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2025 Magnetic Resonance Imaging (MRI) Brain

Diagnostic Imaging

MRI-Brain-HH

Last Review Date: 04/25/2025
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Guideline Initiated: 06/30/2019

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Magnetic Resonance Imaging (MRI) Brain

MRI Brain Related National Coverage Determination (NCD)/ Local Coverage Determination (LCD)

Please refer to https://www.cms.gov/medicare-coverage-database/search.aspx if applicable to the individual's health plan membership.

Type/ID Number	Title
NCD 220.2	MRI
LCD 35175	MRI and CT Scans of the Head and Neck
LCD 35391	Multiple Imaging in Oncology
LCD 37373	MRI and CT Scans of the Head and Neck

Clinical Judgment

These medical policies are designed to provide clinical guidance and do not supplant a provider's independent professional judgment. Physicians retain full and independent authority to determine appropriate care based on each patient's individual clinical circumstances. Although services may be subject to documentation requirements, medical necessity review, or coverage limitations, nothing in this policy is intended to restrict or interfere with a physician's independent medical judgment.

MRI General Contraindications

MRI is contraindicated for **ANY** of the following:

- Safety, related to clinical status (body mass index exceeds MRI capability, intravascular stents within recent 6 weeks)
- Safety, related to implanted devices (aneurysm clips, cochlear implant, implantable cardio-defibrillators, insulin pump, permanent pace maker, spinal cord stimulator)[1]
  References: [40] [9] [23]

Preamble: Pediatric Diagnostic Imaging

HealthHelp's clinical guidelines for the Diagnostic Imaging program, are intended to apply to both adults and pediatrics (21 years of age or younger), unless otherwise specified within the criteria.

[1]Some implanted devices that were once absolute contraindications to a MRI may now be accepted, including if the specific MRI is able to accommodate the device or the device itself is deemed safe for MRI.

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MRI Brain Guideline

Magnetic resonance imaging (MRI) of the brain is considered medically appropriate when the documentation demonstrates **ANY** of the following:

1. Headache for **ANY** of the following:
    a. Chronic headaches with change in pattern or intensity (eg, last longer, more frequent or severe).
    b. Migraine aura is atypical and complex (eg, aura lasts more than 1 hour, **NO** aura, visual or sensory illusions).
    c. New, acute (less than 72 hours) and/or sudden-onset headache with **ANY** of the following:
        i. Age is 50 years or older.
        ii. Cancer history
        iii. Coagulopathy is known **OR** active anticoagulant use.
        iv. Familial first-degree (child, parent, sibling), or personal history of arteriovenous fistula (AVF) or brain aneurysm. (*__NOTE__: *Combination studies with CTA Brain, CTA Neck are appropriate.*)
        v. Fever
        vi. Immunocompromised status
        vii. Intracranial bleeding/stroke history
        viii. Pregnancy or puerperium
        ix. Sentinel headache (eg, thunderclap, "worst headache of my life") occurs with rapid intensity **AND** lasts less than 48 hours and prior imaging (CT, CTA, MRA) are non-diagnostic or indeterminate.
        x. Valsalva maneuver related (eg, coughing, exercising, sexual intercourse)
    d. Persistent headache, in a pediatric individual, and **ANY** of the following:
        i. Age is less than 6 years old.
        ii. Increased intracranial pressure is suspected and symptomatic (eg, recurring headache after waking, with or **WITHOUT** nausea/vomiting).
        iii. Occipital location
        iv. Prevents or disrupts sleep

v. Severe and intracranial pathology is suspected (eg, cancer history, coagulopathy, congenital heart disease, hypertension, immune deficiency, neurofibromatosis, sickle cell disease)

vi. **NO** family history of headache.

e. Postural headache and spontaneous intracranial hypotension is suspected.

f. Symptoms persist or worsen **AND** adherence to physician-directed treatment.

g. Trigeminal autonomic cephalgia (TAC) (eg, cluster, paroxysmal hemicrania/ hemicrania continua and short-lasting unilateral neuralgiform headache) evaluation. (*__NOTE__: *Imaging is indicated **ONCE** to eliminate secondary causes*.)

References: [64] [38] [46] [60] [36]

2. Arteriovenous malformation (AVM) or fistula (AVF) is suspected or known. [22]

3. Cancer is suspected or known for **ANY** of the following:

   a. Cancer screening (including non-central nervous system (CNS) cancers and hereditary cancer syndromes). (See the **National Comprehensive Cancer Network [NCCN] Guidelines** for more information.)

   b. Recurrence or metastasis is suspected.

   c. Staging evaluation

   d. Surveillance following the NCCN Guidelines recommended schedule. (See the **National Comprehensive Cancer Network [NCCN] Guidelines** for more information.)

   References: [2] [12]

4. Central sleep apnea is known from polysomnogram, age is over 1 year and central neurological cause (eg, chiari malformation, infectious/inflammatory disease, tumor) is suspected. (*__NOTE:__ *Must be in the absence of chronic opioid use, heart failure, high altitude or treatment emergent central sleep apnea*).

5. Cerebral spinal fluid (CSF) abnormality (eg, hydrocephalus, infection, leak, shunt malfunction or spontaneous intracranial hypotension) is suspected or known and **ANY** of the following:

   a. Arnold chiari is suspected or known.

   b. CSF leak is suspected or known (*__NOTE:__ *CSF fluid should always be confirmed with laboratory testing [Beta-2 transferrin assay]*).

   c. Hydrocephalus is suspected known.

   d. Shunt evaluation

e. Syrinx or syringomyelia is known, for initial evaluation.

References: [60] [58] [48]

6. Normal pressure hydrocephalus is suspected or known and symptomatic (eg, cognitive disturbance, gait difficulty, urinary incontinence).
References: [21] [43]

7. Congenital abnormalities are suspected or known and **ANY** of the following:
   a. Achondroplasia is known for evaluation of cervicomedullary junction.
   b. Cerebral palsy, if etiology is **NOT** established during neonatal period **AND** there is a change in development **OR** a progressive neurological disorder is suspected.
   c. Macrocephaly evaluation, in a pediatric individual and **ANY** of the following:
      i. Anterior fontanelle is closed.
      ii. Increased intracranial pressure is suspected.
      iii. Neurodevelopmental exam is abnormal.
      iv. Ultrasound is abnormal, non-diagnostic or indeterminate.
   d. Microcephaly is known in a pediatric individual.
   e. Skull deformity is known (eg, craniosynostosis), for evaluation. (*__NOTE__: *CT is preferred imaging to assess bony structures; MRI imaging is preferred to assess intracranial soft tissue*.)

References: [1] [45] [41] [27]

8. Cranial nerve (including visual abnormalities) are suspected or known and **ANY** of the following:
   a. Bell's palsy for evaluation of extracranial nerve course and **ALL** of the following:
      i. Atypical signs (eg, dysphagia, dizziness, headache)
      ii. Facial twitching/spasms prior to onset
      iii. **NO** improvement at 2 to 4 months
   b. Binocular diplopia and intracranial pathology is suspected **AND** ophthalmologic exam is abnormal.
   c. Bulbar/pseudobulbar symptoms (eg, difficulty chewing, dysarthria, dysphagia, dysphonia, facial muscle weakness) are present.
   d. Cranial nerve palsy (cranial nerve IX through XII) evaluation
   e. Hemifacial spasm evaluation

f. Horner's syndrome is suspected or known and symptomatic (eg, anhidrosis, miosis, ptosis), localizing the lesion to the central nervous system (CNS).

g. Occipital neuralgia evaluation to exclude a structural lesion

h. Ophthalmologic, physical or neurological exam is abnormal (eg, optic atrophy, ocular nerve palsies, papilledema, pathologic nystagmus, visual field deficit).

i. Optic neuritis is suspected or known.

j. Sensorineural hearing loss on audiogram is asymmetric.

k. Strabismus, in a pediatric individual, **AND** developmental delay or fundoscopic exam is abnormal.

l. Trigeminal neuralgia is suspected or known.

References: [52] [31] [39] [15] [30] [16] [4] [29] [50] [56] [7]

9. Global development delay (GDD) is known, in a pediatric individual whose age is less than 18 years, or developmental delay **AND** symptoms demonstrated on exam are new or progressing.

10. Infectious or inflammatory disease (eg, abscess, meningitis, neurosarcoidosis, complications of rhinosinusitis, vasculitis) is suspected or known and **ANY** of the following:

    a. Autoimmune disease or vasculitis is suspected or known, with positive inflammatory markers (eg, c-reactive protein [CRP]) **AND** CNS involvement.

    b. Encephalitis is suspected with headache **AND** altered mental status **OR** for follow-up.

    c. Endocarditis is known and intracranial septic emboli are suspected.

    d. Intracranial abscess or brain infection is suspected and **ANY** of the following:

        1. Laboratory findings are abnormal (eg, elevated white blood cells).

        2. Mental status is acutely altered **OR** neurological symptoms (eg, bowel/bladder dysfunction, dizziness, headache) are acute.

        3. Treatment is completed, for follow-up.

    e. Meningitis is suspected or known **AND** is symptomatic (eg, fever, headache, stiff neck) **OR** laboratory findings are positive (eg, elevated white blood cells or abnormal lumbar puncture).

    f. Neurosarcoidosis for initial evaluation and follow-up

    g. Rhinosinusitis is acute (less than 4 weeks in duration) and orbital or intracranial complication is suspected.

References: [33] [11] [47] [6] [38] [24] [59]

11. Mass, neoplasm, tumor, cyst or lesion is known and **ANY** of the following:
    a. Arachnoid cyst evaluation follow-up, and **EITHER** of the following:
        i. Age is less than 4 years old, serial imaging is warranted.
        ii. Age is older than 4 years old and symptoms (eg, headaches, hydrocephalus, increased intracranial pressure, local mass effect, visual/ endocrine dysfunction) are new or progressing.
    b. Dermoid cysts/sinuses are midline **AND** intracranial extension is suspected.
    c. Histiocytic neoplasms (eg, Erdheim-Chester disease, Langerhans cell histiocytosis, Rosai-Dorfman disease) are known, to monitor treatment response or for surveillance.
    d. Low-grade tumor (WHO I to II) (eg, astrocytoma, glioma, meningioma) is known for **ANY** of the following:
        i. Evaluation of new or changing neurological symptoms (eg, dizziness, headache, facial paralysis).
        ii. Surveillance per **National Comprehensive Cancer Network (NCCN) Guidelines**. (*See **Surveillance** section*)
        iii. Treatment response assessment
    e. Neurocutaneous syndromes tumor is known, to monitor for **ANY** of the following:
        i. Neurofibromatosis 1 and **ANY** of the following:
            A. Intracranial tumors are known, for follow-up.
            B. Tumors are suspected based on clinical evaluation.
        ii. Neurofibromatosis 2 for screening when asymptomatic; follow-up annually beginning at age 10 years
        iii. Sturge Weber syndrome to rule out intracranial involvement
        iv. Tuberous sclerosis; follow-up every 1 to 3 years until age 25
        v. Von Hippel Landau syndrome; follow-up every 2 years
    f. Pineal cyst is known, size 5 mm or more, **AND** presents with atypical features (eg, ataxia, gaze paralysis, headache, nausea/vomiting, papilledema).
    g. Pituitary adenoma is known, for follow-up for **ANY** of the following:
        i. Functioning adenoma to assess treatment response **OR** 1 year follow-up after drug holiday
        ii. Macroadenoma is asymptomatic (10 mm or more); follow-up every 6 to 18 months or post-surgical follow-up every 1 to 2 years.

iii. Microadenoma is asymptomatic **AND** non-functioning (less than 10 mm); repeat in one year, every 2 to 3 years, if stable.

iv. Neuroendocrine signs/symptoms (nausea, pain, vomiting) are new.

h. Rathke cleft cyst is known, for follow-up for **ANY** of the following:

i. Asymptomatic, follow-up at 1 year, 3 years and 5 years

ii. Neurological symptoms are new.

iii. Post-treatment follow-up, yearly for 5 years

iv. Prior imaging is abnormal, non-diagnostic or indeterminate.

i. Soft tissue mass of the head is known **AND** prior imaging (ultrasound, X-ray) is non-diagnostic or indeterminate.

References: [44] [17] [20] [63] [37] [10] [42] [62] [32] [18]

12. Mass, neoplasm, tumor, cyst or lesion is suspected and **ANY** of the following:

a. Brain tumor is suspected and neurological symptoms are acute, new or progressing.

b. CNS lesion is suspected with vertigo and neurological signs (eg, ataxia, change in sensation, double vision, weakness, vision loss).

c. Histiocytic neoplasms (Erdheim-Chester disease, Langerhans cell histiocytosis, Rosai-Dorfman disease), for screening

d. Pituitary tumors are suspected and **ANY** of the following:

i. Central diabetes insipidus (low ADH)

ii. Genetic disorder (eg, MEN1), that predisposes individual to increases risk of pituitary tumor, is known.

iii. Neurologic findings (eg, compression of the optic chiasm, diplopia, gaze palsy)

iv. Pituitary apoplexy with sudden onset of neurological and hormonal symptoms

v. Pituitary gland hypofunctioning or hyperfunctioning is suspected based on hormone testing (eg, acromegaly, central hyperthyroidism, Cushing disease, elevated prolactin, growth hormone deficiency, hypogonadotrophic hypogonadism, hypopituitarism).

vi. Precocious puberty in a child (male age is less than 9, female age is less than 8) and central cause is suspected based on hormonal studies.

References: [49] [20] [62]

13. Multiple Sclerosis (MS) is suspected or known and **ANY** of the following: (*__NOTE:__ *In the pediatric population, use a similar scan frequency for disease and therapeutic monitoring. Increase frequency of imaging (eg, every 6 months) in children with highly active disease or in situations where imaging will change management*).
    a. Dissemination in time (DIT) is demonstrated for diagnosis (every 6 to 12 months).
    b. MRI disease activity is **NOT** associated with new symptoms on routine follow-up scan; repeat scan in 6 months.
    c. Neurologic signs (eg, fatigue, numbness, tingling) are suspicious for MS and **EITHER** of the following:
        i. Clinically isolated syndrome (eg, brain stem syndrome, optic neuritis, transverse myelitis)
        ii. Neurological signs are recurrent, variable and **NOT** attributed to another etiology.
    d. New baseline establishment and **NO** recent imaging (within 12 months), postpartum **OR** 3 to 6 months after switching disease modifying therapy
    e. Progressive multifocal leukoencephalopathy (PML) surveillance when on natalizumab (Tsyabri®) and **ANY** of the following:
        i. Anti-John Cunningham (anti-JC) virus antibody negative; follow-up annually
        ii. High-risk individuals who switch from natalizumab to other therapeutics; follow-up every 3 to 4 months for up to 12 months.
        iii. PML occurrence (eg, anti-JC virus antibody index values [greater than 0.9], previously treated with immunosuppressive therapies, seropositive for JC virus and have been treated with natalizumab for at least 18 months) is high risk; follow-up every 3 to 4 months.
        iv. Treatment is started; follow-up in 12 months.
    f. Signs are new **AND** exacerbation is suspected.
    g. Subclinical disease activity assessment every 1 to 2 years while on disease modifying therapy (DMRT), less frequently when stable for 2 to 3 years.

    References: [66] [14] [5]

14. Neurodegenerative conditions for **ANY** of the following:
    a. Lecanemab-irmb (Leqembi) is prescribed (and authorized by the healthplan if appropriate) for Alzheimer's disease or cognitive impairment.
    b. Movement disorder (eg, facial palsy or spasm, focal/lateral movement disorder, Huntington's disease, Parkinson's disease) is suspected or known. (*__NOTE:__ *MRI*

*is **NOT** indicated for essential tremor, isolated focal dystonia or Tourette's Syndrome*).

c. Neurocognitive disorders (eg, Alzheimer's disease, cognitive impairment, dementia, diffuse Lewy body) evaluation with mental status score of **EITHER** the mini-mental state examination (MMSE) or Montreal cognitive assessment (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 work-up (such as thyroid function testing, liver function testing, complete blood count, electrolytes and B12).

d. Neurodegeneration with brain iron accumulation is suspected.

References: [25] [65] [35] [43]

15. Post-surgical assessments for evaluation of complications or disease recurrence

16. Seizure disorder and epilepsy is suspected or known and seizures are **ANY** of the following: (*__NOTE__: *Imaging is **NOT** indicated for idiopathic focal seizures, generalized epilepsy with typical features, simple febrile seizures*).

    a. Activity or pattern is changed

    b. Known and **NO** prior imaging

    c. Medically refractory

    d. Unprovoked and new onset

    e. Symptomatic with syncope **AND** neurological deficits (eg, altered mental status, dizziness, tremors)

    References: [34] [3] [61]

17. Stroke, transient ischemic attack (TIA) **OR** vascular disease is suspected or known and **ANY** of the following:

    a. Cavernous malformations or other low flow vascular malformations are suspected.

    b. Central venous thrombosis is suspected.

    c. Coagulopathy is known **OR** active anticoagulant use.

    d. Familial first-degree (child, parent, sibling) or personal history of brain aneurysm(s).

    e. Hemorrhage, hematoma or vascular abnormalities are known, for follow-up.

    f. Sensory or motor deficits are acute, new or fluctuating (limb weakness, speech difficulties, visual loss, lack of coordination, or mental status changes).

g. Sickle cell disease and **ANY** of the following:

i. Neurological signs (eg, headache, paresthesias, sensory changes) are present.

ii. Silent cerebral infarcts are suspected, age is 2 years old or more, with known Hemoglobin SS (HbSS) sickle cell disease or Hemoglobin S Beta (HbSß) thalassemia.

iii. Stroke risk is increased, in an individual aged 2 to 16 years, when transcranial doppler velocity is more than 200.

h. Subarachnoid hemorrhage is suspected and prior imaging (CT or CTA) is non-diagnostic or indeterminate.

i. Vertigo, **AND** cerebrovascular disease risk factors (eg, coronary artery disease, diabetes, hypertension) are known and stroke is suspected.

References: [46] [19] [33] [53] [13] [8] [55]

18. Symptom evaluation for **ANY** of the following:

a. Cyclical vomiting syndrome or abdominal migraine with neurological symptoms (eg, altered mental status, dizziness, tremors)

b. Mastication muscle weakness is unilateral.

c. Mental status change (eg, amnesia, confusion, inability to follow simple commands, loss of words)

d. Neurological exam with focal abnormality **NOT** evaluated by advanced imaging, or has progressed since prior advanced imaging.

e. Neurological deficits (eg, altered mental status, dizziness, tremors) are new or worsening.

f. Psychological changes (eg, abnormal behaviors, emotions or thoughts) are new or progressing.

g. Syncope **AND** neurological deficits (eg, altered mental status, dizziness, tremors) **OR** seizure is suspected.

References: [52] [38] [65] [46] [34] [57]

19. Trauma is suspected or known and **ANY** of the following:

a. Brain injury is subacute or chronic **AND** there are new cognitive/neurologic deficit(s).

b. Coagulopathy is known **OR** active anticoagulant use.

c. Post concussive syndrome evaluation, when **NO** prior imaging was done, **AND** symptoms are persistent and/or disabling.

d. Skull fracture is suspected or known, based on physical exam or prior imaging.

e. Symptoms are acute, new or fluctuating, CT is non-diagnostic or indeterminate and **ANY** of the following:

i. Amnesia

ii. Focal neurologic findings

iii. Headache

iv. Increased intracranial pressure signs (eg, headache, vertigo, vomiting)

v. Mental status change

vi. Motor changes

vii. Seizures

viii. Vomiting

References: [58] [54] [26]

20. Vertigo **AND** hearing loss/tinnitus is unilateral and progressive.
References: [65] [56] [51]

Functional Brain MRI Guideline

A functional magnetic resonance imaging (fMRI) of the brain, for mapping of a lesion in relation to the eloquent cortex (eg, language, motor, sensory or vision centers) is considered medically appropriate when the documentation demonstrates peri-procedural care for **ANY** of the following:

1. Post-procedural evaluation of eloquent cortex for therapeutic follow-up or other documented medical reason clearly explaining the medical necessity for follow-up
References: [28]

2. Pre-procedure planning for brain tumor radiation therapy, focal brain lesion (tumor or vascular malformation) surgery or epilepsy surgery
References: [28]

Combination CT and MRI for Metastases Evaluation Guideline

Combination CT/MRI studies (5 or less concurrent studies, with a CT or MRI appropriate for cancer location: abdomen, brain, cervical spine, chest, lumbar spine, neck, pelvis and/or thoracic spine) for **ANY** of the following situations:

1. Staging evaluation, for baseline pre-therapy

2. Surveillance following the National Comprehensive Cancer Network (NCCN) Guidelines recommended schedule (*See **Surveillance** section*)

Head and Neck Cancer Surveillance section

Bone Cancer Surveillance

Bone cancer surveillance includes **ANY** of the following:

1. Chondrosarcoma surveillance for **ANY** of the following:
    a. Atypical cartilaginous tumor surveillance with cross-sectional imaging (CT + contrast, MRI ± contrast) every 6 to 12 months for 2 years, then annually as clinically indicated
    b. Low-grade, extracompartmental appendicular tumor, grade I axial tumors or high-grade (grade II or III, clear cell or extracompartmental) tumors surveillance with **ALL** of the following:
        i. Chest CT at least every 6 months for 5 years, then annually for at least 10 years, then if symptoms are new or progressing.
        ii. MRI (± contrast) or CT (+ contrast) if symptoms are new or progressing.
2. Chordoma surveillance with **ALL** of the following:
    a. Chest CT imaging every 6 months, annually for 5 years, then annually thereafter, then if symptoms are new or worsening.
    b. Imaging of primary site, timing and modality (eg, MRI ± CT [both + contrast]) if symptoms are new or progressing, up to 10 years
3. Ewing Sarcoma after primary treatment completed surveillance with **ALL** of the following:
    a. Chest CT: every 3 months
    b. Primary site imaging with MRI ± CT (both + contrast), increase intervals after 24 months and after 5 years, annually, then if symptoms are new or progressing (indefinitely) (*__NOTE__: *PET/CT [head-to-toe] is appropriate*)
4. Giant cell tumor of the bone surveillance with **ALL** of the following:
    a. Chest CT or MRI imaging every 6 to 12 months for 4 years, then annually thereafter, then if symptoms are new or progressing
    b. Surgical site imaging if symptoms are new or progressing (eg, CT and/or MRI, both with contrast)

5. Osteosarcoma surveillance with primary site and chest imaging (using same imaging that was done for initial work-up) for **ANY** of the following: (*__NOTE__: *PET/CT [head-to-toe] is appropriate*.)
    a. Image every 3 months for years 1 and 2
    b. Image every 4 months for year 3
    c. Image every 6 months for years 4 and 5
    d. Image annually for year 6 and thereafter, then if symptoms are new or progressing

References: [2025 Bone Cancer Version 1.2026]

Central Nervous System (CNS) Cancer Surveillance

Central nervous system (CNS) cancer surveillance includes **ANY** of the following:

1. Brain metastasis, limited **OR** extensive, image with brain magnetic resonance imaging (MRI) every 2 to 3 months for 1 to 2 years, then every 4 to 6 months indefinitely
2. Glioblastoma, *IDH* wild-type, magnetic resonance imaging with (MRI) of the brain and **ANY** of the following:
    a. Pre-operative and post-operative; within 48 hours
    b. Pre-radiation planning; every 3 to 5 weeks, post-operatively
    c. Post-radiation; 3 to 6 weeks post-radiation, then every 2 to 3 months for 3 years, then every 2 to 4 months indefinitively
3. Glioma, imaging with MRI of the brain and **ANY** of the following:
    a. Astrocytoma, *IDH* mutated and **ANY** of the following:
        i. Grade 2 and **ANY** of the following:
            A. After radiation therapy (RT) **AND** chemotherapy: every 6 months until tumor progression
            B. After RT **OR** chemotherapy: every 3 to 4 months for the 1st 5 years, then every 3 to 4 months until tumor progression
            C. After surgery: every 3 to 4 months until tumor progression
        ii. Grade 3 and **ANY** of the following;
            A. After RT **AND** chemotherapy: every 6 months until tumor progression
            B. After RT **OR** chemotherapy: every 3 to 4 months for the 1st 5 years, then every 3 to 4 months until tumor progression

iii. Grade 2 or 3, recurrent; image every 2 to 3 months

b. Oligodendroglioma, *IDH* mutated, 1p/19q co-deleted and **ANY** of the following:

i. Grade 2 and **ANY** of the following:

A. After radiation therapy (RT) **AND** chemotherapy: every 6 to 9 months until tumor progression

B. After RT **OR** chemotherapy: every 3 to 4 months for the 1st 5 years, then every 3 to 4 months until tumor progression

C. After surgery: every 3 to 4 months until tumor progression (*__NOTE__: *For individuals who underwent gross total resection, every 6 to 9 months for 5 years post-surgery until tumor progression*)

ii. Grade 3 and **ANY** of the following:

A. After radiation therapy (RT) **AND** chemotherapy: every 6 to 9 months until tumor progression

B. After RT **OR** chemotherapy: every 3 to 4 months for the 1st 5 years, then every 3 to 4 months until tumor progression

iii. Grade 2 or 3, recurrent, image every 3 to 4 months

4. Leptomeningeal metastases imaging with MRI of the brain and/or total spine every 2 to 3 months for the 1st 2 years, every 6 months until year 5, then annually indefinitively
5. Medulloblastoma, imaging with MRI of the brain every 2 to 3 months for 2 years
6. Primary CNS lymphoma, image every 2 to 3 months for 2 years

References: [2025 Central Nervous System Cancers Version 1.2025]

Esophageal and Esophagogastric Junction Cancer Surveillance

Esophageal and esophagogastric junction cancer surveillance includes **ANY** of the following[2]:

1. Adenocarcinoma, squamous cell carcinoma; imaging studies if symptoms are new or progressing
2. Tumor classification T1b[a] (N0 on ultrasound) after endoscopic resection or ablation, imaging surveillance includes computed tomography (CT) chest and abdomen (+ contrast, unless **contraindicated**) every 6 months for the first 2 years and annually for up to 5 years

[2]Routine esophageal/esophagogastric junction cancers are **NOT** recommended for cancer-specific surveillance, for more than 5 years after the end of treatment.

3. Tumor classification T1b or greater, any N[a] or T1a N+, imaging surveillance includes esophagectomy performed with or **WITHOUT** adjuvant therapy then surveillance includes chest and abdomen CT (+ contrast, unless **contraindicated**) every 6 months for the first 2 years and annually for up to 5 years
4. Tumor classification any T and/or any N, with neoadjuvant chemotherapy **OR** chemoradiotherapy **AND** esophagectomy, with or **WITHOUT** adjuvant treatment, imaging surveillance includes chest and abdomen CT (+ contrast, unless **contraindicated**) every 6 months for up to 2 years, then annually for up to 5 years and EGD, then if symptoms are new or progressing
5. Tumor classification (pretreatment) N0 to N+, T1b to T4, T4b, with definitive chemoradiation (**WITHOUT** esophagectomy), surveillance imaging includes chest and abdomen CT (+ contrast unless **contraindicated**) every 3 to 6 months for the first 2 years and annually for up to 5 years

References: [2025 Esophageal and Esophagogastric Junction Cancers Version 3.2025]

Head and Neck Cancers Surveillance

Head and neck cancers surveillance for locoregionally advanced disease after treatment, includes **ANY** of the following:

1. Short-term surveillance (less than 6 months after treatment), if there is high-risk of early recurrence, symptoms of early recurrence or before starting adjuvant post-operative therapy:
    a. Computed tomography (CT) or magnetic resonance imaging (MRI) within 3 to 4 months post-operatively to establish a new baseline for future comparisons
    b. FDG positron emissions tomography/computed tomography (FDG PET/CT) within 3 to 6 months of definitive radiation or systemic therapy/RT.
    c. Incomplete response is suspected: CT or MRI scan earlier (eg, 4 to 8 weeks) based on new or progressing symptoms. (*__NOTE__: *Use ultrasound [US] of the neck for targeted sampling.*)
2. Long-term surveillance (6 months or more from end-of-treatment, up to 5 years after treatment) with CT, MRI, FDG PET/CT to obtain surveillance for lesions that are recurrent, second primary or at distant sites.[3]

References: [2025 Head and Neck Cancer Version 2.2025]

[3]Per the National comprehensive cancer network (NCCN) Guidelines for Head and Neck Cancers, there are no consensus guidelines for the surveillance imaging type, frequency or duration for locoregionally advanced disease. If an FDG PET/CT at 3 months post-treatment is negative, there are no data to support substantial benefit for further routine imaging when asymptomatic with negative exam. In the absence of multi-institutional prospective data, a tailored approach to

Histiocytic Neoplasms Surveillance

NCCN Histiocytic Neoplasms Version 3.2024

Histiocytic neoplasms surveillance imaging includes **ANY** of the following:

1. Erdheim-Chester disease surveillance imaging includes **ANY** of the following:
    a. Fluorodoxyglucose (FDG)-positron emission tomography/computed tomography (PET/CT) every 3 to 6 months after starting therapy until stabilization of the disease, and as clinically indicated after 2 years.
    b. Organ specific imaging with CT (+ contrast) or MRI (± contrast) every 3 to 6 months until disease stabilization and then every 6 to 12 months
2. Langerhans cell histiocytosis surveillance imaging includes FDG-PET/CT , FDG-PET or CT/ magnetic resonance imaging (MRI) every 3 to 6 months for the first 2 years after completion of therapy, then **NO** more than annually (*__NOTE__: *For individuals who are asymptomatic with a single-site bone lesion, imaging surveillance can end after 1 year, with continued tracking of symptoms*)
3. Rosai-Dorfman disease (RDD), surveillance imaging includes **ANY** of the following: (*__NOTE__: *for individuals who are asymptomatic with a single-site bone lesion, imaging surveillance can end after 1 year, with continued tracking of symptoms*)
    a. FDG-PET/CT every 3 to 6 months after starting therapy until stabilization of disease
    b. Organ specific imaging with CT (+ contrast) or MRI (± contrast) every 3 to 6 months until disease stabilization and then every 6 to 12 months

References: [2025 Histiocytic Neoplasms Version 3.2025]

Melanoma: Uveal Surveillance

Uveal melanoma surveillance imaging includes **ANY** of the following:

1. Low risk disease surveillance imaging every 12 months for 5 years or clinically as indicated, includes **ANY** of the following:
    a. Chest/abdomen/pelvis computed tomography (CT) (+ contrast)
    b. Magnetic resonance (MR) (+ contrast) or ultrasound of liver
2. Medium risk disease surveillance imaging every 6 to 12 months for 10 years, then as clinically indicated, includes **ANY** of the following:
    a. Chest/abdomen/pelvis CT (+ contrast)

surveillance with attention to tumor type, stage, prognostic factors, symptomatology and physical exam changes or restrictions is recommended.

b. MR (+ contrast) or ultrasound of liver

3. High risk disease surveillance imaging every 3 to 6 months for 5 years, then every 6 to 12 months for 10 years, then clinically as indicated, includes **ANY** of the following:
   a. Chest/abdomen/pelvis CT (+ contrast)
   b. MR (+ contrast) or ultrasound of liver

References: [2025 Melanoma: Uveal Version 1.2025]

Pediatric Central Nervous System Cancers

Pediatric central nervous system cancer surveillance includes **ANY** of the following:

1. Medulloblastoma and **ANY** of the following:
   a. Risk is low or average (after completion of adjuvant/maintenance treatment) and **ALL** of the following:
      i. Brain magnetic resonance imaging (MRI) every 3 to 4 months for 2 years, then every 6 months for 3 years, then if symptoms are new or progressing.
      ii. Spine MRI (cervical, lumbar **AND** thoracic) every 6 months for 2 years, then if symptoms are new or progressing.
   b. Risk is high or very high (after completion of adjuvant/maintenance treatment) and **ANY** of the following:
      i. Brain MRI every 3 to 4 months for 2 years, then every 6 months for 3 years, then if symptoms are new or progressing.
      ii. Spine MRI (cervical, lumbar **AND** thoracic) every 3 to 4 month for 2 years, then annually for 3 years, then if symptoms are new or progressing.
2. Pediatric diffuse high-grade glioma, image with brain MRI 2 to 6 weeks after radiation therapy, then every 2 to 3 months for year 1, then every 3 to 6 months indefinitely

References: [2025 Pediatric Central Nervous System Cancers Version 3.2025]

Soft Tissue Sarcoma Surveillance

Soft tissue sarcoma surveillance includes **ANY** of the following: (*__NOTE__: *Use contrast imaging; for long term surveillance to minimize radiation exposure,MRI may be substituted.*)

1. Desmoid tumor (aggressive fibromatosis) imaging surveillance includes computed tomography (CT) or magnetic resonance imaging (MRI) every 3 to 6 months for 3 years, then every 6 to 12 months thereafter
2. Extremity, trunk or head and neck, for long-term follow-up with **ANY** of the following:

a. Long-term follow-up with **ALL** of the following:
    i. Chest CT imaging (- contrast) to detect asymptomatic distant recurrence
    ii. MRI for imaging of primary site
b. Stage I tumors and **ALL** of the following:
    i. Chest CT imaging (- contrast) every 6 to 12 months
    ii. Post-operative baseline and periodic imaging of primary site with MRI or CT if MRI is **contraindicated or unavailable**.
c. Stage II and III tumors and **ANY** of the following:
    i. Baseline and periodic imaging of primary site
    ii. Chest and other known sites of metastatic disease imaging (CT [- contrast] or X-ray) every 2 to 6 months for 2 to 3 years, then every 6 months to complete a total of 5 years, then annually.
    iii. Post-operative reimaging to assess the primary tumor site and rule out metastatic disease (MRI or CT if MRI is **contraindicated or unavailable**.

3. Retroperitoneal/intra-abdominal, after management of primary disease imaging surveillance includes chest/abdomen/pelvis CT or MRI every 3 to 6 months for 3 years, then every 6 months for the next 2 years, then annually.

References: [2025 Soft Tissue Sarcoma Version 1.2025]

Thymomas and Thymic Carcinomas Surveillance

Thymomas and thymic carcinomas surveillance after primary treatment includes **ANY** of the following:

1. R0 resection surveillance imaging with chest computed tomography (CT) (+ contrast) or magnetic resonance imaging (MRI) for **ANY** of the following:
    a. Thymic carcinoma every 6 to 12 months for 2 years, then annually until year 5
    b. Thymoma every 6 months for 2 years, then annually until year 10
2. R1 and R2 resection surveillance imaging with chest CT (+ contrast) or MRI for **ANY** of the following:
    a. Thymic carcinoma every 3 to 6 months for 2 years, then annually for 5 years
    b. Thymoma every 6 months for 2 years, then annually for 10 years
3. Locally advanced disease surveillance imaging with chest CT (+ contrast) or MRI for **ANY** of the following:

a. Thymic carcinoma every 3 to 6 months for 2 years, then annually for 5 years

b. Thymoma every 6 months for 2 years, then annually for 10 years

References: [2025 Thymomas and Thymic Carcinomas Version 2.2025]

Thyroid Carcinoma Surveillance

Thyroid carcinoma surveillance imaging includes **ANY** of the following:

1. Anaplastic carcinoma (stage IVC surveillance imaging includes computed tomography (CT) or magnetic resonance imaging (MRI) (+ contrast) of brain, neck, chest, abdomen and pelvis at frequent intervals as clinically indicated (*__NOTE__: *consider fluorodeoxyglucose-positron emission tomography (FDG-PET)/CT 3 to 6 months after initial therapy*)
2. Medullary carcinoma surveillance imaging includes **ANY** of the following:
    a. MRI of whole body, if calcitonin levels are very elevated 150 pg/ml or more.
    b. Calcitonin level is 150 pg/ml or more: surveillance with CT or MRI (+ contrast) of the neck, chest, and liver, as clinically indicated
    c. FDG-PET/CT or Ga-68 DOTATE or MRI (+ contrast) of the neck, chest, abdomen with liver protocol, based on calcitonin/carcinoembryonic antigen (CEA) doubling time

References: [2025 Thyroid Carcinoma Version 1.2025]

MRI Brain Summary of Changes

MRI Brain guideline had the following version changes from 2024 to 2025:

- Added the following to keep in line with current evidence:
    - Criteria under "Cerebral spinal fluid" for clarity
    - Criteria under "Congenital abnormalities" for clarity
    - Criteria under "Infectious or inflammatory disease is suspected or known" for clarity
    - "Lecanemab-irmb (Leqembi) is prescribed (and authorized by the health plan if appropriate) for Alzheimer's disease or cognitive impairment" under "Neurodegenerative disorders" new indication per EBM
    - "Skull fracture is suspected or known, based on physical exam or prior imaging." under "Trauma" for clarity
- Removed the following as current evidence no longer supports the indication:
    - "Adulhelm" indication as the medication was discontinued in 2024

- Combination studies as they are redundant
- "Cranial neuropathy, multiple" as it is redundant
- "Vocal cord lesions or vocal cord paralysis evaluation" per lack of EBM

MRI Brain Procedure Codes

Table 1. MRI Brain Associated Procedure Codes

CODE	DESCRIPTION
70551	Magnetic resonance (eg, proton) imaging, brain (including brain stem); without contrast material
70552	Magnetic resonance (eg, proton) imaging, brain (including brain stem); with contrast material(s)
70553	Magnetic resonance (eg, proton) imaging, brain (including brain stem); without contrast material, followed by contrast material(s) and further sequences
70554	Magnetic resonance imaging, brain, functional MRI; including test selection and administration of repetitive body part movement and/or visual stimulation, not requiring physician or psychologist administration
70555	Magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing
0866T	Quantitative magnetic resonance image (MRI) analysis of the brain with comparison to prior magnetic resonance (MR) study(ies), including lesion detection, characterization, and quantification, with brain volume(s) quantification and/or severity score, when performed, data preparation and transmission, interpretation and report, obtained with diagnostic MRI examination of the brain

MRI Brain Definitions

Abscess is a swollen area within body tissue, containing an accumulation of pus.
Achondroplasia is a rare autosomal dominant condition characterized by impaired endochondral ossification, resulting in disproportionate short stature and abnormal growth of long bones, vertebrae, and several bones in the skull.
Acoustic neuromas (vestibular schwannomas) are noncancerous, usually slow growing tumors that form along the branches of the eighth cranial nerve (also called the vestibulocochlear nerve). This nerve leads from the brain to the inner ear and branches into divisions that play important roles in both hearing and balance.
Acromegaly is a disorder caused by excessive production of growth hormone by the pituitary gland and marked especially by progressive enlargement of hands, feet and face.
Acute refers to initial diagnosis, up to 4 weeks.
Adenoma describes a benign tumor or a glandular structure or of glandular origin.
Alzheimer's disease is a degenerative brain disease of unknown cause that is the most common form of dementia. It usually starts in late middle age or in old age and results in progressive memory loss, impaired thinking, disorientation and changes in personality and mood.

Amnesia is defined as a significant loss of memory function, which can be categorized into various types such as anterograde amnesia (inability to form new memories) and retrograde amnesia (inability to recall past memories).
Amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease, is a fatal neurodegenerative disease that affects the nerve cells in the brain and spinal cord that control voluntary muscle movement and breathing.
Aneurysm refers to weakness in an artery wall, allowing it to abnormally balloon out or widen.
Anhidrosis is defined as the absence or significant reduction of sweating, which can result from various central or peripheral autonomic disorders, drug side effects, or other conditions affecting sweat gland function.
Anosmia is the loss or impairment of the sense of smell.
Anterior fontanelle is the largest and most easily palpated fontanelle located at the junction of the frontal and parietal bones, typically soft, flat, and pulsatile, and usually closes between 5 and 24 months of age.
Anti-John Cunningham (anti-JC) virus antibodies are a predictive factor for progressive multifocal leukoencephalopathy (PML) in multiple sclerosis (MS) patients treated with natalizumab. A positive result for anti-JCV antibodies indicates an increased risk of developing PML.
Apoplexy is defined as the abrupt and sometimes catastrophic hemorrhagic infarction occurring in the pituitary gland.
Arachnoid cysts is a benign, cerebrospinal fluid-filled cavity within the arachnoid membrane, often found incidentally and typically asymptomatic.
Arteriovenous fistula (AVF) is an abnormal connection between an artery and a vein. It happens when one or more arteries are directly connected to one or more veins or venous spaces called sinuses.
Arteriovenous malformation (AVM) are congenital high-flow vascular malformations characterized by abnormal shunting of blood from high-flow feeding arteries to low-resistance veins via a cluster of aberrant blood vessels termed a central nidus, bypassing the normal capillary bed.
Astrocytomas are tumors that originate from the star-shaped cells (astrocytes) that support the brain. They are the most common brain tumors in adults.
Ataxia is a pathological abnormality of organization or modulation of movement, typically caused by cerebellar dysfunction, but can also result from lesions in the corticospinal tract or dorsal columns of the spinal cord.
Atrophy is a decrease in size or wasting away of a body part or tissue.
Audiogram/Audiometric testing is a graphic representation of the relation of vibration frequency and the minimum sound intensity for hearing.
Aura is a subjective sensation (as of voices or colored lights or crawling and numbness) experienced at the onset of a neurological condition and especially a migraine or epileptic seizure.

Bell's palsy an acute, idiopathic, self-limited, typically monophasic paralysis of the face caused by dysfunction of the facial nerve (cranial nerve VII) with no detectable cause.

Beta-2 transferrin test is a laboratory assay used to detect cerebrospinal fluid (CSF) in cases of suspected CSF rhinorrhea or otorrhea.

Binocular diplopia is double vision that occurs when both eyes are open and disappears when one eye is closed. It's typically caused by a misalignment of the eyes, often due to problems with the eye muscles or nerves that control them.

Brief Resolved Unexplained Event (BRUE) is an event in an infant that is characterised by a marked change in breathing, tone, colour or level of responsiveness, followed by a complete return to a baseline state, and that cannot be explained by a medical cause. A BRUE is a diagnosis of exclusion.

Bulbar palsy involves problems with function of the glossopharyngeal nerve (CN IX), the vagus nerve (CN X), the accessory nerve (CN XI), and the hypoglossal nerve (CN XII). These all emerge from pathways in the medulla oblongata. A lower motor neuron lesion can impair their function. It includes symptoms such as lip trembling, drooling, dysphonia, weak jaw and facial muscles, pharyngeal muscle weakness.

Cavernous malformations are low-flow vascular lesions of the central nervous system characterized by clusters of dilated capillaries without intervening brain parenchyma, prone to symptomatic hemorrhage and often associated with seizures and focal neurologic deficits.

Central diabetes insipidus (CDI) is defined as a disorder characterized by the inability of the hypothalamus-posterior pituitary to synthesize and secrete vasopressin (AVP) in response to increased plasma osmolality, leading to excessive excretion of large volumes of dilute urine and increased thirst.

Central hyperthyroidism is a rare condition where excess thyroid hormone production is caused by the pituitary gland, not the thyroid gland itself. It's characterized by elevated thyroid hormones (T3 and T4) and normal or even elevated levels of TSH (thyroid-stimulating hormone).

Central sleep apnea (CSA) is a breathing disorder that causes your body to decrease or stop the effort of breathing during sleep. It is usually caused by an issue in the brain or heart. Certain medications (like pain medications) can cause this breathing pattern too. It is different from obstructive sleep apnea (OSA) because the problem is not caused by a blockage of the airway. Types of central sleep apnea include Cheyne-Stokes breathing, drug-induced apnea, high-altitude periodic breathing, idiopathic central sleep apnea, medical condition-induced central sleep apnea and treatment-emergent central sleep apnea. Symptoms of central sleep apnea include difficulty falling asleep, excessive daytime sleepiness (EDS), frequent nighttime awakening, pause in breathing, snoring, and waking up short of breath.

Central venous thrombosis, specifically cerebral venous sinus thrombosis (CVST), is a rare condition where a blood clot forms in one of the brain's veins, usually in the venous sinuses. It can cause a range of symptoms, including headaches, seizures and neurological deficits.

Cerebral Palsy (CP) is a term for a group of neurological disorders that affect a person's ability to move, maintain balance, and posture. CP is the most common motor disability in childhood.
Cerebritis is an acute inflammatory response in the brain that affects the permeability of blood vessels. It's the earliest stage of a brain infection, and can progress to an abscess.
Cerebrospinal fluid (CSF) is a colorless liquid that is comparable to serum, is secreted from the blood into the lateral ventricles of the brain, and serves chiefly to maintain uniform pressure within the brain and spinal cord.
Cerebrospinal fluid (CSF) leak is a leak of cerebrospinal fluid that results from a hole or tear in the dura (the outermost layer of the meninges).
Cervicomedullary junction (CMJ) is the anatomical point where the medulla oblongata (the lower part of the brainstem) transitions into the cervical spinal cord. This region marks the beginning of the spinal cord and is located at the base of the skull and the top of the neck. It's a critical area, housing vital structures and susceptible to injury or abnormalities.
Chiari malformation (Arnold-Chiari syndrome) is a congenital abnormality in which the lower surface of the cerebellum and the lower brain stem protrude into the spinal canal through the foramen magnum.
Cholesteatoma is a benign but locally destructive cystic mass of keratinizing squamous epithelium that can erode bone structures in the middle ear and mastoid.
Chronic refers to 3 months or more.
Cluster headache are attacks of severe, unilateral pain in the orbital, supraorbital, or temporal regions, lasting 15 to 180 minutes, and occurring from once every other day to eight times a day, often accompanied by ipsilateral autonomic symptoms and restlessness or agitation.
Coagulopathy is an imbalance between the clotting and fibrinolytic systems, which can be hereditary or acquired in origin, often resulting in abnormal bleeding or clotting.
Computed tomography (CT) is an imaging test that uses X-rays to computer analysis to generate cross sectional images of the internal structures of the body that can be displayed in multiple planes.
Congenital is a condition or trait present from birth.
Cranial nerve palsy is a dysfunction or paralysis of one or more of the twelve cranial nerves, which can result in various neurological deficits depending on the affected nerve.
Craniosynostosis is the premature fusion of one or more cranial sutures, leading to abnormal skull shape and potential complications such as increased intracranial pressure and neurodevelopmental issues.
Cushing disease occurs when your body makes too much cortisol, a hormone related to the body's stress response. It's a rare pituitary disorder that is progressive.
Cyclical vomiting syndrome (CVS) is a rare disorder that usually starts in childhood. It causes repeated episodes of being sick (vomiting) and feeling sick (nausea). The cause of CVS is not fully understood. The vomiting episodes are not caused by an infection or another illness.

Cyst is a closed sac having a distinct membrane and developing abnormally in a cavity or structure of the body.
Dementia is a usually progressive condition marked by the development of multiple cognitive deficits, such as memory impairment, aphasia and the inability to plan and initiate complex behavior.
Dermoid cysts is a benign, congenital lesion composed of ectodermal and mesodermal elements, often containing hair, sebaceous glands, and other skin appendages.
Diplopia is a disorder of vision in which two images of a single object are seen (as from unequal action of the eye muscles).
Dissection refers to the separation of the layers within the wall of an artery, most commonly the aorta, due to a tear in the intimal layer, leading to the formation of a false lumen.
Dissemination in space can be established with at least one T2 lesion in at least two of four locations characteristic for MS (juxtacortical, periventricular, infratentorial and spinal cord).
Dissemination in time (DIT) means that there is Multiple Sclerosis-like neurological damage that is occurring at multiple points in time.
Dural venous sinuses are valveless channels formed by the separation of the periosteal and meningeal layers of the dura mater, responsible for draining venous blood from the brain and cerebrospinal fluid (CSF) into the internal jugular veins.
Dysarthria is a motor speech disorder characterized by slow, weak, imprecise, and/or uncoordinated movements of the oral musculature, resulting in reduced intelligibility of speech.
Dysphagia is difficulty with swallowing or the sensation of food getting stuck in the esophagus.
Dysphonia is difficulty in speaking due to a physical disorder of the mouth, tongue, throat or vocal cords
Dysosmia is a qualitative olfactory dysfunction characterized by altered perception of odors, including parosmia (distorted perception of odors) and phantosmia (false perception of odors without an odor source).
Dystonia is a movement disorder that causes the muscles to contract involuntarily. This can cause repetitive or twisting movements. The condition can affect one part of your body (focal dystonia), two or more adjacent parts (segmental dystonia), or all parts of your body (general dystonia).
Electronystagmography is a diagnostic test that measures eye movements using electrodes placed near the eyes to assess the vestibular and oculomotor systems and help localize lesions.
Embolism is an obstruction of an artery, typically by a clot of blood or an air bubble, that has traveled from another part of the body.
Encephalitis is an inflammation of the brain parenchyma, often caused by viral or autoimmune processes, and can lead to severe neurological dysfunction, including seizures, focal deficits, and encephalopathy.
Endocarditis is inflammation of the inside lining of the heart chambers and heart valves (endocardium). It is caused by a bacterial or rarely, a fungal infection.

Epilepsy is a chronic neurological disorder characterized by recurrent unprovoked seizures due to abnormal excessive or synchronous neuronal activity in the brain.

Erdheim-Chester Disease (ECD) is a rare blood disorder that causes the body to produce too many white blood cells. These cells, called histiocytes, are large phagocytic cells that normally respond to injury and infection. ECD is characterized by the accumulation of histiocytes in multiple tissues and organs.

Essential tremor (also known as benign essential tremor and familial tremor) is a common movement disorder that involves a tremor (unwanted and uncontrolled shaking) in both hands and arms during action and when standing still.

Fistula-in-ano, also known as an anal fistula, is a tunnel that connects the anal canal to the skin around the anus. It's an abnormal passageway that usually develops in the upper part of the anus.

Functioning adenoma refers to a benign tumor, typically found in the pituitary gland or adrenal gland, that produces and releases excessive amounts of hormones.

Glioma are primary central nervous system (CNS) tumors that originate from glial cells or neural stem/progenitor cells and are classified into various types and grades based on histological and molecular characteristics.

Global developmental delay (GDD) is term used for children under 5 years of age. It is defined as a significant delay in two or more domains of development, including activities of daily living as well as motor, cognitive, speech/language and personal/social skills.

Glomus tumor is defined as the volume of plasma filtered by the kidneys per unit of time, typically measured in milliliters per minute and normalized to body surface area (mL/min/1.73 m^2).

Head Thrust Test also known as the head impulse test, is a clinical maneuver used to assess the function of the vestibulo-ocular reflex (VOR) and diagnose vestibular disorders such as vestibular neuritis and labyrinthitis.

Hematoma is a mass of usually clotted blood that forms in a tissue, organ or body space as a result of a broken blood vessel.

Hemicrania continua is a rare primary headache disorder characterized by continuous unilateral pain with periods of exacerbation, often accompanied by ipsilateral cranial autonomic symptoms and a complete response to indomethacin.

Hemifacial spasm is a neurological disorder characterized by involuntary, irregular contractions of the muscles innervated by one facial nerve, typically caused by mechanical compression of the facial nerve after it has left the brainstem.

Hemoglobin SS (HbSS) sickle cell disease also known as sickle cell anemia, is a genetic disorder that occurs when a person inherits two genes for hemoglobin S (HbS) from their parents. HbS is an abnormal form of hemoglobin that causes red blood cells to become rigid and sickle-shaped. This can lead to chronic anemia, as sickle cells only live for about 10 to 20 days,

compared to up to 120 days for normal red blood cells. The sickle cells can also get stuck in the spleen's blood filter and die, damaging the spleen in the process.

Hemorrhage is a copious or heavy discharge of blood from the blood vessels.

Head impulse nystagmus test of skew (HINTS) exam is a cluster of three bedside clinical tests that aim to assess individuals presenting with acute-onset dizziness, vertigo, nystagmus, head motion intolerance and nausea/vomiting, also known as acute vestibular syndrome (AVS).

Histiocytic neoplasms is a type of cancer that arises from histiocytes, which are cells derived from the mononuclear phagocyte system, including macrophages, dendritic cells, and monocytes.

Horner's syndrome is a syndrome marked by sinking in of the eyeball, constriction of the pupil (miosis), drooping of the upper eyelid (ptosis), face vasodilation and anhidrosis (abnormal deficiency or absence of sweating) caused by paralysis of the cervical sympathetic nerve fibers on the affected side.

Huntington's disease is a hereditary brain disorder that is a progressive, neurodegenerative condition marked especially by impairments in thinking and reasoning, disturbances of emotion and behavior and the involuntary spasmodic movements of chorea that is associated with the loss or atrophy of nerve cells in the basal ganglia especially of the caudate nucleus and putamen.

Hydrocephalus is an abnormal increase in the amount of cerebrospinal fluid within the cranial cavity (as from obstructed flow, excess production, or defective absorption) that is accompanied by expansion of the cerebral ventricles and often increased intracranial pressure, skull enlargement and cognitive decline.

Hypogonadotropic hypogonadism is a condition where the body doesn't produce enough gonadotropins (hormones that stimulate the ovaries or testes), leading to decreased production of sex hormones like testosterone (in males) or estrogen (in females).

Immunosuppression is the deliberate reduction or inhibition of the immune system's ability to respond to antigens, typically achieved through medications or therapies, to prevent organ rejection or treat autoimmune diseases, but it increases the risk of infections and malignancies.

Increased intracranial pressure (ICP) is defined as a persistent elevation of intracranial pressure above 20 mm Hg or a cerebrospinal fluid opening pressure greater than 25 cm H2O.

Ischemic stroke occurs when the blood supply to part of the brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. Brain cells begin to die in minutes.

Langerhans cell histiocytosis (LCH) is a rare clonal proliferative disorder of Langerhans-type dendritic cells, characterized by granulomatous lesions and varying degrees of organ involvement and dysfunction.

Leptomeningeal carcinomatosis is a severe complication of late-stage cancer characterized by the spread of malignant cells to the leptomeninges, including the pia mater, arachnoid, and subarachnoid space, leading to rapid mortality despite treatment.

Leukoria occurs when light reflected in the pupil appears white, gray, yellow or silvery instead of red. This is different from the normal red reflex that occurs when light bounces off the retina at the back of the eye.

Lewy body dementia (LBD) is a disease associated with abnormal deposits of a protein called alpha-synuclein in the brain. These deposits, called Lewy bodies, affect chemicals in the brain whose changes, in turn, can lead to problems with thinking, movement, behavior and mood.
Liver function tests (LFT) are blood tests that measure different enzymes, proteins and other substances (eg, alanine transaminase [ALT], aspartate transaminase [AST], serum bilirubin) made by the liver.
Macroadenoma is a pituitary adenoma that measures 1 cm or greater in maximal diameter.
Macrocephaly is the condition in which the head circumference of an infant is above 2 standard deviations, which is above the 97th percentile.
Magnetic resonance angiogram (MRA) is a test that uses a magnetic field and pulses of radio wave energy to provide images of blood vessels inside the body, allowing for evaluation of blood flow and blood vessel wall condition. MRA is used to look for aneurysms, clots, tears in the aorta, arteriovenous malformations and stenosis caused by plaque in the carotid arteries (neck) or blood vessels leading to the lungs, kidneys or legs.
Magnetic resonance imaging (MRI) is a non-invasive diagnostic technique that produces computerized images of internal body tissues and is based on nuclear magnetic resonance of atoms within the body induced by the application of radio waves.
Meningioma is a slow-growing, encapsulated, typically benign tumor arising from the meninges and often causes damage by pressing upon the brain and adjacent parts.
Meningitis is an inflammation (swelling) of the protective membranes covering the brain and spinal cord. A bacterial or viral infection of the fluid surrounding the brain and spinal cord usually causes the swelling.
Metastases is the spread of a disease-producing agency (such as cancer cells) from the initial or primary site of disease to another part of the body.
Microadenoma is a very small, noncancerous tumor (less than 10 mm) that typically develops in the pituitary gland.
Microcephaly is a condition of abnormal smallness of the circumference of the head that is present at birth or develops within the first few years of life and is often associated with developmental delays, impaired cognitive development, poor coordination and balance, deficits in hearing and vision and seizures.
Migraine (typical) is a headache that can cause severe throbbing pain or a pulsing sensation, usually on one side of the head. It's often accompanied by nausea, vomiting and extreme sensitivity to light and sound.
Mini-Mental State Examination is a set of 11 questions that doctors and other healthcare professionals commonly use to check for cognitive impairment (problems with thinking, communication, understanding and memory).
Miosis is the excessive constriction of the pupil of the eye.

Montreal Cognitive Assessment (MoCA) is a brief test of cognitive function, taking 10 minutes to administer. It assesses short-term memory, visuospatial function, executive function, attention, concentration and working memory, language and orientation.

Multiple sclerosis (MS) is a demyelinating disease marked by patches of hardened tissue in the brain or the spinal cord and associated especially with partial or complete paralysis and jerking muscle tremor.

Natalizumab is a prescription medicine used to treat relapsing forms of multiple sclerosis (MS).

Neuralgia is acute paroxysmal pain radiating along the course of one or more nerves usually without demonstrable changes in the nerve structure

Neurocutaneous disorders are disorders that affect the brain, spinal cord, organs, skin and bones. The diseases are lifelong conditions that can cause tumors to grow in these areas.

Neurofibromatosis is a rare genetic disorder that causes benign tumors to grow on nerves and other parts of the body. There are three types of neurofibromatosis: neurofibromatosis 1 (NF1), neurofibromatosis 2 (NF2) and schwannomatosis.

Neuromyelitis optica spectrum disorder (NMOSD) is an inflammatory disorder of the central nervous system characterized by severe, immune-mediated demyelination and axonal damage predominantly targeting optic nerves and the spinal cord.

Neuropathy is damage, disease or dysfunction of one or more nerves, especially of the peripheral nervous system, that is typically marked by burning or shooting pain, numbness, tingling, muscle weakness or atrophy It is often degenerative and is usually caused by injury, infection, disease, drugs, toxins or vitamin deficiency.

Neurosarcoidosis is a condition where the chronic inflammatory disease sarcoidosis affects the nervous system, specifically the brain, spinal cord and optic nerve. It's characterized by inflammation and can damage the myelin sheath, disrupting nerve signals.

Nystagmus is a visual condition in which the eyes make repetitive, uncontrolled movements. These movements often result in reduced vision and depth perception and can affect balance and coordination; and can occur from side to side, up and down, or in a circular pattern.

Occipital neuralgia is a type of chronic headache where pain stems from the occipital region and spreads through the occipital nerves. These nerves run from the top of the spinal cord to the scalp.

Optic atrophy is a condition where the optic nerve, which carries visual information from the eye to the brain, is damaged or degenerated. This damage can lead to vision loss, which may range from mild visual changes to severe vision impairment.

Optic chiasm is the part of the brain where the optic nerves from each eye meet. It's located at the base of the brain, below the hypothalamus, and above the pituitary gland. The optic chiasm is X-shaped.

Optic neuritis is inflammation of the optic nerve.

Orthostatic headache is a headache while upright, that is relieved by lying down.

Otorrhea is drainage of liquid from the ear.

Papilledema is swelling of the optic nerve head due to increased intracranial pressure (ICP), which can lead to vision loss if not treated promptly.
Paresthesia is a sensation of pricking, tingling, or creeping on the skin that has no objective cause.
Parkinson's disease is a chronic progressive neurological disease chiefly of later life that is linked to decreased dopamine production in the substantia nigra and is marked especially by tremor of resting muscles, rigidity, slowness of movement, impaired balance and a shuffling gait.
Paroxysmal hemicrania is a rare form of headache that brings on severe throbbing and claw-like pain usually on one side of the face near the eye and occasionally around the back of the neck. The pain may be accompanied by red and tearing eyes.
Pediatric approximate ages are defined by the US Department of Health (USDH), the Food and Drug Administration (FDA), and the American Academy of Pediatrics (AAP) as the following:

1. Infancy, between birth and 2 years of age
2. Childhood, from 2 to 12 years of age
3. Adolescence, from 12 to 21 years of age, further defined by the AAP into:
    a. Early (ages 11–14 years)
    b. Middle (ages 15–17 years),
    c. Late (ages 18–21 years)
    d. Older ages may be appropriate for children with special healthcare needs.

Pineal cyst is a benign, fluid-filled sac in the brain that's usually asymptomatic.
Polyangiitis is the inflammation of multiple types of vessels, such as small arteries and veins.
Polysomnogram (PSG) is a sleep study that records physiological variables while you sleep. The test is used to diagnose sleep disorders.
Pontine angle tumor, also known as a cerebellopontine angle (CPA) tumor, is a tumor that develops in the cerebellopontine angle. The cerebellopontine angle is the area between the lower brain and the brain stem, and the part of the brain that connects to the spinal cord.
Post-concussive syndrome (PCS) occurs when symptoms of a mild traumatic brain injury last longer than expected after an injury. These symptoms may include headaches, dizziness and problems with concentration and memory. They can last weeks to months.
Progressive multifocal leukoencephalopathy (PML) is a disease of the white matter of the brain, caused by a virus infection (polyomavirus JC) that targets cells that make myelin—the material that insulates nerve cells (neurons).
Prolactin (also known as lactotropin and PRL) is a hormone that's responsible for lactation, certain breast tissue development and contributes to hundreds of other bodily processes. Prolactin levels are normally low in people assigned male at birth (AMAB) and non-lactating and non-pregnant people.

Pseudobulbar affect (PBA) is a condition that's characterized by episodes of sudden uncontrollable and inappropriate laughing or crying. Pseudobulbar affect typically occurs in people with certain neurological conditions or injuries, which might affect the way the brain controls emotion.
Ptosis is the drooping of the upper eyelid.
Puerperium is the period of about six weeks after childbirth during which the mother's reproductive organs return to their original non-pregnant condition.
Pulsatile tinnitus is a rhythmic pulsing noise in one or both ears that occurs in the absence of external sound and tends to be synced with the heartbeat.
Rathke cleft cyst is a benign, fluid-filled sac located in the sella turcica, the bony cavity that houses the pituitary gland. It's thought to arise from remnants of the Rathke's pouch, a structure involved in the development of the pituitary gland during fetal development.
Recurrence is a new occurrence of something that happened or appeared before.
Refractory is resistance to treatment or cure.
Rhinorrhea is excessive mucous drainage from the nose.
Rhinosinusitis is inflammation of the mucous membranes of the nose and one or more paranasal sinuses that includes the following symptoms: mucopurulent discharge, nasal obstruction, congestion, facial pain, pressure, fullness and/or decreased sense of smell.
Rosai-Dorfman disease is an uncommon histiocytic disorder most frequently presenting as bilateral cervical lymphadenopathy in children and young adults.
Sarcoidosis is a chronic disease of unknown cause, that is characterized by the formation of nodules, especially in the lymph nodes, lungs, bones and skin.
Schwannomas are noncancerous, usually slow growing tumors that form along the branches of the eighth cranial nerve (also called the vestibulocochlear nerve). This nerve leads from the brain to the inner ear and branches into divisions that play important roles in both hearing and balance.
Screening is the systematic application of a test or inquiry to identify individuals at sufficient risk of a specific disorder to warrant further investigation or direct preventive action, among persons who have not sought medical attention for symptoms of that disorder.
Seizure is a sudden, uncontrolled electrical disturbance in the brain. It can cause changes in behavior, movements or feelings and in levels of consciousness.
Sensorineural hearing loss is a type of hearing loss that occurs due to damage to the inner ear (cochlea) or the auditory nerve that carries sound signals to the brain.
Sentinel headache is headache characterized by sudden, severe head pain, often described as "the worst headache of my life." It is sometimes called a "thunderclap" headache. The pain usually peaks within five minutes, persists for at least one hour and may be accompanied by nausea or vomiting.
Short-lasting unilateral neuralgiform headache is a rare primary headache disorder that comes with infrequent attacks that last seconds. The pain can be severe stabbing on one side of the face.

Shunt is a hollow tube surgically placed in the brain (or occasionally in the spine) to help drain cerebrospinal fluid and redirect it to another location in the body where it can be reabsorbed.
Sickle cell disease is a chronic anemia that occurs in individuals who are homozygous for the gene controlling hemoglobin S (eg, African or Mediterranean descent). It is characterized by destruction of red blood cells and by episodic blocking of blood vessels by the adherence of sickle cells to the vascular endothelium. This causes the serious complications of the disease (such as organ failure).
Skew deviation test is a clinical examination used to detect vertical misalignment of the eyes, which is indicative of a brainstem lesion.
Spontaneous intracranial hypotension (SIH) is a condition characterized by cerebrospinal fluid (CSF) hypovolemia due to a noniatrogenic spinal CSF leak, often presenting with orthostatic headache.
Staging in cancer is the process of determining how much cancer is within the body (tumor size) and if it has metastasized (spread).
Strabismus is a disorder in which both eyes do not line up in the same direction, therefore, they do not look at the same object at the same time and is caused by an imbalance of the muscles of the eyeball.
Stroke, sometimes called a brain attack, occurs when something blocks blood supply to part of the brain or when a blood vessel in the brain bursts. In either case, parts of the brain becomes damaged or dies. A stroke can cause lasting brain damage, long-term disability or even death.
Sturge-Weber syndrome is a rare congenital condition that is characterized by a port-wine stain affecting the facial skin on one side in the area innervated by the first branch of the trigeminal nerve and by malformed blood vessels in the brain that may cause progressive intellectual disability, epilepsy and glaucoma in the eye on the affected side.
Subarachnoid hemorrhage (SAH) is defined as bleeding into the subarachnoid space surrounding the brain, most commonly caused by the rupture of cerebral aneurysms.
Surveillance in cancer is the ongoing, timely and systematic collection and analysis of information on new cancer cases, extent of disease, screening tests, treatment, survival and cancer deaths.
Syncope is loss of consciousness resulting from insufficient blood flow to the brain.
Syringomyelia is a chronic progressive disease of the spinal cord associated with sensory disturbances, muscle atrophy and spasticity.
Syrinx is a cerebrospinal fluid-filled cyst which collects inside of the spinal cord or brain stem. A syrinx in the spinal cord is called syringomyelia, and a syrinx in the brain stem is called syringobulbia.
Thrombosis is the formation of a blood clot (partial or complete blockage) within blood vessels, whether venous or arterial, limiting the natural flow of blood and resulting in clinical sequela.
Thunderclap headache is headache characterized by sudden, severe head pain, often described as "the worst headache of my life." It is sometimes called a sentinal headache. The pain usually

peaks within five minutes, persists for at least one hour and may be accompanied by nausea or vomiting.is an uncommon type of headache that strikes suddenly, the pain peaks within 60 seconds and can warn of potentially life-threatening conditions (usually having to do with bleeding in and around the brain).

Tinnitus is a sensation of noise (such as a ringing or roaring) that is typically caused by a bodily condition (such as a disturbance of the auditory nerve or wax in the ear) and usually is of the subjective form which can only be heard by the one affected.

Tourette syndrome is a neuropsychiatric disorder characterized by multiple motor tics and at least one vocal tic, with onset before age 18, persisting for more than one year, and not attributable to other medical conditions or substances.

Transient ischemic attack (TIA) is a brief interruption of the blood supply to the brain that causes a temporary impairment of vision, speech or movement. The episode usually lasts for just a few moments but may be a warning sign of a full scale stroke.

Transverse myelitis is a neurological disorder that causes inflammation on both sides of a section of the spinal cord. It can damage the myelin, the insulating material that covers nerve cell fibers. This prevents the spinal cord nerves from sending messages throughout the body.

Trigeminal autonomic cephalalgia (TAC) is a type of primary headache characterized by intense pain on one side of the head in the area where the trigeminal nerve is located, that may cause autonomic symptoms (watering eye, red eye, drooping eyelid and leaking nose) on the same side of the head where the pain occurs.

Trigeminal neuralgia is an intense paroxysmal neuralgia (pain radiating along the course of one or more nerves usually without demonstrable changes in the nerve structure) involving one or more branches of the trigeminal nerve.

Tuberous sclerosis is a genetic disorder of the skin and nervous system that is characterized by the formation of small benign tumors in various organs (such as the brain, kidney, eye and heart), is accompanied by variable symptoms including seizures, developmental delay or intellectual disability, skin lesions (as hypopigmented macules of the trunk and limbs or telangiectatic facial papules) and is inherited as an autosomal dominant trait or results from spontaneous mutation.

Ultrasound is the diagnostic or therapeutic use of ultrasound and especially a noninvasive technique involving the formation of images used for the examination and measurement of internal body structures and the detection of bodily abnormalities.

Valsalva maneuver is the action of attempting to exhale with the nostrils and mouth or the glottis, while closed. This increases pressure in the middle ear and the chest, as when bracing to lift heavy objects and is used as a means of equalizing pressure in the ears. It can be used to diagnose or treat certain cardiovascular conditions.

Vasculitis involves inflammation of the blood vessels. The inflammation can cause the walls of the blood vessels to thicken, which reduces the width of the passageway through the vessel. If blood flow is restricted, it can result in organ and tissue damage.

Vertigo is a sensation of motion or spinning that is often described as dizziness. People with vertigo feel as though they are actually spinning or moving, or that the world is spinning around them.
Videonystagmography is a test that measures a type of involuntary eye movement called nystagmus using special goggles with cameras.
Von Hippel-Lindau disease is a rare genetic disease that is characterized by hemangiomas of the retina and cerebellum, cysts or tumors of the central nervous system, pancreas, kidneys, adrenals and reproductive organs that is typically inherited as an autosomal dominant trait.
Wegener's Granulomatosis is an uncommon disease of unknown cause characterized by inflammation of small blood vessels and granuloma formation, especially in the upper and lower respiratory tracts and kidneys, that typically has an onset during the ages of 40 to 65 years old.
X-linked adrenoleukodystrophy (X-ALD) is a genetic disease that affects the nervous system and the adrenal glands (small glands located on top of each kidney). People with this disease often have progressive loss of the fatty covering (myelin) that surrounds the nerves in the brain and spinal cord.

MRI Brain References

[1] Accogli, A., Geraldo, A.F., . . . Capra, V. (2022). Diagnostic approach to macrocephaly in children. *Frontiers in Pediatrics, 9*, 794069.
[2] Aizer, A.A., Lamba, N., . . . Wen, P.Y. (2022). Brain metastases: A Society for Neuro-Oncology (SNO) consensus review on current management and future directions. *Neuro-Oncology, 24*(10), 1613-1646.
[3] Anson, B.G., Barkhof, F. . . . Pizzini, F.B. (2021). Neurodegenerative Diseases and Epilepsy. A. Adam & A.K. Dixon (Eds.). *Grainger & Allison's Diagnostic Radiology* (7). (pp. 1550-1561). Philadelphia, PA: Elsevier.
[4] Aulakh, S.K. (2024). Clinical Overview Horner Syndrome. *Clinical Key AI*. Retrieved: April 2025. https://www.clinicalkey.com/#!/content/derived_clinical_overview/76-s2.0-B978032375576400449X#hl0000311
[5] Benedict, R.H.B., Amato, M.P., . . . Geurts, J.J.G. (2020). Cognitive impairment in multiple sclerosis: clinical management, MRI, and therapeutic avenues. *The Lancet Neurology, 19*(10), 860-871.
[6] Bodilsen, J., D'Allessandril, Q.G., . . . Brouwer, M.C. (2024). European society of Clinical Microbiology and Infectious Diseases guidelines on diagnosis and treatment of brain abscess in children and adults. *Clinical Microbiology and Infection, 30*(1), 66-89.
[7] Bora, N., Parihar, P., . . . Shetty, N.D. (2024). Role of Magnetic Resonance Imaging in the Evaluation of Trigeminal Neuralgia Using Steady State Imaging. *Cureus, 16*(5), e60071.

[8] Carletti, Viela, P. & Jager, R. (2023). Imaging Approach to Venous Sinus Thrombosis. *Radiologic Clinics of North America, 61*(3), 501-519.

[9] Carpenter, J.P., Litt, H. & Gowda, M. (2023). Magnetic Resonance Imaging and Arteriography. A.N. Sidawy (Eds.). *Rutherford's Vascular Surgery and Endovascular Therapy* (30). (pp. 336-394.e4). Philadelphia, PA: Elsevier.

[10] Carton, C., Evans, D.G., . . . Oostenbrrink, R. (2023). ERN GENTURIS tumour surveillance guidelines for individuals with neurofibromatosis type 1. *eClnical Medicine, 56*, 101818.

[11] Dejaco, C., Ramiro, S., . . . Schmidt, W.A. (2023). EULAR recommendations for the use of imaging in large vessel vasculitis in clinical practice. *Annals of the Rheumatic Diseases*, 1-11.

[12] Derks, S.H.A.E., Van Der Veldt, A.A.M. & Smits, M. (2022). Brain metastases: the role of clinical imaging. *The British Journal of Radiology, 95*(1130), 20210944.

[13] Donahue, J.H., Patel, S.H., . . . Mukherjee, S. (2021). Imaging Mimics of Brain Tumors. *Radiologic Clinics of North America, 59*(3), 457-470.

[14] Fabian, M.T., Krieger, S.C. . . . Lublin, F.D. (2022). Multiple Sclerosis and Other Inflammatory Demyelinating Diseases of the Central Nervous System. J. Jankovic & J.C. Mazziotta (Eds.). *Bradley and Daroff's Neurology in Clinical Practice* (8), (pp. 1226-1254). Philadelphia, PA: Elsevier.

[15] Fieux, M., Franco-Vidal, V., . . . Tringali, S. (2020). French Society of ENT (SFORL) guidelines. Management of acute Bell's palsy. *European Annals of Otorhinolaryngology, Head and Neck Diseases, 137*(6), 483-488.

[16] Finger, G., Wu, K.C., . . . Prevedello, D.M. (2023). A New Finding on Magnetic Resonance Imaging for Diagnosis of Hemifacial Spasm with High Accuracy and Interobserver Correlation. *Brain Sciences, 13*(10), 1434.

[17] Frank, S & Schoem, S.R. (2021). Nasal Obstruction in the Infant. *Pediatric Clinics of North America, 69*(2), 287-300.

[18] Gamer, H.W., Wessell, D.E., . . . Chang, E.Y. (2023). ACR Appropriateness Criteria Soft Tissue Masses: 2022 Update. *Journal of the American College of Radiology, 20*(5), S234-S245.

[19] Gladstone, D.J., Lindsay, M.P., . . . Poppe, A.Y. (2022). Canadian Stroke Best Practice Recommendations: Secondary Prevention of Stroke Update 2020. *Canadian Journal of Neurological Sciences, 49*(3), 315-337.

[20] Go, R.S., Jacobsen, E., . . . Zurbriggen, L. (2024). Histiocytic Neoplasms Version 3.2024. *National Comprehensive Cancer Network*. Retrieved: April 2025. https://www.nccn.org/professionals/physician_gls/pdf/histiocytic_neoplasms.pdf

[21] Goldsmith, C.E. (2024). Clinical Overview Normal Pressure Hydrocephalus. *Clinical Key AI*. Retrieved: April 2025. https://www.clinicalkey.com/#!/content/derived_clinical_overview/76-s2.0-B9780323755764006384#hl0000250

[22] Guest, W. & Krings, T. (2021). Brain Arteriovenous Malformations. *Neuroimaging Clinics of North America, 31*(2), 205-222.

[23] Gupta, S.K., Ya'qoub, L., . . . Saeed, I.M. (2020). Safety and Clinical Impact of MRI in Patients with Non–MRI-conditional Cardiac Devices. *Radiology: Cardiothoracic Imaging, 2*(5), e200086.

[24] Hagiwara, M., Policeni, B., . . . Corey, A.S. (2022). ACR Appropriateness Criteria Sinonasal Disease: 2021 Update. *Journal of the American College of Radiology, 19*(5S), S175-S193.

[25] Harvey, H.B., Watson, L.C., . . . Corey, A.S. (2020). ACR Appropriateness Criteria Movement Disorders and Neurodegenerative Diseases. *Journal of the American College of Radiology, 17*(5S), S175-S187.

[26] Hayes, L.L., Palasis, S., . . . Karmazyn, B.K. (2018). ACR Appropriateness Criteria Headache-Child. *Journal of the American College of Radiology, 15*(5), S78-S90.

[27] Hersh, D.S., Bookland, M.,J. & Hughes, C.D. (2021). Diagnosis and Management of Suture-Related Concerns of the Infant Skull. *Pediatric Clinics of North America, 68*(4), 727-784.

[28] Hetts, S.W., Shah, L.M., . . . Wintermark, M. (2022). ACR–ASNR–SPR Practice Parameter for the Performance of Functional Magnetic Resonance Imaging (fMRI) of the Brain. *Practice Parameter*. Retrieved: April 2025. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/fmr-brain.pdf

[29] Kanekar, S., Saif, M. & Kanekar, S. (2022). Imaging of Cranial Neuralgias. *Neurologic Clinics, 40*(3), 591-607.

[30] Kartub, B. & Inman, N.J. (2024). Clinical Overview Diplopia. *Clinical Key AI*. Retrieved: April 2025. https://www.clinicalkey.com/#!/content/derived_clinical_overview/76-s2.0-B9780323755764002805#hl0000616

[31] Kennedy, T.A., Corey, A.S., . . . Bykowski, J. (2018). ACR Appropriateness Criteria Orbits Vision and Visual Loss. *Journal of the American College of Radiology,15*(5S), S116-S131.

[32] Kim, G., Moon. J.H., . . . Kim, E.H. (2023). MRI-Based Classification of Rathke's Cleft Cyst and Its Clinical Implication. *Brain Tumor Research and Treatment, 11*(1), 59-65.

[33] Ledbetter, L.N., Burns, J., . . . Corey, A.S. (2021). ACR Appropriateness Criteria Cerebrovascular Diseases-Aneurysm, Vascular Malformation, and Subarachnoid Hemorrhage. *Journal of the American College of Radiology, 18*(11S), S283-S304.

[34] Lee, R.K., Burns, J., . . . Corey, A.S. (2020). ACR Appropriateness Criteria Seizures and Epilepsy. *Journal of the American College of Radiology, 17*(5S), S293-S304.

[35] (2023). LEQEMBI® (lecanemab-irmb) injection package insert. *U.S. Food and Drug Administration (FDA)*. Retrieved: April 2025. https://www.accessdata.fda.gov/scripts/cder/daf/index.cfm?event=overview.process&ApplNo=761269

[36] Lin, P., Chen, S. & Wang, S. (2023). Update on primary headache associated with sexual activity and primary thunderclap headache. *Cephalalgia, 43*(3), 1-10.

[37] Luo, X., Jiang, H., . . . Yu, J. (2023). Base MRI Imaging Characteristics of Meningioma Patients to Discuss the WHO Classification of Brain Invasion Otherwise Benign Meningiomas. *Technology in Cancer Research & Treatment, 22*, 15330338231171470.

[38] Luttrull, M.D., Boulter, D.J., . . . Bykowski, J. (2019). ACR Appropriateness Criteria Acute Mental Status Change, Delirium, and New Onset Psychosis. *Journal of the American College of Radiology, 16*(5S), S26-S37.

[39] Maheshwari, M., Bosemani, T., . . . Pruthi, S. (2024). ACR Appropriateness Criteria Orbital Imaging and Vision Loss-Child. *Journal of the American College of Radiology, 21*(6), S219-S236.

[40] Maralani, P.J., Schieda, N., . . . Weinreb, J. (2020). MRI safety and devices: An update and expert consensus. *Journal of Magnetic Resonance Imaging, 51*(3), 657-674.

[41] Mathijissen, I. (2021). Updated guideline on treatment and management of craniosynostosis. *Journal of Craniofacial Surgery, 32*(1), 371-450.

[42] McDowell, M.M., Kim, S. & Green, S. (2023). Clinical and Radiographic Features of Pineal Cysts in Pediatric and Young Adult Patients. *World Neurosurgery, 176*, e7169-e727.

[43] Moonis, G., Subramaniam, R.M., . . . Corey, A.S. (2020). ACR Appropriateness Criteria Dementia. *Journal of the American College of Radiology, 17*(5S), S100-S112.

[44] Muhlestein, W.E. & Maher, C.O. (2021). Incidental Intracranial Cysts in Children. *Pediatric Clinics of North America, 68*(4), 775-782.

[45] Okafor, C. & Kanekar, S. (2022). Imaging of Microcephaly. *Clinics in Perinatology, 49*(3), 693-713.

[46] Pannell, J.S., Corey, A.S., . . . Burns, J. (2024). ACR Appropriateness Criteria Cerebrovascular Diseases-Stroke and Stroke-Related Conditions. *Journal of the American College of Radiology, 21*(6), S21-S64.

[47] Papadimitriou-Olivgeris, M., Guery, B., . . . Monney, P. (2023). Role of Cerebral Imaging on Diagnosis and Management in Patients With Suspected Infective Endocarditis. *Clinical Infectious Diseases, 77*(3), 371-379.

[48] Patel, S.K., Tari, R. & Mangano, F.T. (2021). Pediatric Hydrocephalus and the Primary Care Provider. *Pediatric Clinics of North America, 68*(4), 793-809.

[49] Peddinti, A.S., Maloji, S. & Manepalli, K. (2021). Evolution in diagnosis and detection of brain tumor– review. *Journal of Physics: Conference Series, 2115*(1), 012039.

[50] Petzold, A., Fraser, C.L., . . . Plant, G.T. (2022). Diagnosis and classification of optic neuritis. *The Lancet Neurology, 21*(12), 1120-1134.

[51] Radhakrishnan, R., Shea, L., . . . Rigsby, C.K. (2022). ACR Appropriateness Criteria Ataxia-Child. *Journal of the American College of Radiology, 19*(11), S240-S255.

[52] Rath, T.J., Policeni, B., . . . Corey, A.S. (2022). ACR Appropriateness Criteria Cranial Neuropathy: 2022 Update. *Journal of the American College of Radiology, 19*(11), S266-303.

[53] Robertson, R.L., Palasis, S., . . . Karmazyn, B. (2020). ACR Appropriateness Criteria Cerebrovascular Disease-Child. *Journal of the American College of Radiology, 17*(5S), S36-S54.

[54] Ryan, M.E., Pruthi, S., . . . Karmazyn, B. (2020). ACR Appropriateness Criteria Head Trauma-Child. *Journal of the American College of Radiology, 17*(5), S125-S137.

[55] Saah, E., Fadaei, P., . . . Sheehan, V. (2022). Sickle Cell Disease Pathophysiology and Related Molecular and Biophysical Biomarkers. *Hematology/Oncology Clinics of North America, 36*(6), 1077-1096.

[56] Sharma, A., Kirsch, C.F.E., . . . Bykowski, J. (2018). ACR Appropriateness Criteria Hearing Loss and/or Vertigo. *Journal of the American College of Radiology, 15*(11S), S321-S331.

[57] Shen, W.K., Sheldon, R.S., . . . Yancy, C.W. (2017). 2017 ACC/AHA/HRS Guideline for the Evaluation and Management of Patients With Syncope. *Journal of the American College of Cardiology, 70*(5), e39–e110.

[58] Shih, R.Y., Burns, J., . . . Corey, A.S. (2021). ACR Appropriateness Criteria Head Trauma: 2021 Update. *Journal of the American College of Radiology, 18*(5S), S13-S36.

[59] Tekes, A., Patasis, S., . . . Kamazyn, B. (2018). ACR Appropriateness Criteria Sinusitis-Child. *Journal of the American College of Radiology, 15*(11), S403-S412.

[60] Timpone, V.M., Parsons, M.S., . . . Policeni, B. (2024). ACR Appropriateness Criteria Imaging of Suspected Intracranial Hypotension. *Journal of the American College of Radiology, 21*(11), S396-S412.

[61] Trofimova, A., Milla, S.S., . . . Karmazyn, B. (2021). ACR Appropriateness Criteria Seizures-Child. *Journal of the American College of Radiology, 18*(5S), S199-S211.

[62] Tsukamoto, T. & Miki, Y. (2023). Imaging of pituitary tumors: an update with the 5th WHO Classifications—part 1. Pituitary neuroendocrine tumor (PitNET)/pituitary adenoma. *Japanese Journal of Radiology, 41*, 789-806.

[63] Ugga, L., Perillo, T., . . . Brunetti, A. (2021). Meningioma MRI radiomics and machine learning: systematic review, quality score assessment, and meta-analysis. *Neuroradiology, 63*, 1293-1304.

[64] Utukuri, P.S., Shih, R.Y., . . . Burns, J. (2023). ACR Appropriateness Criteria Headache: 2022 Update. *Journal of the American College of Radiology, 20*(5), S70-S93.

[65] Wang, L.L., Thompson, T.A., . . . Policeni, B. (2024). ACR Appropriateness Criteria Dizziness and Ataxia: 2023 Update. *Journal of the American College of Radiology, 21*(6), S100-S125.

[66] Wattjes, M.P., Ciccarelli. O., . . . Rovira, A. (2021). 2021 MAGNIMS–CMSC–NAIMS consensus recommendations on the use of MRI in patients with multiple sclerosis. *The Lancet Neurology, 20*(8), 653-670.

Disclaimer section

Purpose

The purpose of the HealthHelp's clinical guidelines is to assist healthcare professionals in selecting the medical service that may be appropriate and supported by evidence to safely improve outcomes. Medical information is constantly evolving, and HealthHelp reserves the right to review and update these clinical guidelines periodically. HealthHelp reserves the right to include in these guidelines the clinical indications as appropriate for the organization's program objectives. Therefore the guidelines are not a list of all the clinical indications for a stated procedure, and associated Procedure Code Tables may not represent all codes available for that state procedure or that are managed by a specific client-organization.

Clinician Review

These clinical guidelines neither preempt clinical judgment of trained professionals nor advise anyone on how to practice medicine. Healthcare professionals using these clinical guidelines are responsible for all clinical decisions based on their assessment. All Clinical Reviewers are instructed to apply clinical indications based on individual patient assessment and documentation, within the scope of their clinical license.

Payment

The use of these clinical guidelines does not provide authorization, certification, explanation of benefits, or guarantee of payment; nor do the guidelines substitute for, or constitute, medical advice. Federal and State law, as well as member benefit contract language (including definitions and specific contract provisions/exclusions) take precedence over clinical guidelines and must be considered first when determining eligibility for coverage. All final determinations on coverage and payment are the responsibility of the health plan. Nothing contained within this document can be interpreted to mean otherwise.

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National and Local Coverage Determination (NCD and LCD)

NOTICE
To ensure appropriate review occurs to the most current NCD and/or LCD, always defer to https://www.cms.gov/medicare-coverage-database/search.aspx.

Background

National Coverage Determinations (NCD) and Local Coverage Determinations (LCD) are payment policy documents outlined by the Centers for Medicare and Medicaid Services (CMS) and the government's delegated Medicare Audit Contractors (MACs) that operate regionally in jurisdictions.
CMS introduced variation between different jurisdictions/Medicare Audit Contractors (MACs) and their associated covered code lists with the transition to ICD 10. The variation resulted in jurisdictions independently defining how codes are applied for exclusions, limitations, groupings, ranges, etc. for the medical necessity indications outlined in the NCD and LCD. Due to this variation, there is an inconsistent use/application of codes and coverage determinations across the United States between the different MACs.
In addition, **WITHOUT** notice, CMS can change the codes that indicate medical necessity and the format of the coverage determinations/associated documents (eg, Articles). This is an additional challenge for organizations to keep up with ongoing, unplanned changes in covered codes and medical necessity indications.

Medical Necessity Codes

Due to the variation in code application between jurisdictions/MACs and that updates can happen without notification, HealthHelp is not able to guarantee full accuracy of the codes listed for any Coverage Determination, and advises that prior to use, the associated Coverage Determination Articles are reviewed to ensure applicability to HealthHelp's programs and any associated NCDs and LCDs.

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11248 11249 11253 11282 11325 11328 11333 11349 11350 11351 11352 11354 11355 11356 11358 11359 11360 11361 11362 11365 11366 11367 11368 11369 11370 11374 11375 11394 11395 11396 11565