CLINICAL GUIDELINES

Pediatric Head Imaging Policy

Version 1.0.2019

Effective February 15, 2019

eviCore healthcare Clinical Decision Support Tool Diagnostic Strategies: This tool addresses common symptoms and symptom complexes. Imaging requests for individuals with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician, specialist and/or individual's Primary Care Physician (PCP) may provide additional insight.

PEDHD-1: General Guidelines

PEDHD-13.1: Arachnoid Cysts

Arachnoid cysts arise in the middle or posterior fossa, and the majority of lesions are discovered incidentally and do not require surgical intervention.

- MRI Brain without and with contrast (CPT® 70553) is indicated for initial evaluation of arachnoid cysts if not already completed.
- Repeat MRI Brain is not indicated for most patients with arachnoid cysts, but can be approved for the following:
  - Annual MRI Brain without and with contrast (CPT® 70553) until age 4 if diagnosed at a younger age.
  - New or worsening headache or focal neurologic deficits suggesting progression of cyst.
  - Preoperative planning.

PEDHD-13.2: Pineal Cysts

Pineal cysts are generally discovered incidentally and do not require surgical intervention.

- MRI Brain without and with contrast (CPT® 70553) is indicated for initial evaluation of pineal cysts if not already completed.
- Repeat MRI Brain is not indicated for most patients with pineal cysts, but can be approved for the following:
  - New or worsening headache or focal neurologic deficits suggesting progression of cyst.
  - Preoperative planning.

PEDHD-13.3: Acoustic Neuromas

- See **PEDPND-2.2: Neurofibromatosis 2** for imaging guidelines in pediatric patients

References

1. Hervey-Jumper SL, Cohen-Gadol AA, and Maher CO. Neurosurgical management of congenital malformations of the brain. *Neuroimag Clin N Am.* 2011 Aug; 21 (3): 705-717. Accessed October 20, 2017. http://www.neuroimaging.theclinics.com/article/S1052-5149(11)00067-0/pdf.
2. Chtinis T, Guttman CR, Zaitsev A, et al. Quantitative MRI analysis in children with multiple sclerosis: a multicenter feasibility pilot study. *BMC Neurol.* 2013 Dec; 13: 173. Accessed October 20, 2017. https://link.springer.com/article/10.1186/1471-2377-13-173.
3. Al-Holou WN, Maher CO, Muraszko KM, et al. The natural history of pineal cysts in children and young adults. *J Neurosurg Pediatr.* 2010 Feb; 5 (2):162-166. Accessed October 20, 2017. http://thejns.org/doi/10.3171/2009.9.PEDS09297.
4. Raybaud C, and Barkovich AJ. Intracranial, orbital and neck masses in children. In: Barkovich AJ, Raybaud C, ed. *Pediatric Neuroimaging.* 5th ed. Philadelphia PA. Wolters Kluwer. 2012; 240-366
5. Jussila M-P, Olsén P, Salokorpi N, Suo-Palosaari M. Follow-up of pineal cysts in children: is it necessary? *Neuroradiology*. 2017;59(12):1265-1273.

PEDHD-14: Pediatric Demyelinating Diseases

PEDHD-14.1: General Considerations

- MRI Brain without and with contrast (CPT® 70553) is the preferred imaging study for evaluation of pediatric demyelinating disease.
  - MRI of the spinal cord (CPT® 72156 and CPT® 72157) without and with contrast is also indicated for evaluation of pediatric demyelinating disease.
  - MRI of the lumbar spine (CPT® 72158) is not indicated unless the patient has a tethered cord or other anatomic abnormality causing caudal displacement of the filum terminalis.
- CT imaging is generally not indicated in the evaluation of demyelinating disease.
- PET Brain (CPT® 78608 and CPT® 78609) and MR spectroscopy (CPT® 76390) are considered investigational for evaluation of pediatric demyelinating diseases.

PEDHD-14.2: Multiple Sclerosis (MS)

Multiple sclerosis is less common in children. About 4 % of MS cases are diagnosed before age 18, and only ~0.7 % of all MS cases begin before age 10.

Ataxia, optic neuritis, diplopia, and transverse myelitis are common presentations. MS can present as an acute encephalitis-like illness, especially in childhood.

Among children with suspected demyelinating diseases, the principal differential diagnosis is often between MS and acute disseminated encephalomyelitis.

- MRI (CPT® 70553) Brain and spinal cord (CPT® 72156 and CPT® 72157) without and with contrast is indicated for initial diagnosis in patients with clinical signs and/or symptoms suggestive of MS.
  - MRI (CPT® 70551) Brain and spinal cord (CPT® 72141 and CPT® 72146) without contrast can be approved if there is a contraindication to gadolinium administration.
- MRI (CPT® 70553) Brain and spinal cord (CPT® 72156 and CPT® 72157) without and with contrast is indicated every 6 months for disease monitoring.
  - MRI (CPT® 70551) Brain and spinal cord (CPT® 72141 and CPT® 72146) without contrast can be approved if there is a contraindication to gadolinium.

PEDHD-14.3: Acute Disseminated Encephalomyelitis (ADEM)

- ADEM has an acute onset, and is more common among younger children than MS, but the signs and symptoms overlap significantly, and distinguishing between MS and ADEM can be challenging based on clinical examination alone.
- MRI (CPT® 70553) Brain and spinal cord (CPT® 72156 and CPT® 72157) without and with contrast is indicated for initial diagnosis in patients with clinical signs and/or symptoms suggestive of ADEM.
  - MRI (CPT® 70551) Brain and spinal cord (CPT® 72141 and CPT® 72146) without contrast can be approved if there is a contraindication to gadolinium.
- MRI (CPT® 70553) Brain and spinal cord (CPT® 72156 and CPT® 72157) without and with contrast is indicated every 3 months for 1 year following diagnosis.
  - MRI (CPT® 70551) Brain and spinal cord (CPT® 72141 and CPT® 72146) without contrast can be approved if there is a contraindication to gadolinium.

- Most patients will have complete clinical recovery by 12 months, while stable MRI abnormalities (gliosis) may persist. These findings do not require additional imaging unless the patient develops new neurologic symptoms.

References

1. Ness J. Demyelinating disorders of the central nervous system. *Nelson Textbook of Pediatrics, Chapter 600.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 2920-2925.
2. Verhey LH, Shroff M, and Banwell B. Pediatric multiple sclerosis pathological, clinical, and magnetic resonance imaging features. *Neuroimag Clin N Am.* 2013 May; 23 (2):227-243. Accessed October 20, 2017. http://www.neuroimaging.theclinics.com/article/S1052-5149(12)00208-0/pdf.
3. Chtinis T, Guttman CR, Zaitsev A, et al. Quantitative MRI analysis in children with multiple sclerosis: a multicenter feasibility pilot study. *BMC Neurol.* 2013 Dec; 13: 173. Accessed October 20, 2017. https://link.springer.com/article/10.1186/1471-2377-13-173.
4. Van Haren K, and Waubant E. Therapeutic advances in pediatric multiple sclerosis. *J Pediatr.* 2013 Sep; 163 (3): 631-637. Accessed October 20, 2017. http://www.jpeds.com/article/S0022-3476(13)00445-9/fulltext.
5. Ketelslegers IA, Neuteboom RF, Boon M, et al. A comparison of MRI criteria for diagnosing pediatric ADEM and MS. *Neurology.* 2010 Mar; 74 (18): 1412; 1415. Accessed October 20, 2017. http://www.neurology.org/content/74/18/1412.
6. Callen DJA, Shroff MM, Branson HM, et al. MRI in the diagnosis of pediatric multiple sclerosis. *Neurology.* 2009 Mar; 72 (11): 961-967. Accessed October 20, 2017. http://www.neurology.org/content/72/11/961.abstract.
7. Callen DJA, Shroff MM, Branson HM, et al. Role of MRI in the differentiation of ADEM from MS in children. *Neurology.* 2009 Mar; 72 (11): 968-973. Accessed October 20, 2017. http://www.neurology.org/content/72/11/968.
8. Marin SE, and Callen DJA. The magnetic resonance imaging appearance of monophasic acute disseminated encephalomyelitis: an update post application of the 2007 consensus criteria. *Neuroimag Clin N Am.* 2013 May; 23 (2): 245-266. Accessed October 20, 2017. http://www.neuroimaging.theclinics.com/article/S1052-5149(12)00209-2/fulltext.
9. Neuteboom R, Wilbur C, Pelt DV, Rodriguez M, Yeh A. The Spectrum of Inflammatory Acquired Demyelinating Syndromes in Children. *Seminars in Pediatric Neurology*. 2017;24(3):189-200.

PEDHD-15: Pituitary Dysfunction

400 Buckwalter Place Boulevard, Bluffton, SC 29910 (800) 918-8924

PEDHD-15.1: General Considerations

- The initial step in the evaluation of all potential pituitary masses is a detailed history, recent physical examination, and thorough neurological exam, including evaluation of the visual fields.
- Endocrine laboratory studies should be performed prior to considering advanced imaging.
- When pituitary imaging is indicated, MRI Brain without and with contrast (CPT® 70553) is the correct study.
  - One study (either brain MRI [CPT® 70553] or MRI Orbit, Face, Neck [CPT® 70543]) is adequate to image the pituitary. The ordering physician should specify that the study is specifically to evaluate the pituitary gland. The reporting of two CPT® codes, to image the pituitary, is not indicated.

PEDHD-15.2: Panhypopituitarism

Endocrine testing should be performed initially.

- MRI Brain without and with contrast (CPT® 70553) with special attention to the pituitary is indicated for newly diagnosed Panhypopituitarism.
- Patients with a normal pituitary on initial MRI do not need routine follow up imaging.
- Patients with mass lesions should have follow up imaging according to the guidelines for the specific diagnosis.

PEDHD-15.3: Isolated Growth Hormone Deficiency

Endocrine testing should be performed initially. For isolated growth hormone deficiency, two measurements of growth hormone with different stimulation agents are performed.

- MRI Brain without and with contrast (CPT® 70553) with special attention to the pituitary is indicated for newly diagnosed isolated growth hormone deficiency.
- Patients with a normal pituitary on initial MRI do not need routine follow up imaging.
- Patients with mass lesions should have follow up imaging according to the guidelines for the specific diagnosis.

PEDHD-15.4: Diabetes Insipidus (DI) and Other Disorders of Anti-Diuretic Hormone

The principal evaluation of ADH deficiency is by urine and blood electrolyte and osmolality testing - serum osmolality greater than 300 with urine osmolality less than 300. Deficiencies in ADH can either be central or nephrogenic.

Central Diabetes Insipidus (DI)

- MRI Brain without and with contrast (CPT® 70553) is indicated for newly diagnosed central DI.
- Head CT without contrast (CPT® 70450) with attention to the skull base may be approved with history of recent significant head trauma.
- Patients with a normal pituitary on initial MRI can have repeat MRI without and with contrast (CPT® 70553) every 12 months as germinomas may cause central DI while still too small to detect on imaging.
  - Serial measurement of □ -hCG is also indicated for these patients, and MRI should be repeated if a significant rise in □ -hCG is detected on screening.
- Patients with mass lesions should have follow up imaging according to the guidelines for the specific diagnosis.

Nephrogenic DI

- Once this diagnosis is firmly established, further advanced imaging is usually not indicated.

Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH)

Laboratory studies should be obtained prior to considering advanced imaging—urine osmolality should be high and serum osmolality low.

- MRI Brain without and with contrast (CPT® 70553) is indicated for initial evaluation of unexplained central SIADH.
- Patients with a normal pituitary on initial MRI do not need routine follow up imaging.
- Patients with mass lesions should have follow up imaging according to the guidelines for the specific diagnosis.

PEDHD-15.5: Precocious Puberty

Defined as the appearance of secondary sexual characteristics before age 8 in girls and before age 9 in boys.

When precocious puberty is documented on physical examination, endocrine lab studies are not necessary prior to advanced imaging.

- Brain MRI Brain without and with contrast (CPT® 70553) is indicated for initial evaluation of any child with documented precocious puberty, following ultrasound of the abdomen (CPT® 76700) in both genders and ultrasound of the pelvis (CPT® 76856) in girls.
- Patients with a normal pituitary on initial MRI do not need routine follow up imaging.
- Patients with mass lesions should have follow up imaging according to the guidelines for the specific diagnosis.

PEDHD-15.6: Benign Pituitary Tumors

- Benign pituitary tumor indications in pediatric patients are identical to those for adult patients. See **HD-19: Pituitary** for imaging guidelines.

PEDHD-15.7: Pituitary Malignancies

See **PEDONC-4.10: Craniopharyngioma and Pituitary Tumors** or **PEDONC-18: Histiocytic Disorders** for imaging guidelines

References

1. Seidenwurm DJ, Wippold FJ, Cornelius RS, et al. Neuroendocrine Imaging. *ACR Appropriateness Criteria®. J Am Coll Radiol.* 2012; 9 (5): 315-324. Accessed October 20, 2017. http://www.ncbi.nlm.nih.gov/pubmed/22554628.
2. Parks JS, and Felner EI. Disorders of the hypothalamus and pituitary gland. *Nelson Textbook of Pediatrics, Chapter 556.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 2635-2662.

PEDHD-16: Pediatric Ear Disorders

PEDHD-16.1: Hearing Loss

A recent (within 60 days) evaluation including a detailed history, physical examination (including otoscopic examination), and age-appropriate audiology testing should be performed on any child with known or suspected hearing loss prior to considering advanced imaging. The selection of imaging testing will depend on the age of the child and type of hearing loss.

- Temporal bone CT without contrast (CPT® 70480) is indicated for the following:
  - Conductive hearing loss of any cause.
  - Preoperative planning for resection of mass lesion or cochlear implant placement.
  - Sensorineural hearing loss in patients who cannot safely undergo MRI.
  - Mixed conductive and sensorineural hearing loss.
  - Congenital hearing loss.
  - Total deafness.
- MRI Brain without and with contrast (CPT® 70553) with attention to internal auditory canals (included in CPT® 70553 and does not require a separate CPT code) is indicated for the following:
  - Conductive hearing loss secondary to known or suspected mass lesion.
  - Preoperative planning for resection of mass lesion or cochlear implant placement.
  - Sensorineural hearing loss of any cause.
  - Mixed conductive and sensorineural hearing loss.
  - Congenital hearing loss.
  - Total deafness.
  - Hearing loss associated with tinnitus
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-16.2: Ear Pain

A recent (within 60 days) evaluation including a detailed history, physical examination (including otoscopic examination), should be performed on any child with ear pain prior to considering advanced imaging. Common causes of ear pain include external and middle ear infections, dental problems, sinus infection, neck problems, tonsillitis, and pharyngitis.

- Advanced imaging is not indicated in the overwhelming majority of pediatric patients with ear pain.
- CT scan temporal bone without contrast (CPT® 70480) or without and with contrast (CPT® 70482), OR, MRI Brain without and with contrast with attention to internal auditory canals (CPT® 70553), OR MRI Orbits/Face/Neck without and with contrast (CPT® 70543) is indicated for the following:
  - Persistent ear pain without obvious cause.
  - Clinical suspicion for complicated or invasive infection such as mastoiditis.
  - Clinical suspicion of mass lesion causing ear pain.
  - Significant trauma with concern for hematoma formation.
  - Preoperative planning.

- Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-16.3: Cholesteatoma

Cholesteatomas are expansive cysts of the middle ear filled with cellular debris. They can be congenital or arise from recurrent middle ear infections or trauma to the tympanic membrane. Hearing loss is usually conductive, although if the lesion is large enough combined conductive and sensorineural hearing loss may be present. Otoscopic exam findings and symptoms may include painless drainage from the ear or chronic/recurrent ear infections.

- CT scan temporal bone without contrast (CPT® 70480) or without and with contrast (CPT® 70482), OR MRI Brain without and with contrast with attention to internal auditory canals (CPT® 70553), OR MRI Orbits/Face/Neck without and with contrast (CPT® 70543) is indicated for preoperative evaluation in cholesteatoma patients.
- CT scan temporal bone without contrast (CPT® 70480) or without and with contrast (CPT® 70482), OR MRI Brain without and with contrast with attention to internal auditory canals (CPT® 70553), OR MRI Orbits/Face/Neck without and with contrast (CPT® 70543) is indicated one time post-operatively to exclude residual or regrown cholesteatoma to avoid the need for a second-look surgery.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-16.4: Vertigo

Isolated vertigo is an uncommon complaint during childhood. Middle ear/Eustachian tube problems are the most common cause of isolated vertigo in children. A recent (within 60 days) face-to-face evaluation including a detailed history, physical examination (including otoscopic examination), should be performed on any child with vertigo prior to considering advanced imaging.

- If physical examination is otherwise normal and the vertigo responds to treatment, advanced imaging is not indicated.
- MRI Brain without and with contrast with attention to internal auditory canals (CPT® 70553) is indicated for the following:
  - Vertigo with associated headache or ataxia.
  - Vertigo associated with tinnitus.
  - Vertigo that does not respond to vestibular treatment.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-16.5: Tinnitus

Tinnitus without hearing loss is a less common complaint during childhood. Children with hearing loss and tinnitus should be imaged according to **PEDHD-16.1: Hearing Loss**. A recent (within 60 days) face-to-face evaluation including a detailed history, physical examination (including otoscopic examination), and age-appropriate audiology testing should be performed on any child with known or suspected tinnitus prior to considering advanced imaging.

- Advanced imaging is not indicated in the overwhelming majority of pediatric patients with isolated tinnitus and normal hearing.
- CT scan temporal bone without contrast (CPT® 70480) or without and with contrast (CPT® 70482), OR MRI Brain without and with contrast with attention to internal auditory canals (CPT® 70553), OR MRI Orbits/Face/Neck without and with contrast (CPT® 70543) is indicated for the following:
  - Clinical suspicion of mass lesion causing tinnitus.
  - Persistent tinnitus after recent significant trauma.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

References

1. Haddad J, and Keesecker S. The ear. *Nelson Textbook of Pediatrics, Chapter 636.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 3069-3103.
2. Angtuaco EJ, Wippold FJ, Cornelius RS, et al. Hearing loss and/or vertigo. *ACR Appropriateness Criteria®*. 2013: 1-14. Accessed October 20, 2017. https://acsearch.acr.org/docs/69488/Narrative/.
3. Minovi A, and Dazert S. Diseases of the middle ear in childhood. *GMS Curr Top Otorhinolaryngol Head Neck Surg.* 2014 Dec; 13:1-29. Accessed October 20, 2017. http://www.egms.de/static/pdf/journals/cto/2014-13/cto000114.pdf.
4. Savastano M, Marioni G, and de Filippis C. Tinnitus in children without hearing impairment. *Int J Pediatr Otorhinolaryngol.* 2009 Dec; 73S: S13-S15. Accessed October 20, 2017. https://www.sciencedirect.com/science/article/pii/S0165587609700035.
5. Kerr R, Kang E, Hopkins B, Anne S. Pediatric tinnitus: Incidence of imaging anomalies and the impact of hearing loss. *International Journal of Pediatric Otorhinolaryngology*. 2017;103:147-149.

PEDHD-17: Autism Spectrum Disorders

The group of diagnoses, including Asperger syndrome, are classified as pervasive development disorders (PDD). These diagnoses are established on clinical criteria, and no imaging study can confirm the diagnosis.

Comprehensive evaluation for autism might include history, physical exam, audiology evaluation, speech, language, and communication assessment, cognitive and behavioral assessments, and academic assessment.

- MRI Brain without and with contrast (CPT® 70553) is indicated for new or worsening focal neurologic findings documented on a physical examination within 60 days of the imaging request.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.
- PET imaging is considered investigational in the evaluation of patients with autism spectrum disorders.

References

1. Raviola G, Trieu ML, Walter HJ, et al. Autism spectrum disorder. *Nelson Textbook of Pediatrics, Chapter 30.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 176-183.
2. Baker E, and Jeste SS. Diagnosis and management of autism spectrum disorder in the era of genomics. *Pediatr Clin N Am.* 2015 June; 62 (3):607-618. Accessed October 20, 2017. http://www.pediatric.theclinics.com/article/S0031-3955(15)00023-1/pdf.
3. Zürcher NR, Bhanot A, McDougle CJ, et al. A systematic review of molecular imaging (PET and SPECT) in autism spectrum disorder: current state and future research opportunities. *Neuroscience and Biobehavioral Reviews* 2015; 52: 56-73.

PEDHD-18: Behavioral and Psychiatric Disorders

- Behavioral and psychiatric disorders of childhood or adolescence generally require no advanced imaging for diagnosis or management.
  - MRI Brain without and with contrast (CPT® 70553) is indicated for new or worsening focal neurologic findings documented on a physical examination within 60 days of the imaging request.
    - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

References

1. Behavioral and Psychiatric Disorders. *Nelson Textbook of Pediatrics, Chapters 20-31.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 124-191.

PEDHD-19: Intellectual Disability, Cerebral Palsy, and Developmental Motor Delay

400 Buckwalter Place Boulevard, Bluffton, SC 29910 (800) 918-8924 www.eviCore.com

PEDHD-19.1: Intellectual Disability

Intellectual disability was formerly known as mental retardation, and may be primary or secondary to a variety of heterogeneous disorders.

- Brain MRI without and with contrast (CPT® 70553) is indicated for new or worsening focal neurologic findings documented on a physical examination within 60 days of the imaging request.
- Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-19.2: Cerebral Palsy

Many patients with intellectual disability also have cerebral palsy, but not all patients with cerebral palsy have intellectual disability.

Cerebral palsy is a static motor encephalopathy caused by a variety of entities spanning developmental, metabolic, genetic, infectious, ischemic, and other acquired etiologies.

- Brain MRI without and with contrast (CPT® 70553) is indicated for:
  - Initial evaluation of newly diagnosed cerebral palsy.
  - New or worsening focal neurologic findings documented on a physical examination within 60 days of the imaging request, including the presence of developmental delay.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

PEDHD-19.3: Developmental Motor Delay

There are many causes for developmental motor delay. Patients with motor delay can have decreased, normal, or increased muscular tone. Patients with low or normal tone do not require imaging unless they have focal neurologic findings.

- Brain MRI without and with contrast (CPT® 70553) is indicated for:
  - Initial evaluation of newly diagnosed developmental motor delay with increased muscle tone.
  - Toe walking, when associated with upper motor neuron signs including hyperreflexia, spasticity, or positive Babinski sign.
  - New or worsening focal neurologic findings documented on a physical examination within 60 days of the imaging request.
  - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.

References

1. Shapiro BK, and Batshaw ML. Intellectual Disability. *Nelson Textbook of Pediatrics, Chapter 36.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 216-222.
2. Johnston MV. Encephalopathies. *Nelson Textbook of Pediatrics, Chapter 598.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 2896-2910
3. Noritz GH, and Murphy NA. Motor delays: early identification and evaluation. *Pediatrics*. 2013 May; 131 (6). Accessed October 20, 2017. http://pediatrics.aappublications.org/content/131/6/e2016.
4. Murias K, Moir A, Myers KA, Liu I, Wei X-C. Systematic review of MRI findings in children with developmental delay or cognitive impairment. *Brain and Development*. 2017;39(8):644-655.
5. Haynes KB, Wimberly RL, Vanpelt JM, Jo C-H, Riccio AI, Delgado MR. Toe Walking. *Journal of Pediatric Orthopaedics*. 2018;38(3):152-156.

PEDHD-20: Ataxia

Ataxia refers to an abnormally ill-coordinated or unsteady gait for age. “Limb ataxia” refers to impaired coordination (for age) of limbs, especially arms. Developmental failure to acquire the ability to walk is a form of developmental delay, not ataxia.

(See **PEDHD-19: Intellectual Disability, Cerebral Palsy, and Developmental Motor Delay**)

- A recent (within 60 days) face-to-face evaluation including a detailed history, physical examination with a thorough neurologic examination, and appropriate laboratory studies should be performed prior to considering advanced imaging, unless the patient is undergoing guideline-supported scheduled follow-up imaging evaluation.
- Brain MRI without and with contrast (CPT® 70553) can be performed to evaluate ataxia, hereditary ataxia, and slowly progressive ataxia.
  - Cervical spine MRI without contrast (CPT® 72141) or without and with contrast (CPT® 72156) is indicated if brain MRI is non-diagnostic.
    - Patients requiring sedation should generally not have non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Considerations**.
- CT Head without and with contrast (CPT® 70470) or with contrast (CPT® 70460) is indicated for patients who have a contraindication to MRI.
  - CT should not be used in place of MRI solely to avoid sedation in young children because MRI is superior for imaging the posterior fossa.
- CT Head without contrast (CPT® 70450) or without and with contrast (CPT® 70470) or MRI Brain without contrast (CPT® 70551) or without and with contrast (CPT® 70553) is indicated for patients with acute ataxia following significant head trauma.
- Repeat imaging may be appropriate no more frequently than every 12 months when requested by a specialist.

References

1. Broderick DF, Wippold FJ, Cornelius RS, et al. Ataxia. *ACR Appropriateness Criteria®.* 2012: 1-16. Accessed October 20, 2017. https://acsearch.acr.org/docs/69477/Narrative/.
2. Prabhu SP, and Young-Poussaint Ty. Pediatric central nervous system emergencies. *Neuroimag Clin N Am.* 2010 Nov; 20 (4):663-683. Accessed October 20, 2017. http://www.neuroimaging.theclinics.com/article/S1052-5149(10)00080-8/pdf.
3. Salman MS, Chodirker BN, Bunge M. Neuroimaging Findings and Repeat Neuroimaging Value in Pediatric Chronic Ataxia. *Canadian Journal of Neurological Sciences / Journal Canadien des Sciences Neurologiques*. 2016;43(06):824-832.

PEDHD-21: Epistaxis

PEDHD-21.1: Imaging

Initial evaluation of epistaxis (nosebleed), including recurrent epistaxis that is refractory to medical management is by direct or endoscopic visualization of the relevant portions of the upper airway.

- If a mass lesion is detected on direct visualization, any one of the following imaging studies is indicated:
  - CT Maxillofacial without contrast (CPT® 70486) or without and with contrast (CPT® 70488).
  - MRI Orbits/Face/Neck without and with contrast (CPT® 70543).

Reference

1. Haddad J, and Keesecker S. Acquired disorders of the nose. *Nelson Textbook of Pediatrics, Chapter 377.* eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 2008-2010

PEDHD-22: Pseudotumor Cerebri

- Pseudotumor cerebri indications in pediatric patients are identical to those for adult patients. See **HD-17: Papilledema/Pseudotumor Cerebri** for imaging guidelines.

PEDHD-23: Cranial Neuropathies

- MRI Brain without and with contrast (CPT® 70553) is indicated for all patients with new or worsening specific cranial nerve abnormalities.
- MRI Neck without and with contrast (CPT® 70543) is also indicated for patients with abnormalities in cranial nerves IX, X, XI, or XII.

References

1. Wippold FJ, Cornelius RS, Aiken AH, et al. Cranial neuropathy. *ACR Appropriateness Criteria®.* 2017:1-22.
2. Rubin M. Overview of neuro-ophthalmologic and cranial nerve disorders. Merck Manual. 2014. Accessed October 20, 2017. https://www.merckmanuals.com/professional/neurologic-disorders/neuro-ophthalmologic-and-cranial-nerve-disorders/overview-of-neuro-ophthalmologic-and-cranial-nerve-disorders.

PEDHD-24: Pediatric Sleep Disorders

- See **Pediatric Sleep Guidelines** for sleep study indications.
- Advanced imaging is not indicated for the following:
  - Parasomnias.
  - Bed wetting (if child is otherwise neurologically normal).
  - Insomnia.
  - Narcolepsy.
  - Restless Leg Syndrome (polysomnography is useful).
- For Obstructive Sleep Apnea, endoscopic examination of the upper airway and lateral upper airway x-rays should be performed initially.
  - CT Maxillofacial without contrast (CPT® 70486) may be indicated for evaluation of obstructive anatomy if operative intervention is being considered.
- For Obstructive Sleep Apnea, endoscopic examination of the upper airway and lateral upper airway x-rays should be performed initially.
  - CT Maxillofacial without contrast (CPT® 70486) may be indicated.
- For Central Sleep Apnea, MRI Brain without contrast (CPT® 70551) or without and with contrast (CPT® 70553) is indicated if the clinical picture and/or polysomnography study suggests central sleep apnea.

References

1. Owens JA. Sleep medicine. *Nelson Textbook of Pediatrics, Chapter 19*. eds Kliegman RM, Stanton BF, St. Geme JW III, et al. 20th edition. 2016, pp 111-123.

PEDHD-25: Temporomandibular Joint (TMJ) Imaging in Children

There is a paucity of clinical symptoms and poor sensitivity of conventional x-rays in diagnosing TMJ arthritis in pediatric patients with arthritis.

- TMJ MRI (CPT® 70336) is indicated annually for detecting silent TMJ arthritis in children with juvenile idiopathic arthritis (JIA).

References

1. Zwir LM, Terreri MT, Sousa SA, et al. Are temporomandibular joint signs and symptoms associated with magnetic resonance imaging finings in juvenile idiopathic arthritis patients? A longitudinal study. *Clin Rheumatol*. 2015 Dec; 34 (12) 057-2063. Accessed October 20, 2017. https://link.springer.com/article/10.1007/s10067-015-2925-y.
2. Arabshahi B, and Cron RQ. Temporomandibular joint arthritis in juvenile idiopathic arthritis: the forgotten joint. *Curr Opin Rheumatol*. 2006 Sep; 18 (5): 490-495. Accessed October 20, 2017. https://www.ncbi.nlm.nih.gov/pubmed/16896288?dopt=Abstract.
3. Stoll ML, Kau CH, Waite PD, Cron RQ. Temporomandibular joint arthritis in juvenile idiopathic arthritis, now what? *Pediatric Rheumatology*. 2018;16(1).

PEDHD-26: Tourette's Syndrome

The diagnosis of Tourette's syndrome is made clinically and advanced neuroimaging is not indicated for either diagnosis or management.

References

1. Serajee FJ, and Mahbubl AHM. Advances in tourette syndrome diagnosis and treatment. *Pediatr Clin N Am*. 2015 June; 62 (3): 687-701. Accessed October 20, 2017. http://www.pediatric.theclinics.com/article/S0031-3955(15)00027-9/pdf.

PEDHD-27: Tuberous Sclerosis

- See **PEDONC-2.9: Tuberous Sclerosis Complex (TSC)** for imaging guidelines.

PEDHD-28: Von Hippel Lindau Syndrome (VHL)

- See **PEDONC-2.10: Von Hippel-Lindau Syndrome (VHL)** for imaging guidelines.

PEDHD-29: CNS Infection

- CNS infection imaging indications in pediatric patients are similar to those for adult patients. See **HD-14: CNS Infection** for imaging guidelines.
- Pediatric-specific imaging considerations include suspected congenital brain infection and neonatal meningitis. The common causes of prenatal infections of the central nervous system are cytomegalovirus, *Toxoplasma gondii*, herpes simplex type 2 virus and most recently zika virus. The findings suggesting prenatal brain infection include microcephaly, microphthalmia, chorioretinitis, cataracts, hypotonia, and seizures. The following are performed for congenital brain infections:
  - The following imaging is considered for newborn infants with suspected prenatal brain infection regardless of inciting organism. (For additional information see CDC's Areas with risk of Zika site: https://wwwnc.cdc.gov/travel/page/zika-information)
    - Head ultrasound (CPT© 76506) can be approved as an initial imaging study.
    - If the ultrasound is abnormal, MRI Brain without and with contrast (CPT® 70553) is indicated.
      - Patients requiring sedation should generally not have only non-contrast MRI studies. See **PEDHD-1.3: Pediatric Head Imaging Modality General Consideration**.
  - Newborn infants with microcephaly should be evaluated as discussed in **PEDHD-7: Macrocephaly, Microcephaly, and Hydrocephalus**.
- Neonatal meningitis is most often caused by bacterial pathogens and usually occurs as a complication of sepsis in the first week of life. In older infants and children, meningeal inoculation occurs secondary to hematogenous spread or penetrating trauma.
- The following imaging is considered for newborns or older infants with an open fontanelle and suspected meningitis.
  - Head ultrasound (CPT© 76506) can be approved as an initial imaging study.
  - If the ultrasound is abnormal, MRI Brain without and with contrast (CPT® 70553) is indicated.

References

1. Hedlund G, Balfe JE, and Barkovich AJ. Infections of the developing and mature nervous system. In: Barkovich AJ, Raybaud C. eds *Pediatric Neuroimaging*. 5th ed. Philadelphia PA. Wolters Kluwer. 2012; 954-1050.
2. De Vries LS, and Volpe JJ. Viral, protozoan, and related intracranial infections. In: Volpe JJ, ed. *Volpe's Neurology of the Newborn*. 6th ed. Philadelphia: Elsevier. 2018; 973-1049.
3. Levine D, Jani JC, Castro-Aragon I, et al. How does imaging of congenital Zika compare with imaging of other TORCH infections? *Radiology.* 2017; 285: 744-761.
4. De Oliveria Melo AS, Aquiar RS, Amorim MM, et al. Congenital Zika virus infection: beyond neonatal microcephaly. *JAMA Neurol.*2016 Dec 1; 73: 1407-1416.
5. Vepraskas SA. Zika Virus – an emerging arbovirus associated with fetal abnormalities. CDC's response to Zika. Accessed October 20, 2017. https://www.cdc.gov/zika/pdfs/pediatric-evaluation-follow-up-tool.pdf.
6. Rabe I, Meaney-Delman D, and Moore CA. "Zika Virus – What Clinicians Need to Know." clinician outreach and communication activity call. Centers for Disease Control and Prevention. 26 Jan. 2016. Available at: http://coursewareobjects.elsevier.com/objects/elr/ExpertConsult/Kliegman/nelson20e/updates/CDC_presentation_01262016.pdf

PEDHD-30: Scalp and Skull Lesions

- Scalp and skull lesion imaging indications in pediatric patients are identical to those for adult patients with the exception of neonates. See **HD-20: Scalp and Skull Lesions** for imaging guidelines.
  - In neonates and young infants, scalp masses include:
    - congenital lesions (cephalocele-discussed above, dermoid cysts, epidermoid cyst),
    - vascular lesions (hemangioma, sinus pericranii), and
    - extracranial hemorrhage related to birth trauma (caput succedaneum, cephalohematoma, subgaleal hematoma).
    - After the first year of life, malignant tumors, such as Langerhans cell histiocytosis metastases from neuroblastoma and rhabdomyosarcoma are an additional cause of a scalp mass.
- The following imaging is considered for newborns with palpable scalp and skull lesions.
  - Head ultrasound (CPT® 76506) can be approved as an initial imaging study.
  - If the ultrasound is abnormal and associated anomalies are suspected, MRI Brain without and with contrast (CPT® 70553) (preferred) or CT without and with contrast (CPT® 70470) is indicated.

References

1. Siegel MJ. Brain. In: *Pediatric sonography.* 5th ed. Philadelphia. Wolters Kluwer. 2018 (in press).

PEDHD-31: Eye Disorders

- Eye disorder imaging indications in pediatric patients are identical to those for adult patients. See **HD-32: Eye Disorders** for imaging guidelines.