [14]
	• Assessment of hemodynamic significance of one of the following documented conditions:
	  ○ Anomalous coronary arteries[15]

○ Anomalous coronary arteries (Grani, 2017) ○ Myocardial bridging of coronary artery • Coronary aneurysms in Kawasaki's disease (Newburger, 2016) or due to atherosclerosis • Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti, 2013)	○ Myocardial bridging of coronary artery • Coronary aneurysms in Kawasaki's disease[16] or due to atherosclerosis • Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter[17]
PRIOR TO ELECTIVE NON-CARDIAC SURGERY • Patients who have no above indication for non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for MPI if **all 4 criteria** are met: ○ Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal; **AND** ○ The patient has **at least one** of the additional cardiac complication risk factors: ▪ Ischemic Heart Disease ▪ History of stroke or transient ischemic attack (TIA) ▪ History of congestive heart failure or ejection fraction ≤ 35% ▪ Insulin-requiring diabetes mellitus ▪ Creatinine ≥ 2.0 mg/dl **AND** ○ The patient has limited functional capacity (< 4 METS), such as one of the following: ▪ Unable to take care of their activities of daily living (ADLs) or ambulate ▪ Unable to walk 2 blocks on level ground ▪ Unable to climb 1 flight of stairs	**PRIOR TO ELECTIVE NON-CARDIAC SURGERY IN ASYMPTOMATIC PATIENTS** • An intermediate or high risk surgery with of one or more risk factors (see below), AND documentation of an inability to walk (or <4 METs) AND there has not been an imaging stress test within 1 year[18-20] ○ **Risk factors:** history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin, and preoperative serum creatinine >2.0 mg/dL. ○ **Surgical Risk:** ▪ **High risk surgery:** Aortic and other major vascular surgery, peripheral vascular surgery, anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss ▪ **Intermediate risk surgery:** Carotid endarterectomy, head and neck surgery, intraperitoneal and intrathoracic surgery, orthopedic surgery, prostate surgery ▪ **Low risk surgery**: Endoscopic procedures, superficial procedure, cataract surgery, breast surgery

AND ○ There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year; and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery. • Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year and with ≥ 3 of the following risk factors: (SE diversion not required) (Lentine, 2012): • Age > 60 • Smoking • Hypertension • Dyslipidemia • Left ventricular hypertrophy • > 1 year on dialysis (for renal transplant patients) • Diabetes mellitus • Prior ischemic heart disease **POST CARDIAC TRANSPLANT** (SE diversion not required) • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography • After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually unless invasive coronary arteriography is planned	• Planning for any organ or stem cell transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, at the discretion of the transplant service. [3, 21] **POST CARDIAC TRANSPLANT** *(SE diversion not required)* • Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography • After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually unless invasive coronary arteriography is planned

NECK CT	
Previous (red indicates deleted text)	New (blue indicates new text)
Suspected tumor or cancer • Suspicious lesions in mouth or throat (Kuno, 2014) • Suspicious mass/tumor found on another imaging study and needing clarification (Aulino, 2018) • Neck Mass or lymphadenopathy (not parotid region and not thyroid region): ○ Present on physical exam and remains non-diagnostic after ultrasound is completed (Kuno, 2014) ○ Mass or abnormality found on other imaging study and needing further evaluation ○ Increased risk for malignancy (Kirsch, 2019) with one or more of the following findings (Pynnonen, 2017): ▪ Fixation to adjacent tissues ▪ Firm consistency ▪ Size >1.5 cm ▪ Ulceration of overlying skin ▪ Mass present ≥ two weeks (or uncertain duration) without significant fluctuation and not considered of infectious cause ▪ History of cancer ○ Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015) **Note**: For discrete cystic lesions of the neck, an ultrasound should be performed as initial imaging unless there is a high suspicion of malignancy • Neck Mass (parotid region) (Aulino, 2018)	**Suspected tumor or cancer** • Suspicious lesions in mouth or throat[3] • Suspicious mass/tumor found on another imaging study and needing clarification[1] • Neck mass or lymphadenopathy (not parotid region and not thyroid region): ○ Present on physical exam and remains non-diagnostic after ultrasound is completed[3] ○ Mass or abnormality found on other imaging study and needing further evaluation ○ Increased risk for malignancy[4] with one or more of the following findings[5]: ▪ Fixation to adjacent tissues ▪ Firm consistency ▪ Size >1.5 cm ▪ Ulceration of overlying skin ▪ Mass present ≥ two weeks (or uncertain duration) without significant fluctuation and not considered of infectious cause ▪ History of cancer ○ Failed 2 weeks of treatment for suspected infectious adenopathy[6] ○ Pediatric (≤18 years old) considerations[7] ▪ Ultrasound should be inconclusive or suspicious unless there is a history of malignancy[8] **Note**: For discrete cystic lesions of the neck, an ultrasound should be performed as initial imaging unless there is a high suspicion of malignancy • Neck Mass (parotid region)[1]

○ Parotid mass found on other imaging study and needing further evaluation **Note**: US is the initial imaging study of a parotid region mass to determine if the location is inside or outside the gland (Aulino, 2018; Burke, 2011; Cicero, 2018 • Neck Mass (thyroid region) (Hoang, 2018) ○ Staging and monitoring for recurrence of known thyroid cancer (Hoang, 2018) ○ To assess extent of thyroid tissue when other imaging suggests extension through the thoracic inlet into the mediastinum or concern for airway compression (Gharib, 2016; Lin, 2016) **Note**: US is the initial imaging study of a thyroid region mass. CT is preferred over MRI in the evaluation of thyroid masses since there is less respiratory motion artifact. Chest CT may be included for preoperative assessment in some cases **Pediatric patients (≤18 years old)** (Wai, 2020) • Neck masses if ultrasound is inconclusive or suspicious (Brown, 2016) • History of malignancy --- **Other indications for a Neck CT** • Salivary gland stones (Cicero, 2018) • To assess for foreign body when radiograph is inconclusive or negative (Guelfguat, 2014) • Vocal cord lesions or vocal cord paralysis (Dankbaar, 2014)	○ Parotid mass found on other imaging study and needing further evaluation **Note**: US is the initial imaging study of a parotid region mass to determine if the location is inside or outside the gland[1, 9, 10] • Neck Mass (thyroid region)[2] ○ Staging and monitoring for recurrence of known thyroid cancer[2] ○ To assess extent of thyroid tissue when other imaging suggests extension through the thoracic inlet into the mediastinum or concern for airway compression[11, 12] **Note**: US is the initial imaging study of a thyroid region mass. Biopsy is usually the next step. In the evaluation of known thyroid malignancy, CT is preferred over MRI since there is less respiratory motion artifact. Chest CT may be included for preoperative assessment in some cases. --- **Other indications for a Neck CT** • Sialadenitis (infection and inflammation of the salivary glands) with indeterminate ultrasound, bilateral symptoms or concern for abscess[15] • Suspected or known salivary gland stones [10, 15-18] • To assess for foreign body when radiograph is inconclusive or negative[19] • Vocal cord lesions or vocal cord paralysis[20]

• For evaluation of tracheal stenosis (Chung, 2011; Heidinger, 2015) • Dysphagia after appropriate work up including endoscopy and fluoroscopic studies (modified barium swallow, or biphasic esophogram) (Levy, 2018; Pasha, 2014) • Unexplained throat pain for more than 2 weeks when ordered by a specialist with all of the following (Feierabend, 2009; Jones, 2015; Shephard, 2019) ○ Complete otolaryngologic exam and laryngoscopy ○ No signs of infection ○ Evaluation for and/or failed treatment of laryngopharyngeal reflux ○ Risk factor for malignancy i.e., tobacco use, alcohol use, dysphagia, weight loss OR age older than 50 years	• For evaluation of tracheal stenosis[21, 22] • Dysphagia after appropriate work up including endoscopy and fluoroscopic studies (modified barium swallow, or biphasic esophogram)[23, 24] • Unexplained throat pain for more than 2 weeks when ordered by a specialist with all of the following[25-27] ○ Complete otolaryngologic exam and laryngoscopy ○ No signs of infection ○ Evaluation for and failed treatment of laryngopharyngeal reflux ○ Risk factor for malignancy, i.e., tobacco use, alcohol use, dysphagia, weight loss OR age older than 50 years

NECK CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR NECK CTA	**INDICATIONS FOR NECK CTA** If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)
Patients with claustrophobia, limited ability to cooperate or an implanted device may be better suited for CTA, whereas those with extensive calcification, renal disease or iodine contrast allergy should have MRA (Adla, 2015).	Patients with claustrophobia, limited ability to cooperate, an implanted device or in an urgent situation may be better suited for CTA, whereas those with extensive calcification, renal disease iodine contrast allergy should have MRA.[1]
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<u>Tumor/pulsatile mass</u> • Pulsatile mass on exam (Aulino, 2019) • Known carotid body tumors, or other masses such as a paraganglioma, arteriovenous fistula pseudoaneurysm, atypical lymphovascular malformation (Nguyen, 2011). **Note**: Ultrasound (US) may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass.	<u>Tumor/pulsatile mass</u> • Pulsatile mass on exam[17] • Known or suspected carotid body tumors, or other masses such as a paraganglioma, arteriovenous fistula pseudoaneurysm, atypical lymphovascular malformation[18] **Note**: Ultrasound (US) may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass.
<u>Other extracranial vascular disease</u> • Takayasu arteritis based on findings in other blood vessels on previous imaging (Zhu, 2012)	<u>Other extracranial vascular disease[19]</u>

• Giant cell arteritis with suspected extracranial involvement (Abdel Razek, 2014; Halbach, 2018; Khan, 2015; Koster, 2018) • Subclavian steal syndrome when ultrasound is positive or indeterminate OR for planning interventions (Potter, 2014) • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall (Franz, 2012; Shakir, 2016) • Horner's syndrome (miosis, ptosis, and anhidrosis) (Kim, 2012). • For evaluation of pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017) • Known extracranial vascular disease that needs follow-up or further evaluation --- [Previous version:] • Pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017)	• Large vessel vasculitis (Giant cell or Takayasu arteritis) with suspected extracranial involvement[20-23] • Subclavian steal syndrome when ultrasound is positive or indeterminate OR for planning interventions[24] • Suspected carotid or vertebral artery dissection; secondary to trauma or spontaneous due to weakness of vessel wall[25, 26] • To identity an arterial source of bleeding in patients with hemorrhage of the head and neck[27] • Horner's syndrome (miosis, ptosis, and anhidrosis)[28] • For evaluation of pulsatile tinnitus (subjective or objective) for suspected arterial vascular etiology[29] • Known extracranial vascular disease that needs follow-up or further evaluation --- [Within the section **Neck CTA/Brain CTA**, the following change was made:] • Pulsatile tinnitus (subjective or objective) for suspected arterial vascular etiology[29]

NECK MRA/MRV	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR NECK MRA	**INDICATIONS FOR NECK MRA** If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)
--- <u>Other extracranial vascular disease</u> • Takayasu arteritis based on findings in other blood vessels on previous imaging (Zhu, 2012) • Giant cell arteritis with suspected extracranial involvement (Abdel Razek, 2014; Halbach, 2018; Khan, 2015; Koster, 2018) • Subclavian steal syndrome when ultrasound is positive or indeterminate OR for planning an intervention (Potter, 2014) • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall (Franz, 2012; Shakir, 2016) • Horner's syndrome (miosis, ptosis, and anhidrosis) (Kim, 2012) • For evaluation of pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017)	--- <u>Other extracranial vascular disease</u> • Large vessel vasculitis (Giant cell or Takayasu arteritis) with suspected extracranial involvement[20-24] • Subclavian steal syndrome when ultrasound is positive or indeterminate OR for planning an intervention[25] • Suspected carotid or vertebral artery dissection; secondary to trauma or spontaneous due to weakness of vessel wall[26, 27] • Horner's syndrome (miosis, ptosis, and anhidrosis)[28] • For evaluation of pulsatile tinnitus (subjective or objective) for suspected arterial vascular etiology[29] • For further evaluation of a congenital vascular malformation of the head and neck

• Known extracranial vascular disease that needs follow-up or further evaluation --- **Neck MRA/Brain MRA** • Recent ischemic stroke or transient ischemic attack (TIA) (Robertson, 2020; Salmela, 2017; Wintermark, 2013) • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech (Lima-Neto, 2017; Searls, 2012) • Suspected carotid or vertebral artery dissection due to trauma or spontaneous due to weakness of vessel wall (Franz, 2012; Shakir, 2016) • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., internal carotid stenosis > 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Marquardt, 2010) • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate (Brott, 2011; DaCosta, 2019; Rerkasem, 2011) • For evaluation of pulsatile tinnitus (subjective or objective) for vascular etiology (Pegge, 2017)	• Known extracranial vascular disease that needs follow-up or further evaluation[30-32] --- **Neck MRA/Brain MRA** • Recent ischemic stroke or transient ischemic attack (TIA)[1, 2, 33] • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[4, 5] • Suspected carotid or vertebral artery dissection secondary to trauma or spontaneous due to weakness of vessel wall[26, 27] • Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., internal carotid stenosis > 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[7-9] • Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[7, 8, 10] • For evaluation of pulsatile tinnitus (subjective or objective) for suspected arterial vascular etiology[29] --- [Added new section:] **Any Combination of Neck MRA/Brain MRA/Brain MRI with IAC**

	• Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology[29, 35]

ORBIT, FACE, NECK, SINUS MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR ORBIT MRI	**INDICATIONS FOR ORBIT MRI** If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be: • Inconclusive or show a need for additional or follow up imaging evaluation OR • The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient. (*Unless approvable in the combination section as noted in the guidelines)
MRI is superior for the evaluation of the visual pathways, globe and soft tissues; CT is preferred for visualizing bony detail and calcifications (Hande, 2012; Kennedy, 2018)	MRI is superior for the evaluation of the visual pathways, globe and soft tissues; CT is preferred for visualizing bony detail and calcifications[1, 2]
• **Abnormal external or direct eye exam** ○ Exophthalmos (proptosis) or enophthalmos ○ Ophthalmoplegia with concern for orbital pathology ○ Unilateral optic disk swelling (Hata, 2017; Margolin, 2019; Passi, 2013) ○ Documented visual field defect (Fadzil, 2013; Kedar, 2011; Prasad, 2012; Sadun, 2011) ▪ Unilateral or with abnormal optic disc(s) (e.g., optic disc blurring, edema, or pallor); **AND** ▪ Not explained by underlying diagnosis, glaucoma, or macular degeneration	• **Abnormal external or direct eye exam** ○ Exophthalmos (proptosis) or enophthalmos ○ Ophthalmoplegia with concern for orbital pathology ○ Unilateral optic disk swelling[3-5] ○ Documented visual field defect[6-9] ▪ Unilateral or with abnormal optic disc(s) (e.g., optic disc blurring, edema, or pallor); **AND** ▪ Not explained by underlying diagnosis, glaucoma, or macular degeneration
• **Optic neuritis** (CMSC, 2018; Gala, 2015; Srikajon, 2018; Voss, 2011)	• **Optic neuritis[10-13]**

○ If atypical presentation, severe visual impairment, or poor recovery following initial onset or treatment onset OR ○ If needed to confirm optic neuritis and rule out compressive lesions --- • **Complex strabismus** to aid in diagnosis, treatment and/or surgical planning (Demer, 2002; Kadom, 2008) **NOTE: FOR OTHER ORBIT MRI INDICATIONS, CLICK** HERE **INDICATIONS FOR ORBIT AND BRAIN MRI COMBINATION STUDIES:** • Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion or optic nerve infiltrative disorders (Behbehani, 2007) • Bilateral optic disk swelling (papilledema) with vision loss (Margolin, 2019) • Optic neuritis if atypical presentation, severe visual impairment, or poor recovery following initial onset or treatment onset (CMSC, 2018)	○ If atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence)[14, 15] ○ If needed to confirm optic neuritis and rule out compressive lesions --- • **Complex strabismus syndromes** (with ophthalmoplegia or ophthalmoparesis) to aid in diagnosis, treatment and/or surgical planning[21-23] **NOTE: FOR ADDITIONAL ONCOLOGIC ORBIT MRI INDICATIONS, CLICK** HERE **INDICATIONS FOR ORBIT AND BRAIN MRI COMBINATION STUDIES:** • Optic neuropathy or unilateral optic disk swelling of unclear etiology to distinguish between a compressive lesion of the optic nerve, optic neuritis, ischemic optic neuropathy (arteritic or non-arteritic), central retinal vein occlusion or optic nerve infiltrative disorders[24] • Bilateral optic disk swelling (papilledema) with vision loss[3] • Optic neuritis ○ if atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence)[10-15] o If needed to confirm optic neuritis and rule out compressive lesions

• Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent, or bilateral optic neuritis (Wingerchuk, 2015) • For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology (Lawson, 2000) **INDICATIONS FOR FACE/SINUS MRI:** ▪ **Rhinosinusitis** (Kirsch, 2017) ○ Clinical suspicion of fungal infection (Gavito-Higuera, 2016) ○ Clinical suspicion of orbital or intracranial complications (Arunkumar, 2011; Lee, 2016), such as ▪ Preseptal, orbital, or central nervous system infection ▪ Osteomyelitis ▪ Cavernous sinus thrombosis ▪ **Sinonasal obstruction, suspected-mass,** based on exam, nasal endoscopy, or prior imaging (Kirsch, 2017; Rosenfeld, 2015) • **Suspected infection** ○ Osteomyelitis (after x-rays) (Pincus, 2009) ○ Abscess • **Anosmia or Dysosmia** based on objective testing that is persistent and of unknown origin (Policeni, 2017; Rouby, 2011; Zaghouani, 2013)	• Known or suspected neuromyelitis optica spectrum disorder with severe, recurrent, or bilateral optic neuritis[25] • For approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology[26] **INDICATIONS FOR FACE/SINUS MRI:** ▪ **Rhinosinusitis[27]** ○ Clinical suspicion of fungal infection[28] ○ Clinical suspicion of orbital or intracranial complications,[18, 19] such as ▪ Preseptal, orbital, or central nervous system infection ▪ Osteomyelitis ▪ Cavernous sinus thrombosis ▪ **Sinonasal obstruction, suspected-mass,** based on exam, nasal endoscopy, or prior imaging[27, 29] • **Anosmia or Dysosmia** based on objective testing that is persistent and of unknown origin[30-32] • **Suspected infection** ○ Osteomyelitis (after x-rays)[33] ○ Abscess based on clinical signs and symptoms of infection

• **Granulomatosis** with polyangiitis (Wegener's granulomatosis) disease (Pakalniskis, 2015)	
▪ **Face mass** (Kirsch, 2017; Koeller, 2016; Kuno, 2014)**:** • Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed • Known or highly suspected head and neck cancer on examination (Kirsch, 2017) • Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015)	▪ **Face mass**[27, 34, 35] • Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed • Known or highly suspected head and neck cancer on examination[27] • Failed 2 weeks of treatment for suspected infectious adenopathy[36]
• **Facial trauma** (Echo, 2010; Lin, 2012; Raju, 2017; Sung, 2014) • Physical findings of direct facial bone injury • For further evaluation of a known fracture for treatment or surgical planning Note: CSF (cerebrospinal fluid) rhinorrhea - Sinus CT is indicated when looking to characterize a bony defect. CSF otorrhea - Temporal Bone CT is indicated. For intermittent leaks and complex cases, consider CT/MRI/Nuclear Cisternography). CSF fluid should always be confirmed with laboratory testing (Beta-2 transferrin assay)	• **Facial trauma**[16, 17, 37, 38] ○ Concern for soft tissue injury to further evaluate for treatment or surgical planning[39] • **Granulomatosis with polyangiitis (Wegener's granulomatosis) disease**[31]
• **Trigeminal neuralgia/neuropathy** (for evaluation of the extracranial nerve course) ○ If atypical features (e.g., bilateral, hearing loss, dizziness/vertigo, visual changes, sensory loss,	• **Trigeminal neuralgia/neuropathy** (for evaluation of the extracranial nerve course) ○ If atypical features (e.g., bilateral, hearing loss, dizziness/vertigo, visual changes, sensory loss,

numbness, pain > 2min, pain outside trigeminal nerve distribution, progression) (ACR, 2017; Hughes, 2016; Policeni, 2017) **NOTE: FOR OTHER FACE/SINUS MRI INDICATIONS, CLICK HERE** --- **INDICATIONS FOR NECK MRI:** **Suspected tumor or cancer**: (ACR, 2018a) • Suspicious lesions in mouth or throat (Kuno, 2014). • Suspicious mass/tumor found on another imaging study and needing clarification • Neck mass or lymphadenopathy (non-parotid or thyroid) ○ Present on physical exam and remains non-diagnostic after ultrasound is completed (Kuno, 2014) Note: For discrete cystic lesions of the neck, an ultrasound should be performed as initial imaging unless there is a high suspicion of malignancy • Increased risk for malignancy with one or more of the following findings (Pynnonen, 2017): ▪ Fixation to adjacent tissues ▪ Firm consistency ▪ Size >1.5 cm ▪ Ulceration of overlying skin ▪ Mass present ≥ two weeks (or uncertain duration) without significant fluctuation and not considered of infectious cause ▪ History of cancer	numbness, pain > 2min, pain outside trigeminal nerve distribution, progression)[30, 40] **NOTE: FOR ADDITIONAL ONCOLOGIC FACE/SINUS MRI INDICATIONS, CLICK HERE** --- **INDICATIONS FOR NECK MRI:** **Suspected tumor or cancer[43]**: • Suspicious lesions in mouth or throat[35] • Suspicious mass/tumor found on another imaging study and needing clarification • Neck mass or lymphadenopathy (non-parotid or non-thyroid) ○ Present on physical exam and remains non-diagnostic after ultrasound is completed[35] ○ Mass or abnormality found on other imaging study and needing further evaluation ○ Increased risk for malignancy with one or more of the following findings[44]: ▪ Fixation to adjacent tissues ▪ Firm consistency ▪ Size >1.5 cm ▪ Ulceration of overlying skin ▪ Mass present ≥ two weeks (or uncertain duration) without significant fluctuation and not considered of infectious cause ▪ History of cancer

• Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015).	○ Failed 2 weeks of treatment for suspected infectious adenopathy[36] ○ Pediatric (≤18 years old) considerations[10] ▪ Ultrasound should be inconclusive or suspicious unless there is a history of malignancy[11] **Note**: For discrete cystic lesions of the neck, an ultrasound should be performed as initial imaging unless there is a high suspicion of malignancy
• Neck Mass (parotid) (ACR, 2018a) ○ Parotid mass found on other imaging study and needing further evaluation (US is the initial imaging study of a parotid region mass) • Neck Mass (thyroid) (ACR, 2018b) ○ Staging and monitoring for recurrence of known thyroid cancer (ACR, 2018b). ○ To assess extent of thyroid tissue when other imaging suggests extension through the thoracic inlet into the mediastinum or concern for airway compression (Gharib 2016; Lin, 2016) Note: US is the initial imaging study of a thyroid region mass. CT is preferred over MRI in the evaluation of thyroid masses since there is less respiratory motion artifact. Chest CT may be included for preoperative assessment in some cases	• Neck Mass (parotid)[43] ○ Parotid mass found on other imaging study and needing further evaluation (US is the initial imaging study of a parotid region mass) • Neck Mass (thyroid)[45] ○ Staging and monitoring for recurrence of known thyroid cancer[45] ○ To assess extent of thyroid tissue when other imaging suggests extension through the thoracic inlet into the mediastinum or concern for airway compression[46, 47] **Note**: US is the initial imaging study of a thyroid region mass. Biopsy is usually the next step. In the evaluation of known thyroid malignancy, CT is preferred over MRI since there is less respiratory motion artifact. Chest CT may be included for preoperative assessment in some cases
Pediatric patients (≤ 18 years old): (Wai, 2020) • Neck masses if ultrasound is inconclusive or suspicious (Brown, 2016) • History of malignancy	

Known or suspected deep space infections or abscesses of the pharynx or neck (Meyer, 2009) **-----** **NOTE: FOR OTHER NECK MRI INDICATIONS, CLICK HERE** **-----** **OTHER INDICATIONS FOR ORBIT/FACE/SINUS/NECK MRI**	**Known or suspected deep space infections or abscesses of the pharynx or neck with signs or symptoms of infection[50]** **-----** **NOTE: FOR ADDITIONAL ONCOLOGIC NECK MRI INDICATIONS, CLICK HERE** **-----** **ADDITIONAL ONCOLOGIC INDICATIONS FOR ORBIT/FACE/SINUS/NECK MRI**

PELVIS CT	
Previous (red indicates deleted text)	New (blue indicates new text)
	[Within the section **Evaluation of suspicious or known mass/tumors**, added the following:] • For abnormal incidental pelvic lymph nodes when follow-up is recommended based on prior imaging (initial 3-month follow-up)[7] -----
[Within the section **Musculoskeletal Indications**, the following changes:] • Sacroiliitis (infectious or inflammatory) after completion of abnormal x-ray and MRI is contraindicated (ACR, 2016; Jans, 2014; Kang, 2015)	[Within the section **Musculoskeletal Indications**, the following changes:] • Sacroiliitis (infectious or inflammatory, such as Ankylosing Spondylitis/Spondyloarthropathies) with non-diagnostic or indeterminate x-ray and rheumatology workup and MRI is contraindicated[26-28]

PELVIS CTA	
Previous (red indicates deleted text)	New (blue indicates new text)
[Within the section **Post-operative or post-procedural evaluation**, the following changes:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms (ACR, 2017; Chaikof, 2018; Uberoi, 2011) ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months ○ Asymptomatic at six (6) month intervals, for one (1) year, then annually ○ Symptomatic/complications related to stent graft – more frequent imaging may be needed ○ Follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.	[Within the section **Post-operative or post-procedural evaluation**, the following changes:] • Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms typically needs to include abdominal imaging, therefore Abdomen Pelvis CTA would usually be the appropriate study

PELVIS MRA	
Previous (red indicates deleted text)	New (blue indicates new text)

[Within the section **Post-operative or post-procedural evaluation**:]
 	
• Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms
  ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months (Chaikof, 2018; Uberoi, 2011)
	[Within the section **Post-operative or post-procedural evaluation**:]
	
	• Follow-up for post-endovascular repair (EVAR) or open repair of abdominal aortic aneurysm (AAA) and iliac artery aneurysms
	  ○ Routine, baseline study (post-op/intervention) is warranted within 1-3 months[2, 21] (abdomen and pelvis MRA when CTA is inconclusive or cannot be performed)

PELVIS MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
Known prostate cancer for workup of recurrence and response to treatment (NCCN, 2019) ● Initial treatment by active surveillance (asymptomatic very low, or low or intermediate risk with expected patient survival ≥ 10 years): ○ Initial multiparametric MRI (mpMRI) for patients who chose active surveillance ○ mpMRI to be repeated no more than every 12 months unless clinically indicated --- **Indication for prostate MRI (suspected prostate cancer)** (Bjurlin, 2018, 2020; Borofsky, 2018; EAU, 2018; Elkhoury, 2019; NCCN, 2021) ● Prior to prostate biopsy when notes indicate that biopsy is planned (Alexander, 2019) ● In individuals with previous negative biopsy and ongoing concerns of increased risk of prostate cancer (i.e., rising or persistent elevated PSA with lab reports on 2 or more separate days OR suspicious digital rectal exam (DRE)) Note: Prostate MRI should not replace biopsy nor be used to determine if biopsy is necessary.	**Known prostate cancer for workup of recurrence and response to treatment[1, 2]** ● Initial treatment by active surveillance (asymptomatic very low, low, or intermediate risk with expected patient survival ≥ 10 years): ○ Initial multiparametric MRI (mpMRI) for patients who chose active surveillance ○ mpMRI to be repeated no more than every 12 months unless clinically indicated --- **Indication for prostate MRI (suspected prostate cancer)[1, 3-8]** ● Prior to prostate biopsy when notes indicate that biopsy is planned[9] ● In individuals with previous negative biopsy and ongoing concerns of increased risk of prostate cancer (i.e., rising or persistent elevated PSA with lab reports on 2 or more separate days OR suspicious digital rectal exam (DRE)) ● When the MRI is requested to potentially avoid a prostate biopsy: ○ If there are risk factors/comorbidities associated with the biopsy, AND there is intent to biopsy if a high-risk lesion is seen on MRI prostate OR ○ If a thorough risk assessment has been done and the patient is considered low risk for cancer AND the PIRADS classification would be used to help risk stratify the patient before making a final decision on biopsy. (Typically, this risk assessment would be done by the person performing the biopsy (i.e., urologist)

	and imaging done at the facility where the fusion biopsy would be performed should a higher risk lesion be identified.)
Evaluation of suspicious or known mass/tumors ● Initial evaluation of suspicious pelvic masses/tumors found only in the pelvis by physical exam and ultrasound has been performed (ACR, 2013, 2014) ● Further evaluation of abnormality seen on ultrasound (US) or when US is inconclusive (ACR, 2013, 2014) ● Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance MR unless tumor(s) are specified as highly suspicious or change was found on exam or last follow-up imaging. ● Initial staging of known cancer ● Follow-up of known cancer (Bourgioti, 2016; NCCN, 2019): ○ Of patient undergoing active treatment within the past year ○ With suspected pelvic metastasis based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation)	**Evaluation of suspicious or known mass/tumors for further evaluation of indeterminate or questionable findings** ● Initial evaluation of suspicious pelvic masses/tumors found only in the pelvis by physical exam or imaging study, such as ultrasound (US), or CT[1] ● Further evaluation of abnormality seen on ultrasound (US) or when US is inconclusive[10] ● Surveillance: One follow-up exam to ensure no suspicious change has occurred in a tumor in the pelvis. No further surveillance MR unless tumor(s) is/are specified as highly suspicious or change was found on exam or last follow-up imaging. ● Initial staging of known cancer ● Follow-up of known cancer[2, 11]: ○ Of patient undergoing active treatment within the past year ○ With suspected pelvic metastasis based on a sign, symptom, (e.g., anorexia, early satiety, intestinal obstruction, night sweats, pelvic pain, weight loss, vaginal bleeding) or an abnormal lab value (alpha-fetoprotein, CEA, CA 19-9, p53 mutation) ● For abnormal incidental pelvic lymph nodes when follow-up is recommended based on prior imaging (initial 3-month follow-up)[3]
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For evaluation of suspected infection or inflammatory disease after preliminary imaging (such as CT, US, or nuclear medicine) has been performed or is contraindicated (includes MR	**For evaluation of suspected infection or inflammatory disease after preliminary imaging (such as CT, US, or nuclear medicine) has been performed or is contraindicated (includes MR**

urography (MRU) which includes abdomen MRI when indicated) (ACR, 2013; Cartwright, 2015) ● Suspected perianal fistula ● Suspected infection (based on elevated WBC, fever, anorexia, or nausea and vomiting) in the pelvis ● For suspected urethral stricture or periurethral pathology (Aldamanhori, 2018)	**urography (MRU) which includes abdomen MRI when indicated)[10, 12-14]** ● Suspected perianal fistula ● Suspected infection (based on elevated WBC, fever, anorexia, or nausea and vomiting) in the pelvis ● For suspected urethral stricture or periurethral pathology[15] ● Suspected peritonitis (would typically need to include MRI Abdomen), abdominal pain and tenderness to palpation is present, and at LEAST one of the following: ○ Rebound, guarding or rigid abdomen, OR ○ Severe tenderness to palpation over the entire abdomen ● Complications of diverticulitis with severe abdominal pain or severe tenderness or mass, not responding to antibiotic treatment (prior imaging study is not required for diverticulitis diagnosis)
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For evaluation of suspected inflammatory bowel disease or follow-up (includes MR enterography and can also approve Abdomen MRI/MRE) ● For suspected inflammatory bowel disease (Crohn's disease or ulcerative colitis) with abdominal pain **AND** one of the following (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018): ○ Chronic diarrhea ○ Bloody diarrhea ● High clinical suspicion after complete work up including physical exam, labs, endoscopy with biopsy (ACR, 2019; Arif-Tiwari, 2019; Lichtenstein, 2018; Rubin, 2019) ● For MR enterography (MRE) if CT or MRI of the abdomen and pelvis are inconclusive ● Known inflammatory bowel disease (Crohn's or ulcerative colitis) with signs/symptoms (e.g., abdominal pain, diarrhea,	**For evaluation of suspected inflammatory bowel disease or follow-up (includes MR enterography and can also approve Abdomen MRI/MRE)** ● For suspected inflammatory bowel disease (Crohn's disease or ulcerative colitis) with abdominal pain **AND** one of the following[17-19]: ○ Chronic diarrhea ○ Bloody diarrhea ● High clinical suspicion after complete work-up including physical exam, labs, endoscopy with biopsy[17-20] ● Known inflammatory bowel disease (Crohn's or ulcerative colitis) with signs/symptoms (e.g., abdominal pain, diarrhea,

or hematochezia) requiring re-evaluation, or for monitoring therapy (ACR, 2019)	or hematochezia) requiring re-evaluation, or for monitoring therapy[17]
For suspected or known hernia ● For pelvic pain due to a suspected occult, spigelian, or incisional hernia when physical exam and prior imaging are non-diagnostic or equivocal or if requested as a preoperative study ○ For confirming diagnosis of a recurrent hernia when ultrasound is negative or nondiagnostic ○ Hernia with suspected complications (e.g., bowel obstruction or strangulation, or non-reducible) based on symptoms (e.g., diarrhea, hematochezia, vomiting, severe pain, or guarding), physical exam (guarding, rebound) or prior imaging (Halligan, 2018).	**For suspected or known hernia** ● For pelvic pain due to a suspected occult, spigelian, or incisional hernia when physical exam and prior imaging (ultrasound AND CT) are non-diagnostic or equivocal[21-24] and limited to the pelvis ● Hernia with suspected complications, such as strangulation or incarceration, based on physical exam (guarding, rebound) or prior imaging[25] (CT preferred)
● Suspected athletic pubalgia (sports hernia) in a patient with persistent groin pain that occurs with exertion, who has not responded to conservative treatment for four weeks, when other imaging is inconclusive (Lee, 2017; Paksoy, 2016).	● Suspected athletic pubalgia (sports hernia) in a patient with persistent groin pain that occurs with exertion, who has not responded to conservative treatment for four weeks, when other imaging is inconclusive[26, 27]
---	[Within **Indications for Musculoskeletal Pelvic MRI** section, the following changes:]
● Sacroiliac Joint Dysfunction when there is (Jans, 2014): ○ Persistent back and/or sacral pain unresponsive to four (4) weeks of conservative treatment, received within the past six (6) months, including physical therapy or physician supervised home exercise plan (HEP)	● Sacroiliac Joint Dysfunction (after initial x-ray) when there is[30]: ○ Persistent back and/or sacral pain unresponsive to four (4) weeks of conservative treatment, received within the past six (6) months, including physical therapy or physician supervised home exercise plan (HEP)

[Within **Other Indications for a Pelvic MRI** section, the following changes:] ● For suspected patent urachus or other urachal abnormalities when ultrasound is non-diagnostic (Buddha, 2019; Villavicencio, 2016) ● For evaluation of suspected pelvic floor weakness in women with functional disorders, such as urinary or fecal incontinence, obstructed defecation, and pelvic organ prolapse (Garcia del Sato, 2014) ● MR defecography for suspected structural cause of defectory outlet obstruction to confirm diagnosis if other testing is equivocal (anorectal manometry and balloon expulsion testing) (Wald, 2014)	[Within **Other Indications for a Pelvic MRI** section, the following changes:] ● For suspected patent urachus or other urachal abnormalities when ultrasound is non-diagnostic[49, 50] ● MR defecography for suspected structural cause of defecatory outlet obstruction to confirm diagnosis if other testing is equivocal (anorectal manometry and balloon expulsion testing)[51]

PET SCANS	
Previous (red indicates deleted text)	New (blue indicates new text)
[Under "**LUNG NODULE** seen on LDCT or CT+ contrast (without known malignancy)", the following changes:] • Solid Component of Dominant Nodule ≥ 8mm or Part solid/mixed nodules with the solid component 8 mm or larger • Mixed nodule (i.e., ground glass and solid nodule) with solid component of the nodule ≥ 4mm on LDCT when there has been ○ Interval growth of the solid component of at least 1.5mm on subsequent LDCT scans **OR** ○ Interval development of a new mixed nodule on subsequent LDCT with the solid nodule component ≥ 4mm	[Under "**LUNG NODULE** seen on LDCT or CT+ contrast (without known malignancy)", the following changes:] • Solid Component of Dominant Nodule (either solitary or clearly dominant) ≥ 8mm and <3cm or Part solid/mixed nodules with the solid component 8 mm or larger • Mixed nodule (i.e., ground glass and solid nodule) with solid component of the nodule ≥ 4mm on LDCT when there has been ○ Interval growth of the solid component of at least 1.5mm on subsequent LDCT scans **OR** ○ Interval development of a new mixed nodule on subsequent LDCT with the solid nodule component ≥ 4mm NOTE: >3cm is considered a MASS; therefore, a tissue type is usually needed prior to PET (to determine if SCLC or NSCLC). However, if the chest CT imaging findings meet criteria for limited stage SCLC and no prior imaging shows metastatic disease elsewhere, PET can be approved prior to biopsy in order to guide biopsy of any FDG-avid adenopathy at the same time the primary is biopsied. If disease clearly is in both sides of the chest and/or outside the chest, then PET is not needed/approvable prior to tissue diagnosis.
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• **SURVEILLANCE PET** is generally **not approvable**. Surveillance means no active treatment, no current suspicion of recurrence and occurs 6 months or more	• **SURVEILLANCE PET** is generally **not approvable**. Surveillance means no active treatment, no current suspicion of recurrence and occurs 6 months or more

after completion of treatment. Possible exceptions† where PET "may be considered" for surveillance: ○ Ewing's ○ Osteosarcoma ○ Breast (Stage 4) ○ Cervical (stage 2-4) ○ Diffuse Large B Cell Lymphoma when disease was only seen previously on PET ○ Melanoma (stage 2b-4) ○ Myeloma/plasmacytoma (ideally use same type imaging as was used in initial dx, up to 5 yrs after the diagnosis of plasmacytoma) ○ Seminoma (Stage 2b, 2c and 3) †NOTE: These cases would need to include a clinical reason why PET is needed (i.e., being considered), rather than conventional imaging (CT, MRI, bone scan). Generally, this would be accepted only when ordered by the treating oncologist or clearly at their recommendation (not as routine follow-up ordered by PCP). **[[To view the tables included within the 2022 PET Scans guideline, please see Appendix RBM-1.** **To view the tables included within the 2023 PET Scans guideline, please see Appendix RBM-2.]]**	after completion of treatment. **Possible exceptions† where PET "may be considered" for surveillance:** ○ Ewing's ○ Osteosarcoma ○ Breast (Stage 4) ○ Cervical (stage 2-4) ○ Diffuse Large B Cell Lymphoma when disease was only seen previously on PET ○ Histiocytic neoplasms every 3-6 months for the first 2 years post completion of treatment ○ Melanoma (stage 2b-4) ○ Myeloma/plasmacytoma (ideally use same type imaging as was used in initial dx, up to 5 yrs after the diagnosis of plasmacytoma) ○ Seminoma (Stage 2b, 2c and 3) †NOTE: These cases would need to include a clinical reason why PET is needed (i.e., being considered), rather than conventional imaging (CT, MRI, bone scan). Generally, this would be accepted only when ordered by the treating oncologist or clearly at their recommendation (not as routine follow-up ordered by PCP). **[[To view the tables included within the 2022 PET Scans guideline, please see Appendix RBM-1.** **To view the tables included within the 2023 PET Scans guideline, please see Appendix RBM-2.]]**

SINUS & MAXILLOFACIAL CT/LIMITED OR LOCALIZED FOLLOW UP SINUS CT	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR SINUS & MAXILLOFACIAL CT **Rhinosinusitis** (Brook, 2019; Chiarella, 2017; Kaplan, 2013; Rosenfeld, 2015) • Symptoms that persist for more than 4 weeks and are not responding to medical management (e.g., 2 or more courses of antibiotics or any combination of antibiotics, steroids, or antihistamines for more than 4 weeks • Clinical suspicion of fungal infection (ACR, 2017; Silveira, 2019) • Clinical suspicion of complications (Dankbaar, 2015), such as ○ Preseptal, orbital, or intracranial infection (Kastner, 2014) ○ Osteomyelitis ○ Cavernous sinus thrombosis • Recurrent acute rhinosinusitis with 4 or more annual episodes without persistent symptoms in between • Chronic recurrent sinusitis (symptoms for >12 weeks) not responding to at least 4 weeks of medical management and with at least two of the following: ○ mucopurulent discharge	**INDICATIONS FOR SINUS & MAXILLOFACIAL CT** **Rhinosinusitis[1-5]** • Clinical suspicion of fungal infection[6, 7] • Clinical suspicion of complications,[8] such as ○ Preseptal, orbital, or intracranial infection[9] ○ Osteomyelitis ○ Cavernous sinus thrombosis • Acute (<4weeks) or subacute (4-12 weeks) sinusitis (viral or bacterial) ○ Not responding to medical management including 2 or more courses of antibiotics at least 5 days each course Note: Imaging may be indicated in those predisposed to complications, including diabetes, immune-compromised state, or a history of facial trauma or surgery. • Recurrent acute rhinosinusitis with 4 or more annual episodes without persistent symptoms in between and is a possible surgical candidate • Chronic recurrent sinusitis (>12 weeks) not responding to medical management*, is a possible surgical candidate, and with at least two of the following: ○ mucopurulent discharge

○ nasal obstruction and congestion ○ facial pain, pressure, and fullness ○ decreased or absent sense of smell	○ nasal obstruction and congestion ○ facial pain, pressure, and fullness ○ decreased or absent sense of smell *Note: Medical management for chronic sinusitis includes nasal saline irrigation and/or topical intranasal steroids. In chronic sinusitis, repeat imaging is not necessary unless clinical signs or symptoms have changed. • Allergic Rhinitis – sinus imaging usually not indicated unless there are signs of complicated infection, signs of neoplasm, or persistence of symptoms/chronic rhinosinusitis despite treatment (including antihistamines) and is a possible surgical candidate[10]
• If suspected as a cause of poorly controlled asthma (endoscopic sinus surgery improves outcomes) (Vashishta, 2013) • To evaluate in the setting of unilateral nasal polyps or obstruction (to evaluate for a potential neoplasm) (Rosenfeld, 2015)	• If suspected as a cause of poorly controlled asthma (endoscopic sinus surgery improves outcomes)[11] • To evaluate in the setting of unilateral nasal polyps or obstruction (to evaluate for a potential neoplasm)[3]
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	[The following section was reformatted for clarity with minor revisions.]
Deviated nasal septum, polyp, or other structural abnormality seen on imaging or direct visualization that may be causing significant airway obstruction (if needed to plan surgery or determine if surgery is appropriate) (Poorey, 2014; Sedaghat, 2015)	**Deviated nasal septum, polyp, or other structural abnormality** seen on imaging or direct visualization • Causing significant airway obstruction AND • Imaging is needed to plan surgery or determine if surgery is appropriate[14, 15]
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Suspected infection • Osteomyelitis (after x-rays, MRI cannot be performed) (Pincus, 2009) • Abscess	**Suspected infection** • Osteomyelitis (after x-rays and MRI cannot be performed)[22] • Abscess based on clinical signs and symptoms of infection

Face mass (Kirsch, 2017; Koeller 2016) • Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed; **OR** • Known or highly suspected head and neck cancer on examination (Kirsch, 2017) • Failed 2 weeks of treatment for suspected infectious adenopathy (Haynes, 2015)	**Face mass**[16, 17, 23] • Present on physical exam and remains non-diagnostic after x-ray or ultrasound is completed; **OR** • Known or highly suspected head and neck cancer on examination[16]; **OR** • Failed 2 weeks of treatment for suspected infectious adenopathy[24]
Facial trauma (ACR, 2015, 2019; Echo, 2010; Oh, 2017; Raju, 2017; Vemuri, 2017) • Severe facial trauma • Suspected facial bone fracture with indeterminate x-ray • For further evaluation of a known fracture for treatment or surgical planning • CSF (cerebrospinal fluid) rhinorrhea when looking to characterize a bony defect (for CSF otorrhea should be a Temporal Bone CT; for intermittent leaks and complex cases, consider CT/MRI/Nuclear Cisternography). CSF fluid should always be confirmed with laboratory testing (Beta-2 transferrin assay)	**Facial trauma**[25-30] • Severe facial trauma • Suspected facial bone fracture with indeterminate x-ray • For further evaluation of a known fracture for treatment or surgical planning • CSF (cerebrospinal fluid) rhinorrhea when looking to characterize a bony defect **Note**: For CSF otorrhea should be a Temporal Bone CT; for intermittent leaks and complex cases, consider CT/MRI/Nuclear Cisternography. CSF fluid should always be confirmed with laboratory testing (Beta-2 transferrin assay)
Salivary gland • Suspicion of salivary gland stones or clinical concern for abscess (Gadodia, 2011; Kalia, 2015; Terraz, 2013) • Sialadenitis with indeterminate ultrasound or bilateral symptoms (Abdel Razek, 2017)	**Salivary gland** • Sialadenitis (infection and inflammation of the salivary glands) with indeterminate ultrasound, bilateral symptoms or concern for abscess[31] • Suspected or known salivary gland stones [32-34]

TEMPORAL BONE, MASTOID, ORBITS, SELLA, INTERNAL AUDITORY CANAL CT	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR ORBIT CT CT is preferred for visualizing bony detail and calcifications. MRI is superior for the evaluation of the visual pathways, globe, and soft tissues (Hande, 2012; Kennedy, 2018) • Abnormal external or direct eye exam (Hande, 2012): ○ Exophthalmos (proptosis) or enophthalmos ○ Ophthalmoplegia with concern for orbital pathology (Stalcup, 2013) ○ Unilateral optic disk swelling if MRI is contraindicated or cannot be performed (Hata, 2017; Margolin, 2019; Passi, 2013) ○ Documented visual defect if MRI is contraindicated or cannot be performed (Fadzil, 2013; Kedar, 2011; Prasad, 2012; Sadun, 2011) ▪ Unilateral or with abnormal optic disc(s) (i.e., optic disc blurring, edema, or pallor); AND ▪ Not explained by an underlying diagnosis, glaucoma, or macular degeneration • Optic Neuritis if MRI is contraindicated or cannot be performed ○ With an atypical presentation, severe visual impairment or poor recovery following initial onset or treatment onset (CMSC, 2018; Voss, 2011) ○ If needed to confirm optic neuritis and rule out compressive lesions • Orbital trauma	**INDICATIONS FOR ORBIT CT** Note: CT is preferred for visualizing bony detail and calcifications. MRI is superior for the evaluation of the visual pathways, globe, and soft tissues[1, 2] • Abnormal external or direct eye exam[1]: ○ Exophthalmos (proptosis) or enophthalmos ○ Ophthalmoplegia with concern for orbital pathology[3] ○ Unilateral optic disk swelling if MRI is contraindicated or cannot be performed[4-6] ○ Documented visual defect if MRI is contraindicated or cannot be performed[7-10] ▪ Unilateral or with abnormal optic disc(s) (i.e., optic disc blurring, edema, or pallor); AND ▪ Not explained by an underlying diagnosis, glaucoma, or macular degeneration • Optic Neuritis if MRI is contraindicated or cannot be performed ○ If atypical presentation (bilateral, absence of pain, optic nerve hemorrhages, severe visual impairment, lack of response to steroids, poor recovery or recurrence)[11-14] ○ If needed to confirm optic neuritis and rule out compressive lesions • Orbital trauma

○ Physical findings of direct eye injury ○ Suspected orbital trauma with indeterminate x-ray ○ For further evaluation of a fracture seen on x-ray for treatment or surgical planning • Orbital or ocular mass/tumor, suspected, or known (Hande, 2012; Kedar, 2011) • Clinical suspicion of orbital infection (Gavito-Higuera, 2016; Kirsch, 2017) • Clinical suspicion of osteomyelitis (Arunkumar, 2011; Lee, 2016) ○ Direct visualization of bony deformity OR ○ Abnormal x-rays • Clinical suspicion of Orbital Inflammatory Disease (e.g., eye pain and restricted eye movement with suspected orbital pseudotumor) (Pakdaman, 2014) • Congenital orbital anomalies (Tawfik, 2012) • Complex strabismus to aid in diagnosis, treatment and/or surgical planning (Demer; 2002; Kadom, 2008)	○ Physical findings of direct eye injury ○ Suspected orbital trauma with indeterminate x-ray ○ For further evaluation of a fracture seen on x-ray for treatment or surgical planning • Orbital or ocular mass/tumor, suspected, or known[1, 7] • Clinical suspicion of orbital infection[15, 16] • Clinical suspicion of osteomyelitis[17, 18] ○ Direct visualization of bony deformity OR ○ Abnormal x-rays • Clinical suspicion of Orbital Inflammatory Disease (e.g., eye pain and restricted eye movement with suspected orbital pseudotumor) if MRI is contraindicated or cannot be performed[19] • Congenital orbital anomalies[20] • Complex strabismus (with ophthalmoplegia or ophthalmoparesis) to aid in diagnosis, treatment and/or surgical planning[21-23]
--- **INDICATIONS FOR SELLA CT** MRI is contraindicated or cannot be performed (ACR NE, 2018; Chaudhary, 2011) • For further evaluation of known sellar and parasellar masses • Suspected pituitary gland disorder (Wu, 2014) based on: o Documented visual field defect suggesting compression of the optic chiasm; **OR** o Laboratory findings suggesting pituitary dysfunction (Freda, 2011); **OR**	--- **INDICATIONS FOR SELLA CT[26]** When MRI is contraindicated or cannot be performed[27, 28] • For further evaluation of known sellar and parasellar masses • Suspected pituitary gland disorder[29] based on any of the following: o Documented visual field defect suggesting compression of the optic chiasm; **OR** o Laboratory findings suggesting pituitary dysfunction[30]; **OR**

o Pituitary apoplexy with sudden onset of neurological and hormonal symptoms o Follow-up to other imaging suggesting sella (pituitary) mass --- **Tinnitus** (Kessler, 2017; Pegge, 2017; Yew, 2014) • Pulsatile tinnitus • Unilateral non-pulsatile tinnitus and MRI is contraindicated or cannot be performed	o Pituitary apoplexy with sudden onset of neurological and hormonal symptoms; **OR** o Other imaging suggesting sella (pituitary) mass --- **Tinnitus**[37-39] • Pulsatile tinnitus with concern for osseous pathology of the temporal bone • Unilateral non-pulsatile tinnitus and MRI is contraindicated or cannot be performed

THORACIC SPINE CT	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR THORACIC SPINE CT **(Combination requests at end of the document)**	**INDICATIONS FOR THORACIC SPINE CT** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:** • **Inconclusive or show a need for additional or follow up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient (the entire spinal cord and/or autonomic postganglionic chain must be assessed)** **(*Unless approvable in the combination section as noted in the guidelines)**
For evaluation of neurologic deficits when Thoracic Spine MRI is contraindicated or inappropriate (Acharya, 2019; ACR, 2013; NASS, 2010) • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign,) or abnormal reflexes (Teoli, 2021) ○ Absent/decreased sensory changes along a particular thoracic dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity	**For evaluation of neurologic deficits when Thoracic Spine MRI is contraindicated or inappropriate[1-3]** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy)[4, 5] ○ Pathologic (e.g., Babinski, Chaddock Sign) or abnormal reflexes[6] ○ Absent/decreased sensory changes along a particular thoracic dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity and likely localized to the thoracic spinal cord

○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) ○ Gait abnormalities (see Table 1 for more details) • Suspected cord compression with any neurological deficits as listed above	○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) - not related to an inherent bowel or bladder process ○ Gait abnormalities (see Table 1 for more details) • Suspected cord compression with any neurological deficits as listed above • Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))
[The following was deleted from the section **For evaluation of back pain with any of the following when Thoracic Spine MRI is contraindicated:**] • Back pain associated with suspected inflammation, infection, or malignancy	-----
[Within the section **As part of initial post-operative/procedural evaluation**, the following changes were made:]	[Within the section **As part of initial post-operative/procedural evaluation**, the following changes were made:]
As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection)**	**As part of initial pre-operative/post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[16, 17] and MRI for cord, nerve root compression, disc pathology, or post-op infection)**
• Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above	• Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • New or changing neurological deficits or symptoms post-operatively [16, 19] - see neurological deficit section above
For evaluation of suspected myelopathy when Thoracic Spine MRI is contraindicated	**For evaluation of suspected myelopathy when Thoracic Spine MRI is contraindicated[22-26]**

(ACR, 2015; Behrbalk, 2013; Davies, 2018; Vilaca, 2016; Waly, 2017) • Does NOT require conservative care • Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation • Any of the neurological deficits as noted above --- **For evaluation of known fracture or known/new compression fractures** --- **CT myelogram is indicated when signs and symptoms are incongruent with MRI findings or MRI cannot be performed/contraindicated/surgeon preference** (Grams, 2010; Morita, 2011; Naganawa, 2011; NASS, 2012; Ozdoba; 2011) • Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac --- **Metastatic tumor**	• Does NOT require conservative care • Progressive symptoms including unsteadiness; broad-based gait; increased muscle tone; pins and needles sensation; weakness and wasting of the lower limbs; diminished sensation to light touch, temperature, proprioception, and vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases • Any of the neurological deficits as noted above --- **For evaluation of known fracture or known/new compression fractures with worsening back pain[27, 31]** --- **CT myelogram: When MRI cannot be performed/contraindicated/surgeon preference[33-37]** • When signs and symptoms are inconsistent or not explained by the MRI findings • Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula) • Surgical planning, especially regarding to the nerve roots or evaluation of dural sac --- • **Metastatic tumor**

• With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam • Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine • With an associated new focal neurologic deficit (Alexandru, 2012) • Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019)	○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam ○ With an associated new focal neurologic deficit[32] ○ Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine[40, 41]
--- **For evaluation of known or suspected inflammatory disease when MRI is contraindicated or cannot be performed** (ACR, 2021) • For known or suspected Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and appropriate rheumatology workup	--- **For evaluation of known or suspected inflammatory disease when MRI is contraindicated or cannot be performed[28]** • Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and appropriate rheumatology workup
--- [Within **Other Indications for a Thoracic Spine CT when MRI is contraindicated or cannot be performed**, the following changes were made:] • Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))	--- [Within **Other Indications for a Thoracic Spine CT when MRI is contraindicated or cannot be performed**, the following changes were made:] • Toe walking in a child with signs/symptoms of myelopathy localized to the Thoracic Spine • Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's) ○ After detailed neurological exam and basic testing completed

COMBINATION STUDIES WITH THORACIC SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE **Indications for combination studies:** (ACR, 2017, 2019) **- For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure** **Any combination of Cervical and/or Thoracic and/or Lumbar CTs** • Any combination of these studies for: ○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015)	**COMBINATION STUDIES WITH THORACIC SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE** **Cervical and Thoracic CT** • Initial evaluation of known syrinx or syringomyelia ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis[50]) ○ To further characterize a suspicious abnormality seen on prior imaging ○ Known syrinx with new/worsening symptom **Any combination of Cervical and/or Thoracic and/or Lumbar CTs** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging. **Exception**- Indications for combination studies[51, 52]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure • Any combination of these studies for: ○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10[53-55] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies)

○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) ○ Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015) • Arnold-Chiari II-IV ○ For initial evaluation and follow-up as appropriate • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging (Hertzler, 2010)	○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[56] ○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[57]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari malformations[58, 59] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[47, 53] ○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele) • Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,[46-48] when anesthesia required for imaging[60] (e.g., meningomyelocele,

• Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords)) • Back pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo), AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006)	lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)

• Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram)
  • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011)
  • Any combination of these for spinal survey in patient with metastases.
  • Tumor evaluation and monitoring in neurocutaneous syndromes - See Background
  • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula - preferred exam CT myelogram) (Starling, 2013)
	• Oncological Applications (e.g., primary nervous system, metastatic)
	  ○ Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram)- See Overview
	  ○ Suspected leptomeningeal carcinomatosis (LC)[61]- See Overview
	  ○ Any combination of these for spinal survey in patient with metastases
	  ○ Tumor evaluation and monitoring in neurocutaneous syndromes
	• CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))[18]

• CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT	• CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning • Post-procedure (discogram) CT

THORACIC SPINE MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR THORACIC SPINE MRI **(Combination requests at end of the document)** **For evaluation of neurologic deficits** (Acharya, 2019; ACR, 2013; NASS, 2010; Stolper, 2017) • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness ○ Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign) or abnormal reflexes (Teoli, 2021) ○ Absent/decreased sensory changes along a particular thoracic dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity	**INDICATIONS FOR THORACIC SPINE MRI** **[+]If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:** • **Inconclusive or show a need for additional or follow-up imaging evaluation OR** • **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient (the entire spinal cord and/or autonomic postganglionic chain must be assessed)** **(*Unless approvable in the combination section as noted in the guidelines)** **For evaluation of neurologic deficits[1-4]** • With any of the following new neurological deficits documented on physical exam ○ Extremity muscular weakness (and not likely caused by plexopathy or peripheral neuropathy)[5, 6] ○ Pathologic (e.g., Babinski, Chaddock Sign) or abnormal reflexes[7] ○ Absent/decreased sensory changes along a particular thoracic dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature ○ Upper or lower extremity increase muscle tone/spasticity, and likely localized to the thoracic spinal cord

○ New onset bowel or bladder dysfunction (e.g., retention or incontinence) ○ Gait abnormalities (see Table 1 for more details) • Suspected cord compression with any neurological deficits as listed above. [Within the section, **For evaluation of back pain with any of the following**, the following changes were made:] • Isolated back pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below cervical and lumbar spine may also be indicated) ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006) • Back pain associated with suspected inflammation, infection, or malignancy [Within the section, **As part of initial post-operative / procedural evaluation**, the following changes were made:] **As part of initial post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology or post-op infection)**	○ New onset bowel or bladder dysfunction (e.g., retention or incontinence)- not related to an inherent bowel or bladder process ○ Gait abnormalities, most likely cause by a suspected or known myelopathy (see Table 1 for more details) • Suspected thoracic cord compression with any neurological deficits as listed above [Within the section, **For evaluation of back pain with any of the following**, the following changes were made:] • Isolated thoracic back pain in pediatric population[12] – conservative care not required if red flags present ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed[13, 14] [Within the section, **As part of initial post-operative / procedural evaluation**, the following changes were made:] **As part of initial pre-operative / post-operative / procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"[15, 16] and MRI for cord, nerve root compression, disc pathology or post-op infection)**

• CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula)) • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Changing neurologic status post-operatively • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above • When combo requests are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required (Fisher, 2013)	• CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula or dural fistula)) • A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms) • Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings • New or changing neurological deficits or symptoms post-operatively[15, 19] - see neurological deficit section above • When combo requests (see above statement[+]) are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required[20]
For evaluation of suspected myelopathy (ACR, 2015; Behrbalk, 2013; Davies, 2018; Sarbu, 2019; Vilaca, 2016) • Does **NOT** require conservative care • Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation	**For evaluation of suspected myelopathy[22-26]** • Does **NOT** require conservative care • Progressive symptoms including unsteadiness, broad-based gait, increased muscle tone, pins and needles sensation, weakness and wasting of the lower limbs, and diminished sensation to light touch, temperature, proprioception, and

• Any of the neurological deficits as noted above --- • **Combination studies for MS** ○ Cervical **and/or** Thoracic MRI for evaluation of suspected multiple sclerosis (MS) when Brain MRI does not fulfill diagnostic criteria (Filippi, 2016) ○ Cervical **and/or** Thoracic MRI with suspected transverse myelitis-with appropriate clinical symptoms (e.g., bilateral weakness, sensory disturbance, and autonomic dysfunction which typically evolve over hours or days) ○ Brain MRI with Cervical **and/or** Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis) (Wingerchuk, 2015) ○ Known MS, entire CNS axis (Brain, **and/or** Cervical **and/or** Thoracic spine) is approvable prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline) ○ Follow-up scans, including brain and spine imaging, if patients have known spine disease: ▪ 6-12 months after starting/changing treatment	vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases • Any of the neurological deficits as noted above --- **Combination studies for MS** • **These body regions might be evaluated separately or in combination as guided by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history (e.g., symptom(s), time course, and where in the CNS the likely localization(s) is/are), and other available information, including prior imaging.** ○ Cervical **and/or** Thoracic MRI for evaluation of highly suspected multiple sclerosis (MS) when Brain MRI has indeterminate findings and/or does not fulfill diagnostic criteria[28] ○ Cervical **and/or** Thoracic MRI with suspected transverse myelitis-with appropriate clinical symptoms (e.g., bilateral weakness, sensory disturbance, and autonomic dysfunction which typically evolve over hours or days) ○ Brain MRI with Cervical **and/or** Thoracic MRI for evaluation of neuromyelitis optica spectrum disorders (recurrent or bilateral optic neuritis; recurrent transverse myelitis)[30] ○ Known MS- entire CNS axis (Brain, **and/or** Cervical **and/or** Thoracic spine) is approvable prior to the initiation or change of disease modification treatments and assess disease burden (to establish a new baseline) ○ Known MS- Follow-up scans, including brain and spine imaging, if patients have known spine disease: ▪ 6-12 months after starting/changing treatment

▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years **For evaluation of trauma or acute injury (ACR, 2018)** • Presents with any of the following neurological deficits as above • With progression or worsening of symptoms during the course of conservative treatment* • History of underlying spinal abnormalities (i.e., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis), both MRI and CT are approvable (ACR, 2021; Koivikko, 2008; Taljanovic, 2009) • When the patient is clinically unevaluable or there are preliminary imaging findings (x-ray or CT) needing further evaluation ("MRI and CT provide complementary information. When indicated it is appropriate to perform both examinations") (ACR, 2018). **For evaluation of known or new compression fractures** (ACR, 2018) --- **Metastatic tumor** • With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam • Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine	▪ Every 1-2 years while on disease-modifying therapy to assess for subclinical disease activity, less frequently when stable for 2-3 years **For evaluation of trauma or acute injury[31]** • Presents with any of the following neurological deficits as above • With progression or worsening of symptoms during the course of a trial of conservative treatment* • History of underlying spinal abnormalities (i.e., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis) (Both MRI and CT would be approvable)[32-34] • When the patient is clinically unevaluable or there are preliminary imaging findings (x-ray or CT) needing further evaluation ("MRI and CT provide complementary information. When indicated it is appropriate to perform both examinations").[31] **For evaluation of known or new compression fractures with worsening back pain[31, 35]** --- • **Metastatic tumor** ○ With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam

• With an associated new focal neurologic deficit (Alexandru, 2012)
• Initial imaging of new or increasing non-traumatic back pain or radiculopathy or back pain occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (McDonald,2019; Ziu, 2019)
 	
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Other Indications for a Thoracic Spine MRI
(Note- See combination requests, below, for initial advanced imaging assessment and pre-operatively)
• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009)
• Known Arnold-Chiari syndrome (For initial imaging see combination below)
  ○ Known Chiari I malformation without syrinx or hydrocephalus, follow-up imaging after initial diagnosis with new or changing signs/symptoms or exam findings consistent with spinal cord pathology (Hitson, 2015)
  ○ Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation
• Syrinx or syringomyelia (known or suspected)
  ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015))
  ○ To further characterize a suspicious abnormality seen on prior imaging
	○ With an associated new focal neurologic deficit[41]
	
	○ Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine [33-35]
	
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	Other Indications for a Thoracic Spine MRI
	(Note- See combination requests, below, for initial advanced imaging assessment and pre-operatively)
	• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata[46-48]
	
	• Known Arnold-Chiari syndrome (For initial imaging (one-time initial MRI-modality assessment) see combination below)
	  ○ Known Chiari I malformation without syrinx or hydrocephalus, follow-up imaging after initial diagnosis with new or changing signs/symptoms or exam findings consistent with spinal cord pathology[49]
	
	  ○ Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation
	• Syrinx or syringomyelia (known or suspected)
	  ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis[50])
	
	  ○ To further characterize a suspicious abnormality seen on prior imaging

○ Known syrinx with new/worsening symptoms • Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))	○ Known syrinx with new/worsening symptoms • Toe walking in a child with signs/symptoms of myelopathy localized to the Thoracic Spine • Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's) ○ After detailed neurological exam and basic testing completed
COMBINATION STUDIES WITH THORACIC SPINE MRI **Indications for combination studies: (ACR, 2017, 2019) - For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure** **Any combination of Cervical and/or Thoracic and/or Lumbar MRIs** • Any combination of these studies for:	**COMBINATION STUDIES WITH THORACIC SPINE MRI** **Cervical and Thoracic MRI** • Initial evaluation of known syrinx or syringomyelia ○ With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis[50]) ○ To further characterize a suspicious abnormality seen on prior imaging ○ Known syrinx with new/worsening symptom **Any combination of Cervical and/or Thoracic and/or Lumbar MRIs** Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging. **Exception**- Indications for combination studies[51, 52]: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure • Any combination of these studies for:

○ Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) ○ Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following (Ozturk, 2010): ▪ Progressive spinal deformity; ▪ Neurologic deficit; ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari I (Radic, 2018; Strahle, 2011) ○ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed (Milhorat, 2009; Strahle, 2015)	○ Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10[53-55] (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies) ○ In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning[56] ○ Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging ○ Scoliosis with any of the following[57]: ▪ Progressive spinal deformity; ▪ Neurologic deficit (new or unexplained); ▪ Early onset; ▪ Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies); ▪ Pre-operative planning; OR ▪ When office notes clearly document how imaging will change management • Arnold-Chiari malformations[58, 59] ○ Arnold-Chiari I ▪ For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed[47, 53]

• Arnold-Chiari II-IV
  ○ For initial evaluation and follow-up as appropriate
	○ Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate
	  ▪ Usually associated with open and closed spinal dysraphism, particularly meningomyelocele

• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging (Hertzler, 2010)	• Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,[46-48] when anesthesia required for imaging[60] (e.g., meningomyelocele, lipomeningomyelocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)
• Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))	
• Back pain in a child with any of the following red flags (conservative care not required when red flags present): ○ Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo), AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006)	

• Drop metastasis from brain or spine (imaging also includes brain)
  • Suspected leptomeningeal carcinomatosis (LC) (Shah, 2011)
  • Any combination of these for spinal survey in patient with metastases
	• Oncological Applications (e.g., primary nervous system, metastatic)
	  ○ Drop metastasis from brain or spine (imaging also includes brain)- see Overview
	  ○ Suspected leptomeningeal carcinomatosis (LC)[61] -see Overview
	  ○ Any combination of these for spinal survey in patient with metastases

• Tumor evaluation and monitoring in neurocutaneous syndromes - See Background • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))	○ Tumor evaluation and monitoring in neurocutaneous syndromes • CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula))

UPPER EXTREMITY CT	
Previous (red indicates deleted text)	New (blue indicates new text)
Joint specific provocative orthopedic examination and MRI is contraindicated or cannot be done (see Table 1) **Note**: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging. • Shoulder (Bencardino, 2013; Jain, 2017; Loh, 2016; Somerville, 2017) ○ Any positive test listed ▪ Rotator cuff weakness (van Kampen, 2014) ▪ Bear hug test ▪ Belly press test ▪ Drop arm test ▪ Full can test ▪ Hornblower's sign ▪ Internal rotation lag sign ▪ Supraspinatus test • Elbow (Kane, 2014; Karbach, 2017) ○ Any positive test listed ▪ Valgus stress ▪ Varus stress ▪ Posterolateral rotatory drawer test ▪ Milking maneuver ▪ Push-up test • Wrist (Pandey, 2014; Ruston, 2013) ○ Any positive test listed ▪ Watson test (scaphoid shift test) ▪ Scapholunate ballottement test	**Joint specific provocative orthopedic examination** and MRI is contraindicated or cannot be performed **Note**: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging. • Shoulder[1-4] ○ Any positive test listed ▪ Rotator cuff weakness[5] ▪ Bear hug test ▪ Belly press test ▪ Drop arm test ▪ Full can test ▪ Hornblower's sign ▪ Internal rotation lag sign ▪ Supraspinatus test (aka Empty Can Test) when positive because of weakness • Elbow[6, 7] ○ Any positive test listed ▪ Valgus stress ▪ Varus stress ▪ Posterolateral rotatory drawer test ▪ Milking maneuver ▪ Push-up test ▪ Popeye sign • Wrist[8, 9] ○ Any positive test listed ▪ Watson test (scaphoid shift test) ▪ Scapholunate ballottement test

▪ Reagan test (lunotriquetral ballottement test) --- **Clinical suspicion of injury** with clinical findings, which may be nonspecific, based on mechanism of injury, x-ray completed, and MRI is contraindicated or cannot be performed • TFCC (triangular fibrocartilage complex) injury (Barlow, 2016; Ng, 2017) • SLAP (superior labral anterior to posterior complex) lesions (Somerville, 2017) **Other Specific Shoulder Conditions which are approvable after active conservative therapy (above) and x-ray (and MRI cannot be performed or CT is noted to be preferred)** • Shoulder Impingement—Hawkin's, Neer's, Painful arc, Load and shift, and Yocum tests • Non-Traumatic Shoulder Instability—Sulcus, Surprise, Anterior or Posterior draw, Apprehension, Anterior slide, Clunk, Crank, Empty can, HERI (hyperextension-internal rotation) tests • Glenoid labral tear (i.e., SLAP lesion) if MRI cannot be completed—Apprehension, Relocation, Surprise, Jobe's, O'Brien's, Superior labral, Anterior slide, Jerk, Compression rotation, Crank tests --- **Bone Fracture** • Suspected stress or insufficiency fracture with a negative initial x-ray (Bencardino, 2017; Sadineni, 2015) ○ Repeat x-rays in 10-14 days if negative or non-diagnostic. • Intraarticular fractures or carpal bone fractures or instability that may require surgery (Kaewlai, 2008)	▪ Reagan test (lunotriquetral ballottement test) ▪ Snuff box pain (after initial x-ray) --- **Clinical suspicion of injury** with clinical findings, which may be nonspecific, based on mechanism of injury, x-ray completed, and MRI is contraindicated or cannot be performed • TFCC (triangular fibrocartilage complex) injury[12, 13] • SLAP (superior labral anterior to posterior complex) lesions[4] --- **Bone Fracture or Ligament Injury** • Suspected stress or insufficiency fracture with a negative initial x-ray[37, 38] ○ Repeat x-rays in 10-14 days if negative or non-diagnostic.

• Suspected scaphoid fracture with negative x-ray • Other upper extremity fractures that may require surgery • Nonunion or delayed union as demonstrated by no healing between two sets of x-rays. If a fracture has not healed by 4-6 months, there is delayed union. Incomplete healing by 6-8 months is nonunion (Morshed, 2014; Salih, 2015) **Occult wrist ganglion, after indeterminate or negative ultrasound and MRI is contraindicated or cannot be performed** (Meena, 2014) ○ Clinical suspicion and failed 4 weeks conservative treatment, including all of the following: ○ Activity modification ○ Rest, ice, or heat ○ Splinting or orthotics ○ Medication **-----** [The following Table was deleted:] **Table 1: Positive Orthopedic Joint Tests, Upper Extremity** **ELBOW** Moving valgus stress test Hook test Passive forearm pronation	• Intraarticular fractures or carpal bone fractures or instability that may require surgery[39] • Suspected scaphoid fracture with negative x-ray • Other upper extremity fractures that may require surgery • Nonunion or delayed union as demonstrated by no healing between two sets of x-rays. If a fracture has not healed by 4-6 months, there is delayed union. Incomplete healing by 6-8 months is nonunion[40, 41] • Clinical suspicion based on mechanism of injury and physical findings, x-ray completed and MRI contraindicated ○ TFCC (triangular fibrocartilage complex) injury[12, 13] ○ SLAP (superior labral anterior to posterior complex) lesions[4] Note: Imaging approvable in the setting of known trauma; otherwise, active conservative therapy is recommended (see background).

Biceps squeeze test Biceps Aponeurosis (BA) flex test Table top relocation test **SHOULDER** Drop Arm Test External rotation lag sign 0 and 90 degrees Full can test Hook test Hornsblower test Internal rotation lag sign Lift off test Popeye sign **WRIST** Snuff box pain (after initial x-ray) Derby relocation test Ulnar foveal sign/test Press test Ulnocarpal stress test (if concern for TFCC tear)	

UPPER EXTREMITY CTA/CTV	
Previous (red indicates deleted text)	New (blue indicates new text)

[Within **Special Circumstances** section, the following changes were made:]
• Renal impairment
  ○ Not on dialysis
  ▪ Mild to moderate, GFR 30-89 ml/min MRA can be done
  ▪ Severe, GFR < 30 ml/min MRA without contrast
  ○ On dialysis
  ▪ CTA with contrast can be done
	[Within **Special Circumstances** section, the following changes were made:]
	• Renal impairment
	  ○ Not on dialysis
	  ▪ Mild to moderate, GFR 30-45 ml/min MRA with contrast can be performed
	  ▪ Severe, GFR < 30 ml/min MRA without contrast
	  ○ On dialysis
	  ▪ CTA with contrast can be performed

UPPER EXTREMITY MRA/MRV	
Previous (red indicates deleted text)	New (blue indicates new text)

[Within **Special Circumstances** section, the following changes were made:]
• Renal impairment
  ○ Not on dialysis
  ▪ Mild to moderate, GFR 30-89 ml/min MRA can be done
  ▪ Severe, GFR < 30 ml/min MRA without contrast
  ○ On dialysis
  ▪ CTA with contrast can be done
	[Within **Special Circumstances** section, the following changes were made:]
	• Renal impairment
	  ○ Not on dialysis
	  ▪ Mild to moderate, GFR 30-45 ml/min MRA with contrast can be performed
	  ▪ Severe, GFR < 30 ml/min MRA without contrast
	  ○ On dialysis
	  ▪ CTA with contrast can be performed

UPPER EXTREMITY MRI	
Previous (red indicates deleted text)	New (blue indicates new text)
INDICATIONS FOR UPPER EXTREMITY MRI (HAND, WRIST, ARM, ELBOW or SHOULDER) (Plain radiographs must precede MRI evaluation) **Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.** **If an MR Arthrogram fits approvable criteria below, approve as MRI.** **Joint specific provocative orthopedic examination** (see Table 1) **Note**: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging. • Shoulder (Bencardino, 2013; Jain, 2017; Loh, 2016, Somerville, 2017) ○ Any positive test listed ▪ Rotator cuff weakness (van Kampen, 2014) ▪ Bear hug test ▪ Belly press test ▪ Drop arm test ▪ Full can test ▪ Hornblower's sign ▪ Internal rotation lag sign ▪ Supraspinatus test • Elbow (Kane 2014, Karbach 2017) ○ Any positive test listed ▪ Valgus stress	**INDICATIONS FOR UPPER EXTREMITY MRI (HAND, WRIST, ARM, ELBOW or SHOULDER) (Plain radiographs must precede MRI evaluation)** **Some indications are for MRI, CT, or MR or CT Arthrogram. More than one should not be approved at the same time.** **If an MR Arthrogram fits approvable criteria below, approve as MRI.** **Joint specific provocative orthopedic examination** **Note**: With a positive orthopedic sign, an initial x-ray is always preferred. However, it is not required to approve advanced imaging. • Shoulder[1-4] ○ Any positive test listed ▪ Rotator cuff weakness[5] ▪ Bear hug test ▪ Belly press test ▪ Drop arm test ▪ Full can test ▪ Hornblower's sign ▪ Internal rotation lag sign • Supraspinatus test (aka Empty Can Test) when positive because of weakness • Elbow[6, 7] ○ Any positive test listed ▪ Valgus stress

▪ Varus stress ▪ Posterolateral rotatory drawer test ▪ Milking maneuver ▪ Push-up test • Wrist (Pandey, 2014; Ruston, 2013) ○ Any positive test listed ▪ Watson test (scaphoid shift test) ▪ Scapholunate ballottement test ▪ Reagan test (lunotriquetral ballottement test) **Joint or muscle pain without positive findings on an orthopedic exam as listed above,** after x-ray completed (Park, 2010; Pieters, 2020) • Persistent joint or musculotendinous pain unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician-supervised exercise**) of at least four (4) weeks, **OR** • With progression or worsening of symptoms during the course of conservative treatment. **Other Specific Shoulder Conditions which are approvable after active conservative therapy (above) and x-ray:** • Shoulder Impingement—Hawkin's, Neer's, Painful arc, Load and shift, and Yocum tests • Non-Traumatic Shoulder Instability—Sulcus, Surprise, Anterior or Posterior draw, Apprehension, Anterior slide, Clunk, Crank, Empty can, HERI (hyperextension-internal rotation) tests	▪ Varus stress ▪ Posterolateral rotatory drawer test ▪ Milking maneuver ▪ Push-up test ▪ Popeye sign • Wrist[8, 9] ○ Any positive test listed ▪ Watson test (scaphoid shift test) ▪ Scapholunate ballottement test ▪ Reagan test (lunotriquetral ballottement test) ▪ Snuff box pain (after initial x-ray) **Joint or muscle pain without positive findings on an orthopedic exam as listed above,** after x-ray completed[10, 11] • Persistent joint or musculotendinous pain unresponsive to conservative treatment*, within the last 6 months which includes active medical therapy (physical therapy, chiropractic treatments, and/or physician-supervised exercise**),of at least four (4) weeks, **OR** • With progression or worsening of symptoms during the course of conservative treatment.

• Glenoid labral tear (i.e., SLAP lesion)—Apprehension, Relocation, Surprise, Jobe's, O'Brien's, Superior labral, Anterior slide, Jerk, Compression rotation, Crank tests
--- 	
Bone Fracture or Ligament Injury
• Suspected stress or insufficiency fracture with a negative initial x-ray (Bencardino, 2017; Sadineni, 2015; Yin, 2010)
  ○ Repeat x-rays in 10-14 days if negative or non-diagnostic
• Pathologic fracture on x-ray (Fayad, 2005)
• Intraarticular fractures that may require surgery
• Suspected scaphoid fracture with negative x-rays
• Nonunion or delayed union as demonstrated by no healing between two sets of x-rays. If a fracture has not healed by 4-6 months, there is delayed union. Incomplete healing by 6-8 months is nonunion (Morshed, 2014).
• Clinical suspicion based on mechanism of injury and physical findings and x-ray completed
  ○ TFCC (triangular fibrocartilage complex) injury (Barlow, 2016; Ng, 2017)
  ○ SLAP (superior labral anterior to posterior complex) lesions (Somerville, 2017)
 	
Occult wrist ganglion, after indeterminate ultrasound
(Meena, 2014)
○ Clinical suspicion and failed 4 weeks conservative treatment including all of the below:
  ○ Activity modification
  ○ Rest, ice, or heat
	--- 	
	Bone Fracture or Ligament Injury
	• Suspected stress or insufficiency fracture with a negative initial x-ray[31-33]
	  ○ Repeat x-rays in 10-14 days if negative or non-diagnostic
	• Pathologic fracture on x-ray[34]
	• Intraarticular fractures that may require surgery
	• Suspected scaphoid fracture with negative x-rays
	• Nonunion or delayed union as demonstrated by no healing between two sets of x-rays. If a fracture has not healed by 4-6 months, there is delayed union. Incomplete healing by 6-8 months is nonunion.[35]
	• Clinical suspicion based on mechanism of injury and physical findings and x-ray completed
	  ○ TFCC (triangular fibrocartilage complex) injury[36, 37]
	  ○ SLAP (superior labral anterior to posterior complex) lesions[4]
	Note: Imaging approvable in the setting of known trauma; otherwise, active conservative therapy is recommended (see background).

○ Splinting or orthotics ○ Medication --- [The following Table was deleted:] **Table 1: Positive Orthopedic Joint Tests, Upper Extremity** **ELBOW** Moving valgus stress test Hook test Passive forearm pronation Biceps squeeze test Biceps Aponeurosis (BA) flex test Table top relocation test **SHOULDER** Drop Arm Test External rotation lag sign 0 and 90 degrees Full can test Hook test Hornsblower test Internal rotation lag sign Lift off test Popeye sign **WRIST** Snuff box pain (after initial x-ray) Derby relocation test Ulnar foveal sign/test Press test Ulnocarpal stress test (if concern for TFCC tear)	

Appendices

Appendix RBM-1: Tables from 2022 PET Scans guideline

(Red indicates deleted text; blue indicates new text.)

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
ADRENAL (other than pheochromocytoma/ paraganglioma)	**Not Indicated**	**Not Indicated**
AIDS-related KAPOSI SARCOMA	with prior inconclusive imaging	**Not Indicated**
ACUTE LYMPHOBLASTIC LEUKEMIA (ALL)	lymphomatous extramedullary disease	lymphomatous extramedullary disease
ACUTE MYELOGENOUS LEUKEMIA (AML)	If suspected extramedullary involvement	If suspected/known extramedullary involvement
ANAL	with prior inconclusive imaging (can be done with PET (PET/CT or PET/MR‡‡ if available))	with prior inconclusive imaging
BASAL CELL (BCC of the skin)	**Not Indicated**	**Not Indicated**

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
BLADDER	Muscle invasive only, with prior inconclusive imaging	Metastatic only, with prior inconclusive imaging
BREAST	Indicated for stage IIb and above (if only T and N are provided, this equates to T3 (tumor > 50mm); or T4 (tumor of any size with direct extension to chest wall and/or skin); or N2 (>3 axillary LN, ipsilateral internal mammary node); or the combination of T2 (tumor >20mm but <50mm) plus N1 (any positive lymph node involvement)	with prior inconclusive imaging OR if initial stagging was done with PET
CERVICAL	Indicated (can consider PET/MR‡‡ if available)	Indicated
CHORDOMA	with prior inconclusive imaging	**Not Indicated**

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
CHOLANGIOCARCINOMA	with prior inconclusive imaging	with prior inconclusive imaging
CHONDROSARCOMA (bone)	**Not Indicated**	**Not Indicated**
COLORECTAL	with prior inconclusive imaging (PET/CT indicated if potentially surgically curable M1 disease, when considered for image-guided liver directed therapies)	with prior inconclusive imaging
ENDOMETRIAL	with prior inconclusive imaging	with prior inconclusive imaging
ESOPHOGEAL and EGJ (esophagogastric junction epicenter < 2m into stomach)	Indicated	Indicated
EWING SARCOMA-Osseous	Indicated (all ages)	Patients <30 yrs old: Indicated Patients >30 yrs old: when initial staging showed metastatic disease Or other signs (PE/imaging) worrisome for progression beyond localized disease

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
FALLOPIAN TUBE CANCER	with prior inconclusive imaging	with prior inconclusive imaging
GALLBLADDER	with prior inconclusive imaging	with prior inconclusive imaging
GASTRIC (include EGJ tumors with epicenter >2cm into stomach)	with prior inconclusive imaging or if radiation is being considered **(Not indicated for T1N0M0 or M1)**	with prior inconclusive imaging. PET/CT is indicated for post radiation imaging
GESTATIONAL TROPHOBLASTIC CANCER	with prior inconclusive imaging	with prior inconclusive imaging
HEAD and NECK (including mucosal melanoma of the head and neck)	Indicated • May be done in conjunction with a dedicated face/neck MRI when surgery or radiation is planned	Indicated • Can concurrently approve a Neck MRI and PET 3-4 months after definitive treatment in patients with locoregionally advanced disease or with altered anatomy. • PET should not be done earlier than 12 weeks after definitive treatment unless

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
		signs or symptoms of recurrence • If final PET/CT is equivocal or borderline for residual disease, a repeat PET/CT at ≥ 6 weeks may help identify those that can be safely observed without additional surgery
HEPATOCELLULAR	with prior inconclusive imaging	with prior inconclusive imaging
LEUKEMIA (refer to specific types listed in table when possible)	If there is lymph node involvement (lymphomatous features), soft tissue and/or extramedullary involvement (myeloid sarcoma) and/or if forms "chloromas" (leukemia tumor balls)	If there is lymph node involvement (lymphomatous features), soft tissue and/or extramedullary involvement (myeloid sarcoma) and/or if forms "chloromas" (leukemia tumor balls)
LUNG • **Non-Small Cell** • **Limited stage small cell Stage I-III** ○ Except T3/T4 • **Extensive small cell**	Indicated Indicated **Not indicated**	Indicated Indicated **Not indicated**

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
○ Stage IV and T3 or T4 disease		
LYMPHOCYTIC LEUKEMIA • **Chronic (CLL) and Small (SLL)**	For suspected high-grade transformation or to guide biopsy with prior inconclusive imaging	with accelerated CLL or to guide biopsy with prior inconclusive imaging (includes negative CT with rising tumor markers or if conventional imaging documents mets, IF clearly considering resection)
LYMPHOMA (Non-Hodgkins and Hodgkins)	Indicated (can consider PET/MR‡‡)	Indicated (can consider PET/MR‡‡)
MELANOMA (See Uveal melanoma below for indications)	only stage III, IV	only stage III, IV
MERKEL CELL	Indicated	Indicated
MESOTHELIOMA (pleural)	Indicated only prior to surgery for stage I-IIIA	Indicated only prior to surgery for stage I-IIIA

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
MULTIPLE MYELOMA		
• **Smoldering myeloma** (asymptomatic)	Indicated	**Not indicated** (unless labs suggest progression to active myeloma)
• **Active myeloma**	Indicated	Indicated
• **Plasmacytoma**	Indicated	Indicated
NEUROBLASTOMA	Indicated when MIBG is negative, inconclusive, or there are discordant findings between MIBG and pathology	Indicated when the FDG PET was used for initial staging
NEUROENDOCRINE TUMORS-NET UNDIFFERENTIATED/DE-DIFFERENTIATED (including pheochromocytoma, paraganglioma, extrapulmonary large/small cell)	Indicated if used after prior negative or inconclusive Ga68 Dotatate scan	Indicated when FDG was used for initial staging, or when used after prior negative/inconclusive Ga68 Dotatate scan (or MIBG scan) OR after inconclusive conventional imaging
OVARIAN	with prior inconclusive imaging	with prior inconclusive imaging
OCCULT PRIMARY	with prior inconclusive imaging (can consider PET/MR‡‡)	with prior inconclusive imaging

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
OSTEOSARCOMA • **Osseous**	For patients >30 years old: Indicated when the prior bone scan is inconclusive or negative (i.e. the primary bone tumor is not seen on bone scan). PET can be approved in conjunction with MR of primary site For patients <30 years old: Indicated	For patients >30 yrs old: Indicated when disease is positive on prior FDG-PET or when there is inconclusive conventional imaging. PET can be approved in conjunction with MR of primary site Indicated
PANCREATIC	With prior inconclusive imaging OR with any of the following high-risk features: • borderline resectable disease • markedly elevated CA19-9 >180 U/ml • large primary tumor/lymph nodes • very symptomatic (jaundice, symptomatic gastric outlet obstruction, venous thromboembolism, extreme pain and excessive weight loss	**Not Indicated**

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
PENILE	with prior inconclusive imaging	with prior inconclusive imaging
PERITONEAL CANCER (PRIMARY)	with prior inconclusive imaging	with prior inconclusive imaging
POST TRANSPLANT LYMPHOPROLIFERATIVE DISORDER (PTLD)	Indicated when the diagnosis is made OR if suspected based on abnormal PE, abnormal imaging or abnormal labs (i.e. significantly elevated or rising viral titers)	Indicated
PROSTATE (FDG PET only) *See other PET tracer section below for prostate cancer*	**Not Indicated**	**Not Indicated**
RENAL	**Not Indicated**	**Not Indicated**
SKIN SQUAMOUS CELL	with prior inconclusive imaging	**Not Indicated**
SMALL BOWEL CARCINOMA	**Not indicated**	with prior inconclusive imaging

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
SOFT TISSUE SARCOMA (including soft tissue/extraosseous Ewing sarcoma and soft tissue/extraosseous osteosarcoma)/ GIST/ Rhabdomyosarcoma	For patients >30 years old: with prior inconclusive imaging For patients <30 years old: Indicated (does not require inconclusive conventional imaging)	For patients >30yrs old with prior inconclusive imaging For patients <30 yrs old: Indicated (does not require inconclusive conventional imaging)
TESTICULAR		
• **Seminoma**	**Not Indicated**	with prior inconclusive imaging or residual mass >3cm or 6 weeks post chemotherapy (If final PET/CT is equivocal or borderline for residual disease PET/CT, a repeat PET/CT a ≥ 6 weeks may help identify those that can be safely observed without additional surgery)
• **Non-Seminoma**	**Not Indicated**	**Not Indicated**
THYMOMA/THYMIC CANCER	Indicated	Indicated
THYROID		
• **Papillary, Follicular, Hurthle**	**Not Indicated**	Indicated with the following 3 criteria:

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
		• A thyroidectomy and radioiodine ablation were done initially; AND • Serum thyroglobulin is >2 ng/ml (unstimulated or stimulated) OR there is a high anti- thyroglobulin antibody (anti-Tg Ab) >1 year after treatment AND • A Negative current I-131/123 scan OR a Negative prior stimulated whole body I-131/ I-123 scan done at TG level similar to the current TG level (a current scan is needed if on radioiodine sensitizing medications)
• **Anaplastic**	With prior inconclusive imaging	With prior inconclusive imaging
• **Medullary**	**Not Indicated** (see Dotatate indications below)	with prior inconclusive imaging when calcitonin levels ≥ 150 pg/ml or CEA levels >5 ng/ml post-surgery with prior insufficient Dotatate scan
UTERINE	with prior inconclusive imaging	with prior inconclusive imaging

ONCOLOGICAL INDICATIONS FOR FDG PET

(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
UVEAL MELANOMA	**Not Indicated**	with prior inconclusive imaging
VAGINAL	Indicated	Indicated
VULVAR	≥T2 or after prior inconclusive imaging	Indicated

MISCELLANEOUS (NON-ONCOLOGIC) INDICATIONS FOR FDG PET

(excluding brain and cardiac PET which have separate Guidelines)

CANCER TYPE	INITIAL STAGING	RESTAGING
CASTLEMAN'S DISEASE	Indicated	Indicated
LANGERHANS CELL HISTIOCYTOSIS		
• **Predominantly osseous disease**	Indicated	Indicated
• **Non-osseous disease**	**Not Indicated**	**Not Indicated**

MISCELLANEOUS (NON-ONCOLOGIC) INDICATIONS FOR FDG PET
(excluding brain and cardiac PET which have separate Guidelines)

CANCER TYPE	INITIAL STAGING	RESTAGING

OTHER (NON-FDG) PET TRACERS covered
GA68-DOTATATE, GA68-DOTATOC and CU64-DOTATATE

CANCER TYPE	INITIAL STAGING	RESTAGING
CARCINOID **EXTRAPULMONARY LARGE AND SMALL CELL** **MEN-1/MEN-2 SYNDOMES** **NEUROENDOCRINE TUMORS (NET)** **PHEOCHROMOCYTOMA** **PARAGANGLIOMA**	• Biopsy proven AND to determine eligibility for somatostatin receptor (SSR) therapy (such Lutetium, Octreotide, Sandostatin) OR • Biopsy proven AND prior CT/ MRI has been or is reasonably expected to be insufficient for any the following reasons: ○ to determine extent of treatment plan ○ to determine if candidate for invasive diagnostic/ therapeutic procedure ○ to determine optimal anatomic location for invasive procedure • (can consider PET/MR‡‡)	• for restaging or monitoring response to active treatment, and/or evaluation for suspicion of recurrence due to new or changing signs/symptoms when CT/MR is negative but biomarkers are rising • PET/MR‡‡ can be considered with negative CT/MR and rising biomarkers • asymptomatic surveillance is not approvable

OTHER (NON-FDG) PET TRACERS covered
GA68-DOTATATE, GA68-DOTATOC and CU64-DOTATATE

CANCER TYPE	INITIAL STAGING	RESTAGING
MEDULLARY THYROID	Prior CT/ MRI insufficient to • Determine extent of treatment plan • Determine if candidate for invasive diagnostic/ therapeutic procedure • Determine optimal anatomic location for invasive procedure	When calcitonin levels ≥ 150 pg/ml or CEA levels >5 ng/ml post-surgery

F18 FLUCICLOVINE (AXUMIN®), PSMA TRACERS (such as F18 piflufolastat (Pylarify®) and GA68) and C11 CHOLINE

CANCER	INITIAL STAGING	RESTAGING

PROSTATE (PET/CT or PET/MRI‡‡) • After a negative Axumin® PET, a subsequent PSMA PET is not covered until a repeat PSA (done at least 3 months later) shows a progressive rise • 11-Choline should be approved only if PSMA and/or Axumin® are not available. Order of preference typically would be PSMA, then Axumin®, then 11-Choline	Only PSMA (not Axumin® or Choline) is indicated for high risk defined as 1 or more of the following: • T3a or higher, • PSA>20, • Gleason Score* 8-10, • Grade Group* 4-5 • Gleason Primary Pattern** 5 Pelvic MRI can be approved concurrently if needed for surgical planning	For post-surgery/radiation with persistent or rising PSA (two separate PSA levels required) as below: • PSA <2 PMSA indicated and DOES NOT require prior conventional imaging • PSA<2 Axumin® indicated if prior bone scan and CT/MRI are negative or inconclusive • PSA>2 PSMA, Axumin® or Choline indicated if prior bone scan and CT/MRI are negative or inconclusive

***Equivalent Scorings:**

Grade Group	Gleason Score	Gleason Pattern
4	8	4+4 3+5 5+3
5	9 or 10	4+5 5+4 5+5

**The Primary Pattern refers to the 1st number in the Gleason Pattern

‡‡**NOTE:** If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required.

Appendix RBM-2: Tables from 2023 PET Scans guideline
(Red indicates deleted text; blue indicates new text.)

FDG PET

ONCOLOGICAL INDICATIONS FOR FDG PET
(SEE SPECIAL TRACERS SECTIONS FOR INDICATIONS OTHER TRACERS)

CANCER TYPE	INITIAL STAGING	RESTAGING
ADRENAL (other than pheochromocytoma/ paraganglioma)	**Not Indicated**	**Not Indicated**
AIDS-related KAPOSI SARCOMA	with prior inconclusive imaging	**Not Indicated**
ACUTE LYMPHOBLASTIC LEUKEMIA (ALL)	lymphomatous extramedullary disease	lymphomatous extramedullary disease
ACUTE MYELOGENOUS LEUKEMIA (AML)	If suspected extramedullary involvement	If suspected/known extramedullary involvement
ANAL (Note that normal size pelvic adenopathy can be considered as inconclusive)	with prior inconclusive imaging (can be done with PET (PET/CT or PET/MR‡‡ if available)).	with prior inconclusive imaging
BASAL CELL (BCC of the skin)	**Not Indicated**	**Not Indicated**

BLADDER	Muscle invasive only, with prior inconclusive imaging	With inconclusive imaging and suspected metastatic disease or recurrence outside of the urinary tract
BREAST	Indicated for stage IIb and above (if only T and N are provided, this equates to T3 (tumor > 50mm); or T4 (tumor of any size with direct extension to chest wall and/or skin); or N2 (>3 axillary LN, ipsilateral internal mammary node); or the combination of T2 (tumor >20mm but <50mm) plus N1 (any positive lymph node involvement)	with prior inconclusive imaging, if initial staging was performed with PET OR if recurs with IIb or higher disease (based on pathology/imaging/exam) since no previous initial staging would have typically been performed for lower grade breast cancer
CERVICAL	Indicated (can consider PET/MR‡‡ if available)	Indicated
CHORDOMA	with prior inconclusive imaging	**with prior inconclusive imaging**
CHOLANGIOCARCINOMA	with prior inconclusive imaging	with prior inconclusive imaging
CHONDROSARCOMA (bone)	**Not Indicated**	**Not Indicated**

COLORECTAL	with prior inconclusive imaging OR potentially surgically curable M1 disease OR when considered for image-guided liver-directed therapies	with prior inconclusive imaging
ENDOMETRIAL	with prior inconclusive imaging	with prior inconclusive imaging
ESOPHOGEAL and EGJ (esophagogastric junction epicenter < 2cm into stomach)	Indicated	Indicated
EWING SARCOMA-Osseous	Indicated (all ages)	Patients <30 yrs old: Indicated Patients >30 yrs old: Indicated for known or suspected metastatic disease (based on PE/imaging)
FALLOPIAN TUBE CANCER	with prior inconclusive imaging	with prior inconclusive imaging
GALLBLADDER	with prior inconclusive imaging	with prior inconclusive imaging
GASTRIC (include EGJ tumors with epicenter >2cm into stomach)	with prior inconclusive imaging or if radiation is being considered **(Not indicated for T1N0M0 or M1)**	with prior inconclusive imaging, PET/CT is indicated or for post radiation imaging

GESTATIONAL TROPHOBLASTIC CANCER	with prior inconclusive imaging	with prior inconclusive imaging
HEAD and NECK (including mucosal melanoma of the head and neck)	Indicated • May be done in conjunction with a dedicated face/neck MRI (or CT) when surgery or radiation is planned	Indicated • Can concurrently approve a Neck MRI and PET 3-4 months after definitive treatment in patients with locoregionally advanced disease or with altered anatomy. • PET should not be done earlier than 12 weeks after definitive treatment unless signs or symptoms of recurrence • If final PET/CT is equivocal or borderline for residual disease, a repeat PET/CT at ≥ 6 weeks may help identify those that can be safely observed without additional surgery
HEPATOCELLULAR	with prior inconclusive imaging	with prior inconclusive imaging
LEUKEMIA (refer to specific types listed in table when possible)	If there is lymph node involvement (lymphomatous features), soft tissue and/or extramedullary involvement (myeloid sarcoma) and/or if	If there is lymph node involvement (lymphomatous features), soft tissue and/or extramedullary involvement (myeloid sarcoma) and/or if

	forms “chloromas” (leukemia tumor balls)	forms “chloromas” (leukemia tumor balls)
LUNG		
• **Non-Small Cell**	Indicated	Indicated
• **Limited stage small cell Stage I-III** ○ And T3/T4 if disease is encompassed in tolerable radiation plan (potentially curable)	Indicated	Indicated
• **Extensive small cell** ○ Stage IV and T3 or T4 disease not able to be treated with curative intent	**Not indicated**	**Not indicated**
LYMPHOCYTIC LEUKEMIA • **Chronic (CLL) and Small (SLL)**	For suspected high-grade transformation or to guide biopsy with prior inconclusive imaging	with accelerated CLL or to guide biopsy with prior inconclusive imaging (includes negative CT with rising tumor markers or if conventional imaging documents mets, IF clearly considering resection)
LYMPHOMA (Non-Hodgkins and Hodgkins)	Indicated (can consider PET/MR‡‡)	Indicated (can consider PET/MR‡‡)
MELANOMA	only stage III, IV indicated	only stage III, IV indicated

(See Uveal melanoma below for indications)		
MERKEL CELL	Indicated	Indicated
MESOTHELIOMA (malignant)		
• **Pleural**	Indicated only prior to surgery for stage I-IIIA	Indicated only prior to surgery for stage I-IIIA
• **Peritoneal**	Indicated	Indicated
MULTIPLE MYELOMA		
• **Smoldering myeloma** (asymptomatic)	Indicated	Indicated annually or possibly more frequently as clinically indicated (labs and/or symptoms to suggest progression)
• **Active myeloma**	Indicated	Indicated
• **Plasmacytoma**	Indicated	Indicated
NEUROBLASTOMA	Indicated when MIBG is negative, inconclusive, or there are discordant findings between MIBG and pathology	Indicated when FDG PET was used for initial staging or if MIBG has become inconclusive or discordant
NEUROENDOCRINE TUMORS (NET) WHEN UNDIFFERENTIATED/DE-DIFFERENTIATED (including	Indicated if used after prior negative or inconclusive Ga68 Dotatate scan	Indicated when FDG was used for initial staging, or when used after prior negative/inconclusive Ga68 Dotatate scan (or MIBG

pheochromocytoma, paraganglioma, extrapulmonary large/small cell)		scan) OR after inconclusive conventional imaging
OVARIAN	with prior inconclusive imaging	with prior inconclusive imaging
OCCULT PRIMARY	with prior inconclusive imaging appropriate to pathology of the biopsy that identified the occult malignancy	with prior inconclusive imaging
OSTEOSARCOMA • **Osseous**	For patients >30 years old: Indicated when the prior bone scan is inconclusive or negative (i.e., the primary bone tumor is not seen on bone scan). PET can be approved in conjunction with MR of primary site For patients <30 years old: Indicated PET can be approved in conjunction with MR of primary site	For patients >30 yrs old: Indicated when disease is positive on prior FDG-PET or when there is inconclusive conventional imaging. PET can be approved in conjunction with MR of primary site For patients <30 years old: Indicated PET can be approved in conjunction with MR of primary site
PANCREATIC	With prior inconclusive imaging OR with any of the following high-risk features: • borderline resectable disease	When PET was used for initial staging and need to assess response to treatment in order to determine if now a surgical candidate

	• markedly elevated CA19-9 >180 U/ml • large primary tumor/lymph nodes • very symptomatic (jaundice, symptomatic gastric outlet obstruction, venous thromboembolism, extreme pain and excessive weight loss	
PENILE	with prior inconclusive imaging	with prior inconclusive imaging
PERITONEAL CANCER (PRIMARY)	with prior inconclusive imaging	with prior inconclusive imaging
POST TRANSPLANT LYMPHOPROLIFERATIVE DISORDER (PTLD)	Indicated when the diagnosis is made OR if suspected based on abnormal PE, abnormal imaging or abnormal labs (i.e., significantly elevated or rising viral titers)	Indicated
PROSTATE (FDG PET only) *See other PET tracer section below for prostate cancer*	**Not Indicated**	**Not Indicated**

RENAL	ONLY when conventional imaging is equivocal for metastatic disease and if present would alter initial treatment plan	ONLY when conventional imaging is clearly insufficient in these circumstances: • For suspected recurrence/metastatic disease outside of the urinary tract • To monitor treatment with a Tyrosine Kinase Inhibitor (such as sunitinib, sorafenib) for advanced RCC when disease was only seen previously on PET
SKIN SQUAMOUS CELL	with prior inconclusive imaging	**Not Indicated**
SMALL BOWEL CARCINOMA	**Not indicated**	with prior inconclusive imaging
SOFT TISSUE SARCOMA (including soft tissue/extraosseous Ewing sarcoma and soft tissue/extraosseous osteosarcoma)/ GIST/ Rhabdomyosarcoma	For patients >30 years old: with prior inconclusive imaging For patients <30 years old: Indicated (does not require inconclusive conventional imaging)	For patients >30yrs old with prior inconclusive imaging For patients <30 yrs old: Indicated (does not require inconclusive conventional imaging)
TESTICULAR • **Seminoma**	**Not Indicated**	with prior inconclusive imaging OR residual mass >3cm with normal AFP and beta-hcG and 6 weeks post chemotherapy

		(If final PET/CT is equivocal or borderline for residual disease, an additional repeat PET/CT > 6 weeks later may help identify those that can be safely observed without additional surgery)
• **Non-Seminoma**	**Not Indicated**	**Not Indicated**
THYMOMA/THYMIC CANCER	Indicated	Indicated
THYROID		
• **Papillary, Follicular**	**Not Indicated**	Indicated with the following 3 criteria: • A thyroidectomy and radioiodine ablation were done initially; AND • Serum thyroglobulin (Tg) is >2 ng/ml (unstimulated or stimulated) OR there is a high anti- thyroglobulin antibody (anti-Tg Ab) >1 year after treatment AND • A Negative current I-131/I-123 scan OR a Negative prior stimulated whole body I-131/ I-123 scan done at Tg level similar to the current Tg level (a current scan is needed if on radioiodine sensitizing medications)

• **Hurthle**	**If Tg is high and/or pathology is high-risk**	IF Tg is high and/or pathology is high-risk
• **Anaplastic**	With prior inconclusive imaging	With prior inconclusive imaging
• **Medullary**	**Not Indicated** (see NET/Dotatate indications below)	With prior inconclusive imaging when calcitonin levels ≥ 150 pg/ml or CEA levels >5 ng/ml post-surgery with prior insufficient Dotatate scan
UTERINE	with prior inconclusive imaging	with prior inconclusive imaging
UVEAL MELANOMA	**Not Indicated**	with prior inconclusive imaging
VAGINAL	Indicated	Indicated
VULVAR	≥T2 or after prior inconclusive imaging	Indicated

MISCELLANEOUS (NON-ONCOLOGIC) INDICATIONS FOR FDG PET

(excluding brain and cardiac PET which have separate Guidelines)

TYPE	INITIAL STAGING	RESTAGING
CASTLEMAN'S DISEASE	Indicated	Indicated
HISTIOCYTIC NEOPLASMS:		
• **Langerhan's**	Indicated	

MISCELLANEOUS (NON-ONCOLOGIC) INDICATIONS FOR FDG PET

(excluding brain and cardiac PET which have separate Guidelines)

TYPE	INITIAL STAGING	RESTAGING
		Indicated if on active treatment for multiple bone disease, high risk bone disease or multisystem involvement
• **Erdheim Chester**	Indicated	
• **Rosai-Dorfman**	Indicated	Indicated if on active treatment Indicated if on active treatment

***SARCOIDOSIS**

- ONLY if conventional testing (CXR, CT and inflammatory serology) remain inconclusive for known sarcoid to determine:
  - if treatment might be helpful
  - extent of disease, if it will potentially change management
  - response to treatment
- OR if strongly supected sarcoid to determine most suitable site to biopsy

***VASCULITIS**

- In limited circumstances, with known vasculitis, AFTER conventional imaging (MRA/CTA/MR/CT) has clearly been shown to be insufficient to determine treatment

*****Adjudications should occur on a case-by-case basis

NON FDG PET TRACERS

GA68-DOTATATE, GA68-DOTATOC and CU64-DOTATATE FOR NET (Neuroendocrine Tumors)

CANCER TYPE	INITIAL STAGING	RESTAGING
CARCINOID **EXTRAPULMONARY LARGE AND SMALL CELL** **MEN-1/MEN-2 SYNDOMES** **NEUROENDOCRINE TUMORS (NET)** **PHEOCHROMOCYTOMA** **PARAGANGLIOMA**	• Indicated • PET/MR‡‡ can be considered	• Indicated • PET/MR‡‡ can be considered
MEDULLARY THYROID	Prior CT/ MRI insufficient to • Determine extent of treatment plan • Determine if candidate for invasive diagnostic/ therapeutic procedure • Determine optimal anatomic location for invasive procedure	When calcitonin levels ≥ 150 pg/ml or CEA levels >5 ng/ml post-surgery

YTTRIUM-90 (Y90)

Y90 PET SCAN: Indicated when performed immediately after treatment of liver malignancy (primary or metastatic) with Y90 (usually within 24 hours while Y90 is still detectible). The Y90 treatment is the tracer for this PET (see Y90 background section).

PSMA TRACERS (such as F18 piflufolastat (Pylarify®), GA 68 PSMA-11, GA 68 gozetotide (Locametz®), and GA 68 gozetotide (Illuccix®)); F18 FLUCICLOVINE (AXUMIN®) and C11 CHOLINE
For PROSTATE CANCER

CANCER	INITIAL STAGING	RESTAGING
PROSTATE (PET/CT or PET/MRI‡‡) • After a negative Axumin® PET, a subsequent PSMA PET is not covered until a repeat PSA (done at least 3 months later) shows a progressive rise • 11-Choline should be approved only if PSMA and/or Axumin® are not available. Order of preference typically would be PSMA, then Axumin®, then 11-Choline	**Only PSMA** (not Axumin® or Choline) is indicated in initial staging for high risk; defined as 1 or more of the following: • Gleason 8, 9 or 10 (specimen contains pattern 4 or 5) • Gleason 7 IF primary pattern** is 4 (4+3=7) • Gleason 7 primary pattern 3 (3+4=7) must ALSO have a PSA >10 and/or cT2b-cT3c disease • Gleason 6 disease (3+3=6) must ALSO have a PSA > 20 and/or cT3a-cT4 disease	For post-surgery/radiation in suspected recurrence with at least two separate detectable PSA levels above the nadir for that patient for: • **Axumin®** (or Choline) ○ Indicated if bone scan and CT/MRI are negative or inconclusive • **PSMA** (preferred tracer) ○ PSA < 10 Indicated

	• >50% cores positive for cancer in random biopsy **The Primary Pattern refers to the 1st number in the Gleason Pattern Pelvic MRI can be approved concurrently if needed for surgical planning	PSA > 10 Indicated if bone scan and CT/MRI are negative or inconclusive For post surgery/radiation in **known recurrence, PSMA** is approvable if: • **Disease** was previously seen only on PSMA PET For **metastatic castrate resistant disease** that have failed both taxanes and ARDI, **PSMA** is approvable if: • Individual is a candidate for Lu-PSMA treatment (Pluvicto®) (must be clearly documented in note) • Restaging on Lu-PSMA treatment (Pluvicto®)