Evidence-based Cancer Imaging Program
Appropriate Use Criteria

Headache

November 30, 2022

Memorial Sloan Kettering Cancer Center

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Background

The Evidence-based Cancer Imaging Program (ECIP) was established to ensure ongoing compliance with the Centers for Medicare and Medicaid Services (CMS) Appropriate Use Criteria Program by expanding upon our existing evidence-based practices at Memorial Sloan Kettering Cancer Center (MSK). ECIP develops and implements appropriate use criteria (AUC) for ordering advanced diagnostic imaging services, and takes into consideration the unique needs of patients with cancer and our expertise as a cancer center.

AUC are guidelines developed by our Imaging Disease Management Teams (IDMT) that link: a specific clinical condition or presentation; one or more imaging exams; and an assessment of the appropriateness of each exam. Using AUCs helps to achieve the goal that all patients receive only what imaging is best for them, while avoiding unnecessary tests.

Abbreviations

Abbreviation	Definition
AUC	Appropriate use criteria
CMS	Centers for Medicare and Medicaid Services
CT	Computed tomography
CTA	Computed tomography angiography
ECIP	Evidence-based Cancer Imaging Program
FDG	Fluorodeoxyglucose
IDMT	Imaging Disease Management Team
IV	Intravenous

Abbreviation	Definition
MRA	Magnetic resonance angiography
MRI	Magnetic resonance imaging
MRV	Magnetic resonance venography
MSK	Memorial Sloan Kettering Cancer Center
NM	Nuclear medicine
OCEBM	Oxford Centre for Evidence-Based Medicine
PET	Positron emission tomography

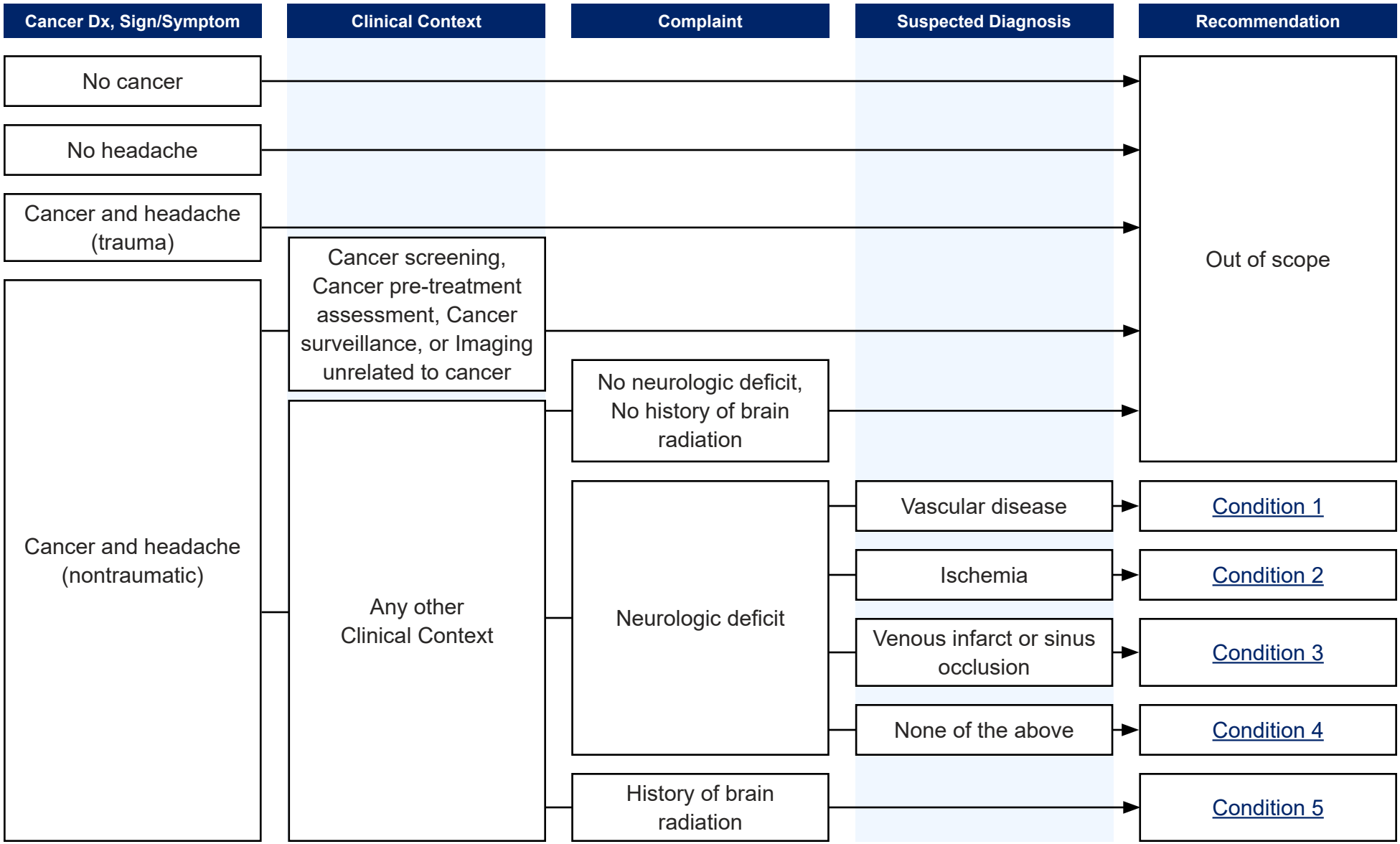
Clinical Context

Clinical Context	Description	Relevant for this AUC?
Cancer screening	Neoplasm detection in asymptomatic patients. Imaging type and schedule informed by guidelines.	☐
Neoplasm detection or diagnostic workup	Assessment of signs or symptoms concerning for neoplastic disease.	☑
Cancer staging or restaging	Establishing location and extent of neoplastic disease. Restaging may occur after treatment or intervention.	☑
Cancer pre-treatment assessment	Imaging performed to optimize the cancer treatment plan.	☐
Therapeutic response assessment	Assessment of treatment response to guide subsequent management.	☑
Therapeutic complication assessment	Evaluation of possible treatment-related complications or adverse events.	☑
Cancer complication or comorbidity assessment	Evaluation of cancer or comorbidity-related complications or adverse events.	☑
Cancer surveillance	Ongoing scheduled assessment of neoplastic disease status.	☐
Survivorship	Assessment of long-term or late effects from cancer or cancer treatment as well as ongoing health needs of cancer survivors.	☑
Imaging unrelated to cancer	Imaging obtained for indication or concern not related to cancer.	☐

Age

Adults only (≥ 18 years)

Appropriate Use Criteria



Condition 1:
Nontraumatic Headache, Cancer, Focal Neurologic Deficit, Vascular Disease Suspected

USUALLY APPROPRIATE	SOMETIMES APPROPRIATE	RARELY APPROPRIATE
MRI brain without and with IV contrast MRI brain without and with contrast is usually appropriate as an initial study.	**MRI brain without IV contrast** Noncontrast MRI brain is sometimes appropriate as the first imaging modality when contrast is contraindicated.	**Arteriography cervicocerebral**
CTA head with IV contrast Conditional: CTA head with contrast may be obtained to evaluate vasculature when vascular disease is suspected.	**CT brain without and with IV contrast** CT brain without and with contrast is sometimes appropriate if MRI is contraindicated or unavailable.	
CTA head and neck with IV contrast Conditional: CTA head and neck with contrast may be obtained to evaluate vasculature when vascular disease is suspected.	**CT brain without IV contrast** CT brain without contrast can be used as the first imaging modality as a rapid screen but may be followed by MRI to increase sensitivity and specificity.	
MRA head without and with IV contrast Conditional: MRA head without and with contrast may be obtained to evaluate vasculature when vascular disease is suspected.	**MRV head without and with IV contrast**	
MRA head without IV contrast Conditional: MRA head without contrast may be obtained to evaluate vasculature when vascular disease is suspected.	**MRV head without IV contrast**	

Condition 2:
Nontraumatic Headache, Cancer, Focal Neurologic Deficit, Ischemia Suspected

USUALLY APPROPRIATE	SOMETIMES APPROPRIATE	RARELY APPROPRIATE
MRI brain without and with IV contrast MRI brain without and with contrast is usually appropriate as an initial study.	**CT brain without and with IV contrast** CT brain without and with contrast is sometimes appropriate if MRI is contraindicated or unavailable.	**MRV head without and with IV contrast**
MRI brain without IV contrast Noncontrast MRI brain may be appropriate as the first imaging modality when contrast is contraindicated, or when clinical factors suggest ischemia.	**MRA head without IV contrast**	**MRV head without IV contrast**
CT brain without IV contrast CT brain without contrast can be used as the first imaging modality as a rapid screen, but may be followed by MRI to increase sensitivity and specificity.	**MRA head without and with IV contrast**	**Arteriography cervicocerebral**
	CTA head with IV contrast	
	CTA head and neck with IV contrast	

Condition 3:
Nontraumatic Headache, Cancer, Focal Neurologic Deficit, Venous Infarct or Sinus Occlusion Suspected

USUALLY APPROPRIATE	SOMETIMES APPROPRIATE	RARELY APPROPRIATE
MRI brain without and with IV contrast MRI brain without and with contrast is usually appropriate as an initial study.	**MRI brain without IV contrast** Noncontrast MRI brain is sometimes appropriate as the first imaging modality when contrast is contraindicated.	**Arteriography cervicocerebral**
MRV head without and with IV contrast Conditional: MRV head without and with contrast may be indicated as part of initial evaluation if venous infarct or sinus occlusion is suspected.	**CT brain without and with IV contrast** CT brain without and with contrast is sometimes appropriate if MRI is contraindicated or unavailable.	
MRV head without IV contrast Conditional: MRV head without contrast may be indicated as part of initial evaluation if venous infarct or sinus occlusion is suspected.	**CT brain without IV contrast** CT brain without contrast can be used as the first imaging modality as a rapid screen but may be followed by MRI to increase sensitivity and specificity.	
	MRA head without IV contrast	
	MRA head without and with IV contrast	
	CTA head with IV contrast	
	CTA head and neck with IV contrast	

Condition 4:
Nontraumatic Headache, Cancer, Focal Neurologic Deficit

USUALLY APPROPRIATE	SOMETIMES APPROPRIATE	RARELY APPROPRIATE
MRI brain without and with IV contrast MRI brain without and with contrast is usually appropriate as an initial study.	**MRI brain without IV contrast** Noncontrast MRI brain is sometimes appropriate as the first imaging modality when contrast is contraindicated.	**MRV head without and with IV contrast**
	CT brain without and with IV contrast CT brain with and without contrast is sometimes appropriate if MRI is contraindicated or unavailable.	**MRV head without IV contrast**
	CT brain without IV contrast CT brain without contrast can be used as the first imaging modality as a rapid screen, but may be followed by MRI to increase sensitivity and specificity.	**Arteriography cervicocerebral**
	MRA head without IV contrast	
	MRA head without and with IV contrast	
	CTA head with IV contrast	
	CTA head and neck with IV contrast	

Condition 5:
Nontraumatic Headache, Cancer, History of Brain Radiation

USUALLY APPROPRIATE
MRI brain without and with IV contrast MRI brain without and with contrast is usually appropriate as an initial study.
MRI brain perfusion without and with IV contrast MRI brain without and with contrast with additional MRI perfusion sequences, if available, is usually appropriate.

SOMETIMES APPROPRIATE
CT brain without and with IV contrast CT brain without and with contrast is sometimes appropriate if MRI is contraindicated or unavailable.
CT brain without IV contrast CT brain without contrast can be used as the first imaging modality as a rapid screen, but may be followed by MRI to increase sensitivity and specificity.
MRI brain without IV contrast
FDG PET/CT brain Conditional: FDG-PET is sometimes appropriate to characterize lesions.
MRI head spectroscopy without and with IV contrast Conditional: MRI head spectroscopy without and with contrast is sometimes appropriate to characterize lesions.

RARELY APPROPRIATE
MRA head without IV contrast
MRA head without and with IV contrast
MRV head without and with IV contrast
MRV head without IV contrast

Key Evidence

FOCAL NEUROLOGIC DEFICIT

Ref No.	Published Evidence	Grade*
1	Argyriou AA, Chroni E, Polychronopoulos P, et al. Headache characteristics and brain metastases prediction in cancer patients. Eur J Cancer Care (Engl). 2006 Mar;15(1):90-95. PMID: 16441682	4
2	Christiaans MH, Kelder JC, Arnoldus EPJ, Tijssen CC. Prediction of intracranial metastases in cancer patients with headache. Cancer. 2002 Apr;94(7):2063-2068. PMID: 11932910	4
3	Douglas AC, Wippold FJ, 2nd, Broderick DF, et al. ACR Appropriateness Criteria Headache. J Am Coll Radiol. 2014 Jul;11(7):657-667. PMID: 24933450	5
4	Goldlust SA, Graber JJ, Bossert DF, Avila EK. Headache in Patients with Cancer. Curr Pain Headache Rep. 2010 Dec;14(6):455-464. PMID: 20927609	5
5	Martínez Barbero JP, Láinez Ramos-Bossini AJ, Rivera-Izquierdo M, Sendra-Portero F, Benítez-Sánchez JM, Cervilla JA. Prevalence and Risk Factors Associated with Tumors and Other Structural Anomalies in Brain MRI Performed to Rule out Secondary Headache: A Multicenter Observational Study. Int J Environ Res Public Health. 2022 Mar;19(6):3521. PMID: 35329206	5
6	Singh TD, Hajeb M, Rabinstein AA, et al. SMART syndrome: retrospective review of a rare delayed complication of radiation. Eur J Neurol. 2021 Apr;28(4):1316-1323. PMID: 33159349	5
7	Valença MM, de Azevedo Filho HRC, de Souza Ferreira MR, et al. Secondary stabbing headache associated with intracranial tumors, aneurysms, and arteriovenous malformation: An alarming warning sign. Headache. 2021 Jan;61(1):80-89. PMID: 33417245	5
8	Whitehead MT, Cardenas AM, Corey AS, et al. ACR Appropriateness Criteria® Headache. J Am Coll Radiol. 2019 Nov;16(11S):S364-S377. PMID: 31685104	5

Notation	Consensus-based Statement	Grade*
§	In addition to reviewing the published literature for evidence, the MSK NeuroOncology/Headache Imaging Disease Management Team leveraged consensus-based expert opinion and clinical best practices to supplement the evidence in this area to define the appropriate imaging guidelines for this clinical condition. Key points: • Patients with known cancer should be scanned when a new headache develops or if the characteristics of a headache change or progress. • In the presence of a focal neurologic deficit, imaging should be primarily directed to identify new lesions.	**5**

*Grade assigned in accordance with the Oxford Centre for Evidence-Based Medicine (OCEBM) Levels of Evidence 2011: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence

Key Evidence

HISTORY OF BRAIN RADIATION

Ref No.	Published Evidence	Grade*
1	Barajas RF, Chang JS, Sneed PK, Segal MR, McDermott MW, Cha S. Distinguishing recurrent intra-axial metastatic tumor from radiation necrosis following gamma knife radiosurgery using dynamic susceptibility-weighted contrast-enhanced perfusion MR imaging. AJNR Am J Neuroradiol. 2009 Feb;30(2):367-372. PMID: 19022867	4
2	Furuse M, Nonoguchi N, Yamada K, et al. Radiological diagnosis of brain radiation necrosis after cranial irradiation for brain tumor: a systematic review. Radiat Oncol. 2019 Feb 6;14(1):28. PMID: 30728041	2
3	Goldlust SA, Graber JJ, Bossert DF, Avila EK. Headache in Patients with Cancer. Curr Pain Headache Rep. 2010 Dec;14(6):455-464. PMID: 20927609	5
4	Hatzoglou V, Ulaner GA, Zhang Z, Beal K, Holodny AI, Young RJ. Comparison of the effectiveness of MRI perfusion and fluorine-18 FDG PET-CT for differentiating radiation injury from viable brain tumor: a preliminary retrospective analysis with pathologic correlation in all patients. Clin Imaging. 2013 May-Jun;37(3): 451–457. PMID: 23068052	4
5	Hoefnagels FW, Lagerwaard FJ, Sanchez E, et al. Radiological progression of cerebral metastases after radiosurgery: assessment of perfusion MRI for differentiating between necrosis and recurrence. J Neurol. 2009 Jun;256(6):878-887. PMID: 19274425	4
6	Hojjati M, Badve C, Garg V, et al. Role of FDG-PET/MRI, FDG-PET/CT, and Dynamic Susceptibility Contrast Perfusion MRI in Differentiating Radiation Necrosis from Tumor Recurrence in Glioblastomas. J Neuroimaging. 2018 Jan;28(1):118-125. PMID: 28718993	4
7	Li H, Deng L, Bai HX, et al. Diagnostic Accuracy of Amino Acid and FDG-PET in Differentiating Brain Metastasis Recurrence from Radionecrosis after Radiotherapy: A Systematic Review and Meta-Analysis. AJNR Am J Neuroradiol. 2018 Feb;39(2):280-288. PMID: 29242363	3
8	Lupattelli M, Alì E, Ingrosso G, et al. Stereotactic Radiotherapy for Brain Metastases: Imaging Tools and Dosimetric Predictive Factors for Radionecrosis. J Pers Med. 2020 Jul 4;10(3):59. PMID: 32635476	5

Ref No.	Published Evidence	Grade*
9	Mitsuya K, Nakasu Y, Horiguchi S, et al. Perfusion weighted magnetic resonance imaging to distinguish the recurrence of metastatic brain tumors from radiation necrosis after stereotactic radiosurgery. J Neurooncol. 2010 Aug;99(1):81-88. PMID: 20058049	4
10	Suh CH, Kim HS, Jung SC, Choi CG, Kim SJ. Multiparametric MRI as a potential surrogate endpoint for decision-making in early treatment response following concurrent chemoradiotherapy in patients with newly diagnosed glioblastoma: a systematic review and meta-analysis. Eur Radiol. 2018 Jun;28(6):2628-2638. PMID: 29374321	3
11	Whitehead MT, Cardenas AM, Corey AS, et al. ACR Appropriateness Criteria® Headache. J Am Coll Radiol. 2019 Nov;16(11S):S364-S377. PMID: 31685104	5

Notation	Consensus-based Statement	Grade*
§	In addition to reviewing the published literature for evidence, the MSK NeuroOncology/Headache Imaging Disease Management Team leveraged consensus-based expert opinion and clinical best practices to supplement the evidence in this area to define the appropriate imaging guidelines for this clinical condition. Key points: • Patients with known cancer should be scanned when a new headache develops or if the characteristics of a headache change or progress. • When such a patient has known history of brain radiation, imaging should be primarily directed to identify and characterize new and/or recurrent mass lesions and post-treatment related changes.	5

*Grade assigned in accordance with the Oxford Centre for Evidence-Based Medicine (OCEBM) Levels of Evidence 2011: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence

Multidisciplinary Imaging Disease Management Team

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  Internist & Hospitalist
- **Chaya Moskowitz, PhD**
  Biostatistician

Methodology

Details about our methodology can be found here:
https://www.mskcc.org/departments/radiology/evidence-based-cancer-imaging/methodology

Resources

CMS Appropriate Use Criteria Program Website
https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Appropriate-Use-Criteria-Program

MSK's ECIP Website
https://www.mskcc.org/departments/radiology/evidence-based-cancer-imaging

OCEBM Levels of Evidence
https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence