CLINICAL GUIDELINES

Pediatric Abdomen Imaging Policy

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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.

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PEDIATRIC ABDOMEN IMAGING GUIDELINES

Procedure Codes Associated with Abdomen Imaging	
MRI	**CPT®**
Abdomen MRI without contrast	74181
Abdomen MRI with contrast (rarely used)	74182
Abdomen MRI without and with contrast	74183
Unlisted MRI procedure (for radiation planning or surgical software)	76498
MRA	**CPT®**
Abdomen MRA	74185
CT	**CPT®**
Abdomen CT without contrast	74150
Abdomen CT with contrast	74160
Abdomen CT without and with contrast	74170
Abdomen/Pelvis CT without contrast	74176
Abdomen/Pelvis CT with contrast	74177
Abdomen/Pelvis CT without and with contrast	74178
CT Guidance for Needle Placement (Biopsy, Aspiration, Injection, etc.)	77012
CT Guidance for and monitoring of Visceral Tissue Ablation	77013
CT Guidance for Placement of Radiation Therapy Fields	77014
Unlisted CT procedure (for radiation planning or surgical software)	76497
CTA	**CPT®**
Abdomen CTA	74175
Abdomen/Pelvis CTA	74174
Nuclear Medicine	**CPT®**
PET Imaging; limited area (this code not used in pediatrics)	78811
PET Imaging: skull base to mid-thigh (this code not used in pediatrics)	78812
PET Imaging: whole body (this code not used in pediatrics)	78813
PET with concurrently acquired CT; limited area (this code rarely used in pediatrics)	78814
PET with concurrently acquired CT; skull base to mid-thigh	78815
PET with concurrently acquired CT; whole body	78816
Adrenal Nuclear Imaging Cortex and/or Medulla	78075
Spleen Imaging Only with or without Vascular Flow	78185
Liver Imaging Static	78201
Liver Imaging with Vascular Flow	78202
Liver Imaging SPECT	78205
Liver Imaging SPECT with Vascular Flow	78206
Liver and Spleen Imaging Static	78215
Liver and Spleen Imaging with Vascular Flow	78216

Hepatobiliary System Imaging, Including Gallbladder When Present	**78226**
Hepatobiliary System Imaging, Including Gallbladder When Present; with Pharmacologic Intervention, Including Quantitative Measurement(s) When Performed	**78227**
Gastric Mucosa Imaging	**78261**
Gastroesophageal Reflux Study	**78262**
Gastric Emptying Study	**78264**
Schilling Test	**78270**
B-12 Absorption with Intrinsic Factor	**78271**
GI Bleeding Scintigraphy	**78278**
Gastrointestinal Protein Loss	**78282**
Intestinal Imaging	**78290**
Peritoneal-Venous Shunt Patency	**78291**
Kidney Imaging (Nuclear) Static	**78700**
Kidney Imaging (Nuclear) with Vascular Flow	**78701**
Kidney Image with Function Study (Imaging Renogram)	**78704**
Kidney Flow and Function, Single Study without Pharmacologic Intervention	**78707**
Kidney Imaging with Vascular Flow and Function with Pharmacological Intervention, Single	**78708**
Kidney Imaging with Vascular Flow and Function with and without Pharmacological Intervention, Multiple	**78709**
Kidney Imaging with SPECT	**78710**
Ureteral Reflux Study (Radiopharmaceutical Voiding Cystogram)	**78740**
Radiopharmaceutical Imaging of Inflammatory Process Limited Area	**78805**
Radiopharmaceutical Imaging of Inflammatory Process Whole Body	**78806**
Radiopharmaceutical Imaging of Inflammatory Process SPECT	**78807**
Ultrasound	**CPT®**
Ultrasound, abdomen; complete	**76700**
Ultrasound, abdomen; limited	**76705**
Ultrasound, abdominal wall	**76705**
Ultrasound, retroperitoneal; complete	**76770**
Ultrasound, retroperitoneal; limited	**76775**
Ultrasound, transplanted kidney (with duplex Doppler)	**76776**
Duplex scan of arterial inflow and venous outflow of abdominal, pelvic, scrotal contents and/or retroperitoneal organs; complete study	**93975**
Duplex scan of arterial inflow and venous outflow of abdominal, pelvic, scrotal contents and/or retroperitoneal organs; limited study	**93976**
Duplex scan of aorta, inferior vena cava, iliac vasculature, or bypass grafts; complete	**93978**
Duplex scan of aorta, inferior vena cava, iliac vasculature, or bypass grafts; limited	**93979**

PEDAB-1~General Guidelines

PEDAB-1.1 Pediatric Abdominal Imaging Age Considerations

Many conditions affecting the abdomen in the pediatric population are different diagnoses than those occurring in the adult population. For those diseases which occur in both pediatric and adult populations, minor differences may exist in management due to patient age, comorbidities, and differences in disease natural history between children and adults.

- ✓ Patients age <18 years old should be imaged according to the Pediatric Abdomen Imaging Guidelines, and patients age ≥18 years should be imaged according to the Abdomen Imaging Guidelines, except where directed otherwise by a specific guideline section.

PEDAB-1.2 Pediatric Abdomen Imaging Appropriate Clinical Evaluation and Conservative Treatment

- ✓ A recent (within 60 days) face-to-face evaluation including a detailed history, physical examination, appropriate laboratory studies, and basic imaging such as plain radiography or ultrasound should be performed prior to considering advanced imaging, unless the patient is undergoing guideline-supported scheduled follow-up imaging evaluation.
- ✓ These guidelines are based upon using advanced imaging to answer specific clinical questions that will affect patient management. Imaging is not indicated if the results will not affect patient management decisions. Standard medical practice would dictate continuing conservative therapy prior to advanced imaging in patients who are improving on current treatment programs.
- ✓ Unless otherwise stated in a specific guideline section, the use of advanced imaging to screen asymptomatic patients for disorders involving the abdomen is not supported. Advanced imaging should only be approved in patients who have documented active clinical signs or symptoms of disease.
- ✓ Unless otherwise stated in a specific guideline section, repeat imaging studies of the same body area are not necessary unless there is evidence for progression of disease, new onset of disease, and/or documentation of how repeat imaging will affect patient management or treatment decisions.

PEDAB-1.3 Pediatric Abdomen Imaging Modality General Considerations

- ✓ Ultrasound
  - Ultrasound should be done prior to advanced imaging in most abdominal conditions to rule out those situations that do not require advanced imaging
  - For those patients who do require advanced imaging, ultrasound can be very beneficial in selecting the proper modality, body area, image sequences, and contrast level that will provide the most definitive information for the patient
  - CPT® codes vary by body area and presence or absence of Doppler imaging and are included in the table at the beginning of this guideline.
- ✓ MRI
  - MRI of the abdomen is generally performed without and with contrast (CPT® 74183) unless the patient has a documented contraindication to gadolinium or otherwise stated in a specific guideline section.
  - Due to the length of time for image acquisition and the need for stillness, anesthesia is required for almost all infants and young children (age <7 years), as well as older children with delays in development or maturity. In this patient population, MRI imaging sessions should be planned with a goal of avoiding a short-interval repeat anesthesia exposure due to insufficient information using the following considerations:
    - MRI should always be performed without and with contrast unless there is a specific contraindication to gadolinium use since the patient already has intravenous access for anesthesia.
    - If multiple body areas are supported by eviCore's guidelines for the clinical condition being evaluated, MRI of all necessary body areas should be obtained concurrently in the same anesthesia session.
  - The presence of surgical hardware or implanted devices may preclude MRI.
  - The selection of best examination may require coordination between the provider and the imaging service.
- ✓ CT
  - CT of the abdomen typically extends from the dome of the diaphragm to the upper margin of the sacroiliac joints, and CT of the abdomen and pelvis extends from the dome of the diaphragm through the ischial tuberosities.
    - In general, CT of the abdomen is appropriate when evaluating solid abdominal organs.

- In general, CT of the Abdomen and pelvis is appropriate when evaluating inflammatory or infectious processes, hematuria, or conditions which appear to involve both the abdomen and the pelvis.
- In some cases, especially in follow-up of a known finding, it may be appropriate to limit the exam to the region of concern to reduce radiation exposure

  - The contrast level in pediatric CT imaging is specific to the clinical indication, as listed in the specific guideline sections
  - CT of the abdomen or abdomen and pelvis may be indicated for further evaluation of abnormalities suggested on prior US or MRI studies
  - CT may be indicated without prior MR or US, as indicated in specific sections of these guidelines
  - CT should not be used to replace MRI in an attempt to avoid sedation unless listed as a recommended study in a specific guideline section
  - The selection of the best examination may require coordination between the provider and the imaging service

✓ Nuclear Medicine

  - Nuclear medicine studies are commonly used in evaluation of the pediatric kidney and gallbladder, and other rare indications exist as well:
    - Esophageal motility study (CPT® 78258) and/or Gastroesophageal reflux study (CPT® 78262) is indicated in the evaluation of gastroesophageal reflux
    - Gastric mucosa imaging (Meckel's scan, CPT® 78261) is indicated for the following:
      - Suspected Meckel's diverticulum
      - Barrett's esophagus
    - Thoracic masses suspected of containing gastric mucosa.
    - Gastric emptying study (CPT® 78264) is indicated for evaluation of either suspected delayed or rapid gastric emptying.
    - Gastric emptying study with small bowel transit (CPT® 78265) is indicated for evaluation of suspected abnormalities in both total and regional times for gastrointestinal transit in the small bowel.
    - Gastric emptying study with small bowel and colon transit (CPT® 78266) is indicated for evaluation of suspected abnormalities in both total and regional times for gastrointestinal transit to the colon.
    - Gastrointestinal bleeding scintigraphy (CPT® 78278) is indicated for evaluation of brisk active GI bleeding with indeterminate endoscopy.
    - Gastrointestinal protein loss study (CPT® 78282) is indicated for decreased serum albumin or globulins and no evidence of GI bleeding.

- Nuclear intestinal imaging (CPT® 78290) is indicated for evaluation of ectopic gastric mucosa.
- Peritoneal-venous shunt patency study (CPT® 78291) is indicated for evaluation of shunt patency and function in a patient with ascites.
- Nuclear renal imaging (CPT® 78701, CPT® 78707, CPT® 78708, or CPT® 78709) is indicated for evaluation of the following:
  - Renal transplant follow-up
  - Kidney salvage vs. nephrectomy surgical decisions
  - Acute renal failure with no evidence of obstruction on recent ultrasound
  - Chronic renal failure to estimate prognosis for recovery

✓ 3D Rendering
- 3D Rendering indications in pediatric abdomen imaging are identical to those for adult patients. See **Preface-4.1~3D Rendering** for imaging guidelines.

The guidelines listed in this section for certain specific indications are not intended to be all-inclusive; clinical judgment remains paramount and variance from these guidelines may be appropriate and warranted for specific clinical situations.

References

1. Acr–Spr Practice Parameter For The Performance Of Computed Tomography (CT) Of The Abdomen And Computed Tomography (CT) Of The Pelvis, Amended 2014, available at: http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/CT_Abdomen_Pelvis.pdf
2. Acr–Spr Practice Parameter For The Performance And Interpretation Of Pediatric Magnetic Resonance Imaging (MRI), Amended 2014, available at: http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/MRI_Pediatric.pdf
3. Ing C, DiMaggio C, Whitehouse A et al, Long-term Differences in Language and Cognitive Function After Childhood Exposure to Anesthesia, *Pediatrics* 2012;130:e476-e485.
4. Monteleone M, Khandji A, Cappell J et al, Anesthesia in Children: Perspectives From Nonsurgical Pediatric Specialists, *J Neurosurg Anesthesiol* 2014;26:396-398.
5. DiMaggio C, Sun LS, and Li G, Early Childhood Exposure to Anesthesia and Risk of Developmental and Behavioral Disorders in a Sibling Birth Cohort, *Anesth Analg* 2011; 113:1143-1151.
6. Ramsook C, and Endom EE, Approach to lower gastrointestinal bleeding in children, *Up To Date*, available at:. http://www.uptodate.com/online/content/topic.do?topicKey=pedigast/8638&selectedTitle=1~27&source=search_result.
7. Rossi P, Gourtsoyiannis N, Bezzi M et al, Meckel's diverticulum: imaging diagnosis, *AJR Am J Roentgenol* 1996; 166:567-573.
8. Elsayes KM, Menias CO, Harvin HJ et al, Imaging manifestations of Meckel's diverticulum, *AJR Am J Roentgenol* 2007; 189:81-88.

9. Berquist TH, Nolan NG, Stephens DH et al, Specificity of ^{99}mTc-pertechnetate in scintigraphic diagnosis of Meckel's diverticulum: review of 100 cases, *J Nucl Med* 1976; 17:465-469.
10. Kumar R, Tripathi M, Chandrashekar N et al, Diagnosis of ectopic gastric mucosa using ^{99}Tcm-pertechnetate: spectrum of scintigraphic findings, *Br J Radiol* 2005;78:714-720.
11. Berquist TH, Nolan NG, Stephens DH et al, Radioisotope scintigraphy in diagnosis of Barrett's esophagus, *AJR Am J Roentgenol* 1975;123:401-411.
12. Donohoe KJ, Maurer AH, Ziessman HA et al. Society of Nuclear Medicine Procedure Guideline for Gastric Emptying and Motility, Version 2.0, approved June 6, 2004, available at: http://interactive.snm.org/docs/pg_ch08_0403.pdf.
13. Parkman HP, Hasler WL, and Fisher RS, American Gastroenterological Association Medical Position Statement: diagnosis and treatment of gastroparesis, *Gastroenterology* 2004; 127:1589-1591.
14. Abell TL, Camilleri M, Donohoe KJ et al, Consensus recommendations for gastric emptying scintigraphy: A joint report of the American Neurogastroenterology and Motility Society and the Society of Nuclear Medicine, *Am J Gastroenterol* 2008; 103:753-763.
15. Sarnelli G, Caenepeel P, Geypens B et al, Symptoms associated with impaired gastric emptying of solids and liquids in Functional dyspepsia, *Am J Gastroenterol* 2003; 98:783-788.
16. Lawal A, Barboi A, Krasnow A, et al, Rapid gastric emptying is more common than gastroparesis in patients with autonomic dysfunction, *Am J Gastroenterol* 2007;102:618-623.
17. Chial HJ, Camilleri M, Williams DE et al, Rumination Syndrome in Children and Adolescents: Diagnosis, Treatment, and Prognosis, *Pediatrics* 2003; 111:158-62.
18. Altailji S, Leggett J, Le page K, et al, Utility of gastroesophageal reflux study (GER) to assess for abnormal gastric emptying in comparison to the dedicated standardized gastric emptying study (GE), *J Nucl Med* 2007;48(suppl. 2):289 P.
19. North American Gastroenterological Association Medical Position Statement: Evaluation and management of occult and obscure gastrointestinal bleeding, *Gastroenterology* 2000; 118:197-200.
20. Raju GS, Gerson L, Das A et al, American Gastroenterological Association (AGA) Institute medical position statement on obscure gastrointestinal bleeding, *Gastroenterology* 2007;133:1694-1696.
21. Zuckerman GR, Prakash C, Askin MP et al, AGA Technical review on the evaluation and management of occult and obscure gastrointestinal bleeding, *Gastroenterology* 2000;118:201-221.
22. Morton KA, Clark PB, et al. Diagnostic Nuclear Medicine, Amursys, 2007, (8):122-125.
23. Thrall JH and HA Zeissman. Nuclear Medicine, The Requisites, Mosby, 2001, 288-289.
24. Remer EM, Papanicolaoui N, Casalino DD et al, Renal Failure, *ACR Appropriateness Criteria®*, 2013:1-12.

PEDAB-2~Generalized Abdominal Pain

- ✓ Children with generalized abdominal pain and normal physical examination and laboratory studies, including stool for blood (and stool culture if diarrhea), should initially be evaluated by ultrasound (CPT® 76700 or CPT® 76705) and treated conservatively.
  - Gastroenterology (GI) specialist evaluation is helpful in determining the need for advanced imaging.
- ✓ Children with abdominal pain that can be localized to a particular area of the abdomen should be imaged according to the relevant guideline section
  - **PEDAB-3~Right Lower Quadrant Pain**
  - **PEDAB-4~Flank Pain, Rule Out Renal Stone**
  - **PEDAB-8~Right Upper Quadrant Pain**
  - **PEDAB-24~Abdominal Lymphadenopathy**
  - **PEDAB-28~Bowel Obstruction**
- ✓ Children with generalized acute abdominal pain **AND** any of the following red flag signs or symptoms require additional investigation (which may include advanced imaging). CT Abdomen (CPT® 74160) or Abdomen/Pelvis (CPT® 74177) with contrast is indicated unless otherwise specified in a specific guideline section:
  - Pain that wakes the child from sleep
  - Unexplained fever (T≥100.4°F)
  - Dysphagia
  - GI bleeding
  - Significant vomiting
  - Severe chronic diarrhea or nocturnal diarrhea in a toilet-trained child
  - Failure to thrive, involuntary weight loss, or delay in linear growth or pubertal development
  - Family history of inflammatory bowel disease, celiac disease, or peptic ulcer disease
  - Abdominal mass, hepatomegaly, and/or splenomegaly on exam
  - Jaundice
  - Arthritis
  - Costovertebral angle tenderness
  - Perianal disease
  - Spinal tenderness

References

1. Sreedharan R and Liacouras CA, Major Symptoms and Signs of Digestive Tract Disorders, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1240-1249.
2. Sreedharan R and Liacouras CA, Functional Abdominal Pain (Nonorganic Chronic Abdominal Pain), *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1346-1349.
3. Cogley JR, O'Connor SC, Houslryar R, and Al Dulaimy K, Emergent Pediatric US: What Every Radiologist Should Know, Radiographics 2012:32: 651-665.

PEDAB-3~Right Lower Quadrant Pain

- ✓ For patients age ≤14 years:
  - If local expertise exists, ultrasound (CPT® 76700 or CPT® 76705) is indicated as the initial examination. If positive or negative, no further diagnostic imaging is necessary.
    - If the appendix is not visualized on ultrasound and the white blood cell count is not elevated, no further imaging is necessary.
  - If insufficient local ultrasound expertise exists or the ultrasound findings are inconclusive, any of the following studies are indicated for evaluation of right lower quadrant pain:
    - CT Abdomen/Pelvis with contrast (CPT® 74177)
    - CT Abdomen/Pelvis without contrast (CPT® 74176)
    - MRI Pelvis without contrast (CPT® 72195)
    - MRI Pelvis without and with contrast (CPT® 72197)
- ✓ For patients age ≥15 years:
  - Any of the following studies are indicated:
    - CT Abdomen/Pelvis with contrast (CPT® 74177)
    - CT Abdomen/Pelvis without contrast (CPT® 74176)
    - MRI Pelvis without contrast (CPT® 72195)
    - MRI Pelvis without and with contrast (CPT® 72197)

If the appendix is absent, follow guidelines in: **PEDAB-2~Generalized Abdominal Pain**

References

1. Smith MP, Katz DS, Rosen MP et al, Right Lower Quadrant Pain—Suspected Appendicitis, *ACR Appropriateness Criteria®*, 2013:1-10.
2. Aiken JJ and Oldham KT, Acute Appendicitis, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1349-1355.
3. Aspelund G, Fingeret A, Gross E et al, Ultrasonography/MRI Versus CT for Diagnosing Appendicitis, *Pediatrics* 2014;133:586-593.
4. Moore MM, Gustas CN, Choudhary AK et al, MRI for clinically suspected pediatric appendicitis: an implemented program, *Pediatr Radiol* 2012; 42:1056-1063.
5. Kotagal M, Richards MK, Chapman T et al, Improving ultrasound quality to reduce computed tomography use in pediatric appendicitis: the Safe and Sound campaign, *Am J Surg* 2015:209:896-900.
6. Kotagal M, Richards MK, Flum DR et al, Use and accuracy of diagnostic imaging in the

evaluation of pediatric appendicitis, J Pediatr Surg 2015;50:642-646.
7. Cohen B, Bowling J, Midulla P et al, The non-diagnostic ultrasound in appendicitis: is a non-visualized appendix the same as a negative study?, J Pediatr Surg 2015;50:923-927.
8. Bachur RG, Levy LA, Callahan MJ, Rangel SJ, and Monuteaux MC, Effect of Reduction in the Use of Computed Tomography on Clinical Outcomes of Appendicitis, *JAMA Pediatr* 2015;169:755-760.

PEDAB-4~Flank Pain, Rule Out Renal Stone

- ✓ Flank Pain imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-4~Flank Pain, Rule out Renal Stone** for imaging guidelines.
- ✓ Pediatric-specific imaging considerations include the following:
  - In children, ultrasound (CPT® 76770 or CPT® 76775) is the preferred initial study
  - If ultrasound is inconclusive, CT Abdomen/Pelvis without contrast (CPT® 74176) is indicated.
  - If CT is inconclusive or there is significant concern for radiation exposure from frequent CT use for a particular patient, MRI without and with contrast of the abdomen (CPT® 74183) and pelvis (CPT® 72197) is indicated.
  - If hematuria is present, see **PEDAB-7~Hematuria** for imaging guidelines.
- ✓ Nuclear kidney imaging (CPT® 78707, CPT® 78708, or CPT® 78709) is indicated for evaluation of recurrent flank pain when CT and ultrasound are non-diagnostic, or for suspected obstructive uropathy.

References

1. Coursey CA, Casalino DD, Remer EM et al, Acute Onset Flank Pain—Suspicion of Stone Disease, *ACR Appropriateness Criteria®*, 2011:1-9.
2. ACR–SPR Practice Guideline for the Performance of Renal Scintigraphy. http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/Renal_Scintigraphy.pdf.
3. Tekgül S, Riedmiller H, Gerharz E, et al. European Association of Urology, European Society for Paediatric Urology, Guidelines on Paediatric Urology, 2009. http://www.uroweb.org/fileadmin/tx_eauguidelines/2009/Full/Paediatric_Urology.pdf. February 8, 2012.

PEDAB-5~Urinary Tract Infection (UTI)

PEDAB-5.1 Upper Urinary Tract

- ✓ Males with first time UTI (and females with first or second UTI) should undergo ultrasound evaluation (CPT® 76770 or CPT® 76775), as the initial imaging modality to diagnose hydronephrosis, pyelonephritis, or congenital renal anomaly.
  - o If hydronephrosis is present, this should be further evaluated with voiding cystourethrography (VCUG), to evaluate for vesicoureteral reflux.
- ✓ Diuretic renography using Tc-99m MAG 3 (CPT® 78707, CPT® 78708, or CPT® 78909) is the study of choice for the following indications:
  - o Differentiating a dilated non-obstructed urinary system from a true stenosis (e.g., UPJ obstruction; ureteral-vesical junction [UVJ] obstruction), and for
  - o Quantifying renal parenchymal function.
  - o Ultrasound findings that are compatible with a multicystic dysplastic kidney to evaluate function of the affected kidney or a ureteral-pelvic junction (UPJ) obstruction of the contralateral kidney
  - o Diagnostic evaluation of upper tract dilatation when VCUG is negative
  - o Renal function evaluation in patients with hydronephrosis
- ✓ Magnetic resonance urography (MRU) (CPT® 74183 and CPT® 72197), is appropriate (where available) for investigation of a dilated upper urinary tract
  - o **NOTE:** MRU requires sedation in young children
  - o MRU can also quantitate renal function
  - o MRU is very sensitive for the detection of acute pyelonephritis, and where available can be used in place of CT
- ✓ Technetium-99m-dimercaptosuccinic acid (Tc-99m DMSA) scintigraphy (CPT® 78700, CPT® 78701, or CPT® 78710), is indicated in the following:
  - o Children aged 5 years or younger with febrile UTI for the diagnosis of acute pyelonephritis. Sensitivity of DMSA scintigraphy is much higher than ultrasound and is equivalent to CT, but at a lower radiation dose.
  - o Detection of post-pyelonephritic renal scarring at least 6 months after the documented upper tract UTI

- ✓ Radiopharmaceutical nuclear medicine imaging (CPT® 78805, CPT® 78806, or CPT® 78807) is indicated for evaluation of suspected pyelonephritis or diffuse interstitial nephritis.

PEDAB-5.2 Lower Urinary Tract

- ✓ Fluoroscopic Voiding cystourethrography (VCUG) is indicated for detection of possible vesico-ureteral reflux (VUR) in neonates or young children when hydronephrosis is seen on ultrasound.
- ✓ The American Academy of Pediatrics clinical practice guidelines no longer recommend routine VCUG for infants and young children from 2 to 24 months of age after the first febrile UTI.
  - The current recommendation is to postpone the VCUG until the second febrile UTI UNLESS there are:
    - Atypical or complex clinical circumstances
    - Renal/bladder ultrasound reveals hydronephrosis, scarring, or obstructive uropathy
- ✓ Vesicoureteral Reflux (VUR)
  - Fluoroscopic VCUG is typically performed for diagnosis and grading of VUR, and should be the first modality used for diagnosis.
  - Radionuclide cystography (CPT® 78740), because of its lower radiation burden and higher sensitivity for reflux > Grade I, is recommended for follow-up imaging of VUR, and investigation of VUR in siblings of affected patients.
- ✓ Male patients with first UTI should be evaluated with fluoroscopic VCUG studies rather than radionuclide cystography, to visualize the male urethra for possible posterior urethral valves
- ✓ For female patients, radionuclide cystography (CPT® 78740) may replace fluoroscopic VCUG as the initial study, since urethral anatomy is rarely abnormal except in complex malformations
- ✓ MR urography is indicated for evaluation of ectopic distal ureteral insertion, or other complex lower urinary tract anatomy.
- ✓ Siblings of patients with known vesicoureteral reflux can have radiopharmaceutical VUCG (CPT® 78740) if they have renal scarring on ultrasound or history of UTI and no prior evaluation for VUR

References

1. Mandell GA, Eggli DF, Gilday DL, et al. Society of Nuclear Medicine Procedure Guideline for Renal Cortical Scintigraphy in Children. *Society Nuclear of Medicine Procedure Guidelines Manual*.1997, pp.135 -139
2. Urinary Tract Infection: Clinical Practice Guideline for the Diagnosis and Management of the Initial UTI in Febrile Infants and Children 2 to 24 Months, *Pediatrics* 2011; 128:595-610.
3. Karmazyn B, Coley BD, Binkovitz LA et al, Urinary Tract Infection—Child, *ACR Appropriateness Criteria®*, 2012:1-11.
4. Elder JS, Urinary Tract Infections, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1829-1834.
5. Jackson EC, Urinary Tract Infections in Children: Knowledge Updates and a Salute to the Future, *Pediatr Rev* 2015; 36:153-164.
6. Peters CA, Skoog SJ, Arant BS et al, American Urological Association, Management and screening of primary vesicoureteral reflux in children: AUA guideline 2010, available at: http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines.cfm?sub=vur2010.
7. Fettich J, Colarinha P, Fischer S et al, Paediatric Committee of the European Association of Nuclear Medicine, Guidelines for direct radionuclide cystography in children, available at: http://www.eanm.org/publications/guidelines/gl_paed_drc.pdf.
8. Palestro CJ, Brown ML, Forstrom LA et al, Society of Nuclear Medicine Procedure Guideline for 111In-Leukocyte Scintigraphy for suspected infection /inflammation, Version 3.0, approved June 2, 2004. http://interactive.snm.org/docs/Leukocyte_v3.pdf.
9. De Vries EFJ, Roca M, Jamar F et al, Guidelines for the labelling of leucocytes with ^{99m}Tc-HMPAO, Eur J Nucl Med Mol Imaging 2010;37:842-848.

PEDAB-6~Pediatric Acute Gastroenteritis

- ✓ Imaging is not indicated in pediatric acute gastroenteritis unless there is a concern for other causes of symptoms
- ✓ When necessary, imaging in children with suspected gastroenteritis should begin with plain x-rays of the abdomen, including supine and left lateral decubitus views. The left lateral decubitus view is useful for the detection of air-fluid levels and for detection of gas in the rectum and to exclude obstruction.
- ✓ Ultrasound (CPT® 76700 or CPT® 76705) should be performed if there is organomegaly, palpable mass, or suspicion for intussusception (See: **PEDAB-27~Intussusception**)
  - While ultrasound (CPT® 76700 or CPT® 76705) may detect findings of gastroenteritis, imaging is not necessary to make the diagnosis of uncomplicated gastroenteritis
- ✓ CT Abdomen/Pelvis with contrast (CPT® 74177) is indicated if abdominal red flag symptoms are present as listed in **PEDAB-2~Generalized Abdominal Pain**.

References

1. Bhutta ZA, Acute Gastroenteritis in Children, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1323-1339.
2. Levine A and Santucci KA. *Pediatric gastroenteritis*. eMedicine, October 9, 2014, *http://emedicine.medscape.com/article/801948-overview*, Accessed June 4, 2015
3. Granado-Villar D, Cunill-De Santu B, and Granados A, Acute Gastroenteritis, *Pediatr Rev* 2012; 33:487-495.

PEDAB-7~Hematuria

Hematuria is a relatively common complaint in pediatric patients, and the imaging considerations are different than those occurring in adult patients.

- ✓ For patients with asymptomatic gross hematuria or microscopic hematuria present on separate urinalysis evaluations, ultrasound of the kidneys (CPT® 76770 or CPT® 76775) and bladder (CPT® 76856 or CPT® 76857) are indicated.
- ✓ For patients with painful hematuria and no recent trauma, any of the following studies can be approved:
  - CT Abdomen/Pelvis without contrast (CPT® 74176)
  - Ultrasound of kidneys (CPT® 76770 or CPT® 76775)
  - Ultrasound of bladder (CPT® 76856 or CPT® 76857)
- ✓ For patients with hematuria and recent trauma, the following studies are indicated:
  - CT Abdomen/Pelvis with contrast (CPT® 74177)
  - CT Cystography (CT Pelvis with bladder contrast—CPT® 72193), if gross hematuria is present and pelvic fracture or traumatic bladder injury is suspected.

References

1. Dillman JR, Coley BD, Karmazyn B et al, Hematuria—Child, *ACR Appropriateness Criteria®*, 2012:1-11.
2. Pan CG and Avner ED, Clinical Evaluation of the Child with Hematuria, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1778-1781.

PEDAB-8~Right Upper Quadrant Pain

- ✓ Right upper quadrant pain imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-2~Abdominal Pain** for imaging guidelines.
- ✓ Pediatric-specific imaging considerations include the following:
- ✓ MRI is preferred over CT when possible to reduce radiation exposure.
- ✓ Nuclear medicine imaging of the hepatobiliary system (HIDA scan, CPT® 78226 or CPT® 78227) is indicated in the following:
  - Suspected acute cholecystitis when ultrasound is nondiagnostic (CPT® 78226)
    - CPT® 78227 is supported when gallbladder does not fill on routine HIDA scan (CPT® 78226)
  - Chronic Cholecystitis with one of the following (CPT® 78226):
    - Evidence of gallstones on prior ultrasound
    - Recurrent RUQ pain
    - CPT® 78227 is supported when gallbladder does not fill on routine HIDA scan (CPT® 78226)
  - Chronic acalculous cholecystitis with recurrent RUQ pain and no evidence of gallstones on ultrasound (CPT® 78227)
  - Suspected bile leak after trauma or surgery (CPT® 78226)
  - Preoperative assessment prior to partial hepatectomy (CPT® 78226)
  - Preoperative assessment of post-operative liver remnant or monitoring of liver regeneration (CPT® 78226)
  - Assessment of liver transplant or choledochal cyst (CPT® 78226)
  - Sphincter of Oddi dysfunction with recurrent RUQ pain and no evidence of gallstones on ultrasound (CPT® 78226 or CPT® 78227)
  - Calculation of gallbladder ejection fraction or biliary dyskinesia with persistent RUQ pain and no evidence of gallstones on ultrasound (CPT® 78227)

References

1. Yarmish GM, Smith MP, Rosen MP et al, Right Upper Quadrant Pain, *ACR Appropriateness Criteria®*, 2013:1-9.
2. Weissmann GS, Frank MS, Bernstein LH et al, Rapid and accurate diagnosis of acute cholecystitis with 99mTc-HIDA cholescintigraphy, *AJR Am J Roentgenol* 1979; 132:523-528.

3. Tulchinsky M, Ciak BW, Delbeke et al, *SNM Guidelines for Hepatobiliary Scintigraphy* V4.0 – Revised 2010, available at: http://interactive.snm.org/docs/Hepatobiliary_Scintigraphy_V4.0.pdf.
4. Brown RKJ, Parisi MT, Sokol L et al, Practice guideline for the performance of adult and pediatric hepatobiliary scintigraphy, *ACR Practice Guideline* 2008:1-5, available at: http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/Hepatobiliary_Scintigraphy.pdf.
5. Behar J, Corazziari E, Guelrud M et al, Functional Gallbladder and sphincter of Oddi disorders, *Gastroenterology* 2006;130:1498-1509.

PEDAB-9~Inflammatory Bowel Disease, Crohn Disease, or Ulcerative Colitis

Enterography is the most appropriate advanced imaging study for patients with inflammatory bowel disease (IBD).

- ✓ For children with suspected IBD, MR enterography (CPT® 74183 and CPT® 72197) is preferred to avoid radiation exposure.
  - CT enterography (CPT® 74177) is indicated if MR enterography is inconclusive or unavailable.
- ✓ For children with established IBD, MR enterography (CPT® 74183 and CPT® 72197) is indicated for the following:
  - Monitoring response to disease-modifying treatment on an annual basis or when treatment change is being considered.
  - Patients with new or worsening symptoms or suspected complications including abscess, perforation, fistula, or obstruction.
  - CT enterography (CPT® 74177) can be approved if MR enterography is inconclusive or unavailable.

References

1. Kim DH, Carucci LR, Baker ME et al, Crohn Disease, *ACR Appropriateness Criteria®*, 2014:1-22.
2. Duigenan S and Gee MS, Imaging of Pediatric Patients With Inflammatory Bowel Disease, *AJR Am J Roentgenol* 2012; 199:907-915.
3. Grossman AB and Baldassano RN, Inflammatory Bowel Disease, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1294-1304.

PEDAB-10~Abdominal Sepsis (Suspected Abdominal Abscess)

Abdominal sepsis imaging indications in pediatric patients are identical to those for adult patients.

See **AB-3~Abdominal Sepsis (Suspected Abdominal Abscess)** for imaging guidelines.

PEDAB-11~Postoperative Pain Within 60 Days Following Abdominal Surgery

- ✓ CT Abdomen/Pelvis with contrast (CPT® 74177) is indicated in patients with suspected postoperative complications (e.g. bowel obstruction, abscess, anastomotic leak, etc.)
  - Children can also be evaluated with ultrasound (CPT® 76700 or CPT® 76705) initially (especially in small children or in thin older children) or with MRI abdomen and pelvis without and with contrast (CPT® 74183 and CPT® 72197)
  - Because MRI may not be practical for the timely evaluation of post-operative abscesses, MRI should only replace CT when the study can be completed in a similar time frame as CT
- ✓ Radiopharmaceutical nuclear medicine imaging (CPT® 78805, CPT® 78806, or CPT® 78807) is indicated for evaluation of any of the following:
  - Peritonitis
  - Postoperative fever without localizing signs or symptoms
- ✓ Beyond 60 days postoperatively, see: **PEDAB-2~Generalized Abdominal Pain**.

References

1. Katz DS, Baker MF, Rosen MP et al, Suspected Small Bowel Obstruction, *ACR Appropriateness Criteria®,* 2013:1-10.
2. Yagmhai V, Rosen MP, Lalani T et al, Acute (Nonlocalized) Abdominal Pain and Fever or Suspected Abdominal Abscess, *ACR Appropriateness Criteria®,* 2012:1-13.
3. Palestro CJ, Brown ML, Forstrom LA et al, Society of Nuclear Medicine Procedure Guideline for 111In-Leukocyte Scintigraphy for suspected infection /inflammation, Version 3.0, approved June 2, 2004. http://interactive.snm.org/docs/Leukocyte_v3.pdf.
4. De Vries EFJ, Roca M, Jamar F et al, Guidelines for the labelling of leucocytes with ^{99m}Tc-HMPAO, Eur J Nucl Med Mol Imaging 2010;37:842-848.

PEDAB-12~Constipation, Diarrhea, and Irritable Bowel Syndrome

Constipation and diarrhea are is extremely common complaints in children. The overwhelming majority of patients do not require advanced imaging for evaluation of constipation or diarrhea.

Irritable bowel is rare in young children, but more common in adolescents. The overwhelming majority of patients do not require advanced imaging for evaluation of irritable bowel syndrome.

- ✓ Constipation that is associated with the following additional red flag signs or symptoms may require advanced imaging:
  - Red flag symptoms for abdominal pain (**See PEDAB-2~Generalized Abdominal Pain**) Clinical suspicion of tethered cord based on abnormal physical findings over the spine or failure of maximal laxative therapy. (See **PEDSP-5~Tethered Cord** for imaging guidelines)
- ✓ Diarrhea that is associated with the following additional red flag signs or symptoms may require advanced imaging:
  - Red flag symptoms for abdominal pain (**See PEDAB-2~Generalized Abdominal Pain**)
- ✓ Irritable bowel syndrome that is associated with the following additional red flag signs or symptoms may require advanced imaging:
  - Red flag symptoms for abdominal pain (**See PEDAB-2~Generalized Abdominal Pain**)

References

1. Sreedharan R and Liacouras CA, Major Symptoms and Signs of Digestive Tract Disorders, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1240-1249.
2. Sreedharan R and Liacouras CA, Functional Abdominal Pain (Nonorganic Chronic Abdominal Pain), *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1346-1349.
3. Fiorino KN and Liacouras CA, Functional Constipation, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, p 1284.
4. Guarino A and Branski D, Chronic Diarrhea, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, p 1339-1346.
5. Zella GC and Israel EJ, Chronic Diarrhea in Children, *Pediatr Rev* 2012; 33:207-217.

PEDAB-13~Abdominal Mass

PEDAB-13.1 Abdominal Wall Mass

- ✓ For initial imaging of a newly discovered abdominal wall mass, any of the following studies are indicated:
  - Ultrasound (CPT® 76700)
  - MRI Abdomen without contrast (CPT® 74181) or without and with contrast (CPT® 74183)
  - If below the umbilicus, MRI Pelvis without contrast (CPT® 72195) or without and with contrast (CPT® 72197) may be added to MRI Abdomen
- ✓ If ultrasound and/or MRI are inconclusive or insufficient for preoperative planning, any of the following studies are indicated:
  - CT abdomen with contrast (CPT® 74160) or without contrast (CPT® 74150)
  - If below the umbilicus, CT Abdomen/Pelvis with contrast (CPT® 74177) or without contrast (CPT® 74176)

PEDAB-13.2 Intra-Abdominal Mass

- ✓ Ultrasound (CPT® 76700) should be the initial imaging study for children with an intra-abdominal mass.
- ✓ Additional imaging studies will be determined by the results of the ultrasound, and will depend on the location and organ involvement associated with the mass as well as history, physical exam, and laboratory findings. See the following sections for additional imaging guidelines:

  - **PEDONC-1~General Guidelines**
  - **PEDONC-5~Pediatric Lymphomas**
  - **PEDONC-6~Neuroblastoma**
  - **PEDONC-7~Pediatric Renal Tumors**
  - **PEDONC-10~Pediatric Germ Cell Tumors**
  - **PEDONC-11~Pediatric Liver Tumors**
  - **PEDONC-14~Pediatric Adrenocortical Carcinoma**
  - **PEDAB-15~Liver Lesion Characterization**
  - **PEDAB-17~Adrenal Lesions**
  - **PEDAB-19~Indeterminate Renal Lesion**
  - **PEDAB-26~Spleen**

References

1. Kilburn LB, Siegel SE, and Steuber CP, Clinical Assessment and Differential Diagnosis of the Child With Suspected Cancer, *Principles and Practice of Pediatric Oncology*, eds Pizzo PA and Poplack DG, 6th edition 2011, pp. 123-137.
2. Lakkaraju A, Sinha R, Garikipati R, Edward S, Robinson P. Ultrasound for initial evaluation and triage of clinically suspicious soft-tissue masses. *Clin Radiol*, 2009; 64: 615-621.
3. Zoga AC, Weissman BN, Kransdorf MJ, Adler R, et al. ACR Appropriateness Criteria: Soft Tissue Masses. American College of Radiology, 2012

PEDAB-14~Renovascular Hypertension

- ✓ Any of the following studies are indicated for initial evaluation of a pediatric patient with repeated systolic BP >95th percentile for age (≥3 measurements):
  - Doppler or Duplex Ultrasound (CPT® 93975 or CPT® 93976)
  - Complete retroperitoneal ultrasound (CPT® 76770)
  - Captopril renography (CPT® 78709)

Age (years)	95th percentile SBP Boys	95th percentile SBP Girls
1	106	107
2	110	109
3	112	110
4	113	112
5	116	113
6	117	115
7	119	116
8	120	118
9	121	120
10	123	122
11	125	124
12	127	126
13	130	128
14	132	129
15	135	130
16	137	131
17	140	132

- ✓ All follow-up requests for pediatric hypertension will go to Medical Directors for review.

Other considerations for imaging evaluation:

- ✓ Abdominal MRA (CPT® 74185) or CTA (CPT® 74175) may be indicated for pediatric patients with hypertension to exclude fibromuscular dysplasia of the renal arteries.
- ✓ Echocardiography (CPT® 93306) is indicated at initial evaluation to screen for cardiac abnormalities, coarctation of the aorta, and end-organ damage such as left ventricular hypertrophy.

- ✓ Nuclear renal imaging (CPT® 78707, CPT® 78708, or CPT® 78709 is indicated for evaluation of the following:
  - Severe hypertension with progressive renal insufficiency or failure to respond to 3 drug therapy)
  - Malignant or accelerated hypertension
  - Acute worsening of previously stable hypertension
  - Diastolic BP >100 in patient <35 years old
  - New onset severe hypertension (diastolic BP >110) in patient >50 years old
  - Hypertension in presence of asymmetric kidneys or diffuse atherosclerosis
  - Hypertension in presence of acute elevation in creatinine either unexplained or after treatment with ACE inhibitor
  - Abdominal bruit
  - Recurrent acute pulmonary edema and hypertension
  - Hypokalemia with normal or elevated plasma renin level in absence of diuretic therapy
  - Hypertension with known neurofibromatosis

References

1. Bolduc JP, Loiva VL, Therasse E et al, Diagnosis and Treatment of Renovascular Hypertension: A Cost-Benefit Analysis, *AJR Am J Roentgenol* 2005; 184:931-937.
2. Harvin HJ, Casalino DD, Remer EM et al, Renovascular Hypertension, *ACR Appropriateness Criteria®*, 2012:1-12.
3. Moser M and Setaro JF, Resistant or Difficult-to-Control Hypertension. *N Engl J Med* 2006; 355:385-392.
4. Lande MB, Systemic Hypertension, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1639-1647.
5. Brady TM, Hypertension, Pediatr Rev 2012; 33:541-550.
6. Ingelfinger JR, The Child or Adolescent with Elevated Blood Pressure, *N Engl J Med* 2014; 370:2316-2325.
7. Taylor AT, Blaufox MD, Dubovsky EV et al, Society of Nuclear Medicine Procedure guideline for diagnosis of renovascular hypertension, version 3.0, available at: http://interactive.snm.org/docs/pg_ch16_0403.pdf.
8. ACR–SPR Practice Guideline for the Performance of Renal Scintigraphy. http://www.acr.org/~/media/ACR/Documents/PGTS/guidelines/Renal_Scintigraphy.pdf.
9. Hartman RP, Kawashima A, Radiologic evaluation of suspected renovascular hypertension, Am Fam Physician, 2009; 80:273-279.
10. Tekgül S, Riedmiller H, Gerharz E, et al. European Association of Urology, European Society for Paediatric Urology, Guidelines on Paediatric Urology, 2009. http://www.uroweb.org/fileadmin/tx_eauguidelines/2009/Full/Paediatric_Urology.pdf. February 8, 2012.

PEDAB-15~Liver Lesion Characterization

- ✓ Liver lesion characterization imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-29~Liver Lesion Characterization** for imaging guidelines.
- ✓ Nuclear medicine liver imaging (ONE of CPT® codes: 78201, 78202, 78205, 78206, 78215, or 78216) if rarely performed, but can be approved for the following when ultrasound, CT, and MRI are unavailable or contraindicated:
  - Evaluation of liver mass, trauma, or suspected focal nodular hyperplasia (FNH)
  - Differentiation of hepatic hemangioma from FNH
  - Diffuse hepatic disease or elevated liver function tests
  - Suspected accessory spleen (CPT® 78215 or CPT® 78216 only)
- ✓ Pediatric-specific imaging considerations includes:
  - MRI is preferred over CT when possible to reduce radiation exposure.

References

1. Boamah LM and Balistreri WF, Evaluation of Patients with Possible Liver Dysfunction, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1378-1381.
2. Ma IT, Rojas Y, Masand PM et al, Focal nodular hyperplasia in children: An institutional experience with review of the literature, *J Pediatr Surg* 2015;50:382-387.
3. Baker ME, Nelson RC, Rosen MP et al, Liver Lesion—Initial Characterization, *ACR Appropriateness Criteria®* 2014;1-24.
4. Royal HD, Brown ML, Drum DE. Society of Nuclear Medicine Procedure guideline for hepatic and splenic imaging 3.0, version 3.0, approved July 20, 2003, available at: http://interactive.snm.org/docs/pg_ch10_0403.pdf.

PEDAB-16~Pediatric Liver Failure and Cirrhosis

- ✓ Elevated liver function testing imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-30~Elevated Liver Function (LFT) Levels** for imaging guidelines.
- ✓ Causes of liver failure or cirrhosis in pediatric patients are different from adults, and are frequently idiopathic, but commonly due to one of the following:
  - Biliary dysfunction (biliary atresia, cystic fibrosis, etc.)
  - Metabolic disease
  - Post-infectious
- ✓ Liver ultrasound (CPT® 76700) is indicated as an initial study for patients prior to approving CT or MRI for pediatric patients.
  - MRI Abdomen without and with contrast (CPT® 74183) is indicated for evaluation of ultrasound findings that are inconclusive or technically limited, and is preferred over CT when possible to reduce radiation exposure.
- ✓ Repeat liver ultrasound (CPT® 76705) is indicated in pediatric patients in the following circumstances:
  - Known chronic liver dysfunction or cirrhosis of any cause.
  - New or worsening findings on history, physical exam, or laboratory results that suggest progression of liver disease.
  - Doppler ultrasound of the liver (CPT® 93975 or CPT® 93976) is indicated when portal venous congestion or portal hypertension is suspected.
- ✓ Nuclear medicine liver imaging (ONE of CPT® codes: 78201, 78202, 78205, 78206, 78215, or 78216) if rarely performed, but can be approved for the following when ultrasound, CT, and MRI are unavailable or contraindicated:
  - Diffuse hepatic disease or elevated liver function tests.

References

1. Boamah LM and Balistreri WF, Evaluation of Patients with Possible Liver Dysfunction, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1378-1381.
2. Fusillo S and Rudolph B, Nonalcoholic Fatty Liver Disease, *Pediatr Rev* 2015; 36:198-205.
3. Van Rijn RR and Nievelstein RAJ, Paediatric ultrasonography of the liver, hepatobiliary tract and pancreas, *Eur J Radiol* 2014:83:1570-1581.
4. Paranjape SM and Mogayzel PJ, Cystic Fibrosis, *Pediatr Re*v 2014; 35:194-204.

5. Baker ME, Nelson RC, Rosen MP et al, Liver Lesion—Initial Characterization, *ACR Appropriateness Criteria®* 2014;1-24.
6. Royal HD, Brown ML, Drum DE. Society of Nuclear Medicine Procedure guideline for hepatic and splenic imaging 3.0, version 3.0, approved July 20, 2003, available at: http://interactive.snm.org/docs/pg_ch10_0403.pdf.

PEDAB-17~Adrenal Lesions

- ✓ Adrenal cortical lesion imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-16~Adrenal Cortical Lesions** for imaging guidelines.
- ✓ Pediatric-specific imaging considerations include the following:
  - Neonatal adrenal hemorrhage may be identified on renal ultrasound. The most concerning potential diagnosis is neuroblastoma. This can often be adequately evaluated with short interval follow-up retroperitoneal ultrasound (CPT® 76770) in 7-10 days.
    - If repeat ultrasound is inconclusive or there is high clinical concern for neuroblastoma, MRI Abdomen without and with contrast (CPT® 74183) or CT Abdomen without and with contrast (CPT® 74170) is indicated. MRI is preferred over CT when possible to reduce radiation exposure.
  - Neuroblastoma is the most common primary adrenal tumor in pediatric patients. See **PEDONC-6~NEUROBLASTOMA** for imaging guidelines.
- ✓ Additional adrenal imaging considerations include the following:
  - Adrenal Nuclear Imaging of the cortex and/or medulla (CPT® 78075) is indicated for the following:
    - Distinguishing adrenal adenoma from adrenal hyperplasia.
    - Evaluation of suspected pheochromocytoma or paraganglioma.
      - MIBG preferred (ONE of CPT® codes: 78800, 78801, 78802, 78803, or 78804).
      - For known pheochromocytoma or paraganglioma, see **ONC-15~Neuroendocrine Cancers and Adrenal Tumors** for imaging guidelines.
    - Evaluation of suspected neuroblastoma, ganglioneuroblastoma, or ganglioneuroma.
      - MIBG preferred (ONE of CPT® codes: 78800, 78801, 78802, 78803, or 78804), see **PEDONC-6~NEUROBLASTOMA** for imaging guidelines.
    - History of multiple endocrine neoplasia: see **PEDONC-2.8 Multiple Endocrine Neoplasias (MEN)** for imaging guidelines.
    - History of neurofibromatosis: see **PEDONC-2.3 Neurofibromatosis 1 and 2 (NF1 and NF2)** for imaging guidelines.

- History of von Hippel-Lindau disease: see **PEDONC-2.10 Von Hippel-Lindau Syndrome (VHL)** for imaging guidelines.

References

1. White PC, Congenital Adrenal Hyperplasia and Related Disorders, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1930-1943.
2. Gawande, R, Castenaeda, R, Daldrup-Link, H Adrenal hemorrhage in Pearls and Pitfalls, *Pediatric Imaging: Variants and Other Difficult Diagnoses* eds. Heike E, Daldrup-Link, and Newman B, Cambridge University Press, Apr 24, 2014.
3. Moreira SG Jr. and Pow-Sang JM, Evaluation and management of adrenal masses, *Cancer Control* 2002; 9:326-334.
4. Torre JJ, Bloomgarden ZT, Dickey RA, et al, AACE Hypertension Task Force, American Association of Clinical Endocrinologists Medical guidelines for clinical practice for the diagnosis and treatment of hypertension, *Endocr Pract* 2006;12:193-222.
5. Luehr D, Woolley T, Burke R, et al, ICSI Health Care Guideline: Hypertension diagnosis and treatment, thirteenth edition, November 2012, available at: https://www.icsi.org/_asset/wjqy4g/HTN.pdf.
6. Sisson JC, Frager MS, Valk TW et al, Scintigraphic Localization of Pheochromocytoma, *N Engl J Med* 1981;305:12-17.
7. Sharp SE, Gelfand MJ, and Shulkin BL, Pediatrics: Diagnosis of Neuroblastoma, *Semin Nucl Med* 2011;41:345-353.
8. Bombardieri E, Giammarile F, Aktolun C et al, $^{131}I/^{123}I$-Metaiodobenzylguanidine (mIBG) scintigraphy: procedure guidelines for tumour imaging, *Eur J Nucl Med Mol Imaging* 2010;37:2436-2446.
9. Chrisoulidou A, Kaltsas G, Ilias I et al, The diagnosis and management of malignant pheochromocytoma and paraganglioma, *Endocr Relat Cancer* 2007; 14:569-585.
10. Lenders JW, Pacak K, Walther MM et al, Biochemical diagnosis of pheochromocytoma. Which test is best? *JAMA* 2002; 287:1427-1434.
11. Ilias I and Pacak K, Anatomical and functional imaging of metastatic pheochromocytoma, *Ann N Y Acad Sci* 2004; 1018:495-504.
12. Reisch N, Peczkowska M, Januszewicz A et al, Pheochromocytoma: presentation, diagnosis and treatment, *J Hypertens* 2006;24:2331-2339.
13. Manger W. An overview of pheochromocytoma; history, current concepts, vagaries, and diagnostic challenges, *Ann N Y Acad Sci* 2006; 1073:1-2011.
14. Sawka AM, Thabane L, Young W Jr et al, A comparison of biochemical tests for pheochromocytoma: measurement of fractionated plasma metanephrines compared with the combination of 24-hour urinary metanephrines and catecholamines, *J Clin Endocrinol Metabol* 2003; 88:553-558.
15. Ganguly A, Primary aldosteronism, *N Engl J Med* 1998; 339:1828-1834.
16. Orth DN, Cushing's syndrome, *N Engl J Med* 1995; 332:791-803.
17. Derksen J, Nagesser SK, Meinders AE, et al. Identification of virilizing adrenal tumors in hirsute women, *N Engl J Med* 1994;331: 968-973.
18. Azziz, R, Sanchez LA, Knochenhauer ES et al, Androgen excess in women: experience with Over 1000 consecutive patients, *J Clin Endocrinol Metabol* 2004; 89:453-462.
19. Rosenfield, Robert L. Hirsutism, N Engl J Med, 2005; 353:2578-2588.

20. Goodman NF, Bledsoe MB, Cobin RH et al, Hyperandrogenic disorders task force, American Association of Clinical Endocrinologists medical guidelines for clinical practice for the diagnosis and treatment of hyperandrogenic disorders, *Endocr Prac*t 2001;7:120-134.

PEDAB-18~Hemochromatosis

PEDAB-18.1 Hereditary (Primary) Hemochromatosis

✓ Hereditary hemochromatosis imaging indications in pediatric patients are identical to those for adult patients. See **AB-11.2~Hereditary Hemochromatosis and Other Iron Storage Disorders** for imaging guidelines.

PEDAB-18.2 Transfusion-Associated (Secondary) Hemochromatosis

Transfusion-associated hemochromatosis is a common complication of exposure to repeated red blood cell transfusions. This can occur in any patient with exposure to >20 transfusion episodes, but is most common among sickle cell disease, thalassemia, bone marrow failure (aplastic anemia, Fanconi anemia, etc.), oncology patients, and hematopoietic stem cell transplant patients.

✓ T2* MRI has been well established in the determination of organ iron burden in transfusion-associated hemochromatosis. Contrast use is not necessary for evaluation of iron burden. The following studies are indicated for evaluation of transfusion- associated hemochromatosis:
- MRI Abdomen without contrast (CPT® 74181) for liver iron evaluation.
- MRI Cardiac without contrast (CPT® 75557) for cardiac iron evaluation.
- MRI Chest without contrast (CPT® 71550) can be approved as a single study to evaluate both heart and liver iron burden.
- CPT® 74181 and CPT® 75557 can be approved alone, or together.
- If requested, CPT® 71550 will evaluate both heart and liver and should not be approved with any other codes.

✓ Screening MRI is indicated every 12 months for chronically transfused patients at risk of hemochromatosis.

✓ Imaging is indicated every 3 months for treatment response in patients receiving active treatment (chelation and/or phlebotomy).

References

1. Buchanan GR, Yawn BP (Co-Chairs), Evidence-Based Management of Sickle Cell Disease Expert Panel Report, 2014, National Heart, Lung, and Blood Institute, available at: http://www.nhlbi.nih.gov/health-pro/guidelines/sickle-cell-disease-guidelines.
2. Chavhan GR, Babyn PS, Thomas B, Shroff MM, and Haacke EM, Principles, Techniques, and Applications of T2*-based MR Imaging and Its Special Applications, *Radiographics* 2009;29:1433-1449.

3. Children's Oncology Group. Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent, and Young Adult Cancers. Version 4.0, Monrovia, CA: Children's Oncology Group, October 2013, Available online at: http://www.survivorshipguidelines.org.

PEDAB-19~Indeterminate Renal Lesion

- ✓ Indeterminate renal lesion imaging indications in pediatric patients are very similar to those for adult patients. See **AB-35~Indeterminate Renal Lesion** for imaging guidelines.
- ✓ Nuclear medicine studies of the kidney are indicated for evaluation of the following anatomic renal anomalies:
  - Suspected horseshoe kidney (CPT® 78700 or CPT® 78701)
  - Suspected solitary or ectopic kidney (CPT® 78700 or CPT® 78701)
  - Radiopharmaceutical voiding cystogram (CPT® 78740) is indicated for evaluation of antenatally-detected hydronephrosis
- ✓ Pediatric-specific imaging considerations include the following:
  - Pediatric renal cysts have a lower risk of malignant progression than renal cysts in adults.
  - For patients who have simple cysts but are symptomatic are surgical intervention is being considered, CT Abdomen with contrast (CPT® 74160) is indicated.
  - For pediatric patients with complex renal cyst identified on ultrasound, CT Abdomen without and with contrast (CPT® 74170) is indicated.
  - Patients with solid renal masses should be imaged according to guidelines in section **PEDONC-7~Pediatric Renal Tumors**.

References

1. Karmazyn B, Tawadros A, Delaney LR et al, Ultrasound classification of solitary renal cysts in children, *J Pediatr Urol* 2015;11:149.e1-149.e6.
2. ACR-SPR Practice Guideline for the Performance of Adult and Pediatric Renal Scintigraphy. http://www.acr.org/Search?q=Renal_Scintigraphy.pdf.
3. Mandell GA, Eggli DF, Gilday DL, et al. Society of Nuclear Medicine, Procedure Guideline for Renal Cortical Scintigraphy in Children, version 3.0, approved June 20, 2003. http://interactive.snm.org/docs/pg_ch32_0403.pdf.

PEDAB-20~Hydronephrosis

Hydronephrosis is a relatively common finding in pediatric patients, with the following imaging considerations:

- ✓ Patients with prenatal hydronephrosis can be evaluated with retroperitoneal ultrasound (CPT® 76770) within the first week of life, and again after 6 weeks of age.
- ✓ Patients with known uncomplicated hydronephrosis can be followed with retroperitoneal ultrasound (CPT®76770) every 6-12 months.
- ✓ For patients with hydronephrosis associated with urinary tract infection or vesicoureteral reflux see **PEDAB-5~Urinary Tract Infection (UTI)** for imaging guidelines.
- ✓ Patients with ureteropelvic junction obstruction (UPJO) be evaluated with retroperitoneal ultrasound (CPT® 76770), and diuretic renography (CPT® 78707, CPT® 78708, or CPT® 78909) for preoperative planning and postoperatively at 6 -12 months.
  - o If hydronephrosis has resolved on postoperative imaging then no further routine imaging is indicated.
- ✓ Magnetic resonance urography (MRU) (CPT® 74183 and CPT® 72197) is rarely indicated, but can be approved in patients with inconclusive ultrasound and diuretic renography.
- ✓ CT Abdomen with contrast (CPT® 74160) is rarely indicated, but can be approved in patients with inconclusive ultrasound and a suspected vascular cause of UPJO.

References

1. Sinha A, Bagga A, Krishna A et al, Revised guidelines on management of antenatal hydronephrosis, *Indian J Nephrol* 2013;23:83-97.
2. VanDervoort K, Lasky S, Sethna C et al, Hydronephrosis in Infants and Children: Natural History and Risk Factors for Persistence in Children Followed by a Medical Service, *Clin Med Pediatr* 2009;3:63-70.
3. Hsi RS, Holt SK, Gore JL, Lendvay TS, & Harper JD, National Trends in Followup Imaging after Pyeloplasty in Children in the United States, *J Urol* 2015;194;777-782.

PEDAB-21~Polycystic Kidney Disease

- ✓ Abdominal ultrasound (CPT® 76700) or retroperitoneal ultrasound (CPT® 76770) are indicated for clinical concern for polycystic kidney disease, or for screening individuals at risk for autosomal dominant polycystic kidney disease (ADPCKD).

References

1. Belibi FA and Edelstein CL, Unified Ultrasonographic Diagnostic Criteria for Polycystic Kidney Disease, *J Am Soc Nephrol* 2009;20:6-8.
2. Porter CC and Avner ED, Autosomal Recessive Polycystic Kidney Disease, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1796-1798.
3. Porter CC and Avner ED, Autosomal Dominant Polycystic Kidney Disease, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, p 1798.

PEDAB-22~Blunt Abdominal Trauma

- ✓ Blunt abdominal trauma imaging indications in pediatric patients are identical to those for adult patients. See **AB-10.1 Blunt Abdominal Trauma** for imaging guidelines.

PEDAB-23~Hernias

- ✓ Hernia imaging indications in pediatric patients are identical to those for adult patients. See **AB-12~Hernias** for imaging guidelines.

PEDAB-24~Abdominal Lymphadenopathy

- ✓ Abdominal lymphadenopathy imaging indications in pediatric patients are identical to those for adult patients. See **AB-8~Abdominal Lymphadenopathy** for imaging guidelines.

PEDAB-25~Left Upper Quadrant Pain

- ✓ Left upper quadrant pain imaging indications in pediatric patients are identical to those for adult patients. See **AB-2~Abdominal Pain** for imaging guidelines.
- ✓ Nuclear medicine spleen imaging (CPT® 78185) is rarely performed, but can be approved for left upper quadrant pain when neither ultrasound nor CT is available.

Reference

1. Royal HD, Brown ML, Drum DE et al. Society of Nuclear Medicine Procedure guideline for hepatic and splenic imaging 3.0, version 3.0, approved July 20, 2003, available at: http://interactive.snm.org/docs/pg_ch10_0403.pdf.

PEDAB-26~Spleen

- ✓ Spleen imaging indications in pediatric patients are very similar to those for adult patients. See: **AB-34~Spleen** for imaging guidelines.
- ✓ Nuclear medicine spleen imaging (CPT® 78185) is rarely performed, but can be approved for the following indications when CT is unavailable:
  - Splenic trauma
  - Evaluation of splenic function
  - Suspected splenic mass, cyst, abscess, infarct, or metastasis
  - Radiation treatment planning
  - Asplenia
  - Suspected functional accessory spleen
    - Can approve CPT® 78215 or CPT® 78216 instead of CPT® 78185, if requested.
- ✓ Pediatric-specific imaging considerations include the following:
  - MRI is preferred over CT when possible to reduce radiation exposure.

References

1. Brandow AM and Camitta BM, The Spleen, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, p. 1723.
2. Royal HD, Brown ML, Drum DE et al. Society of Nuclear Medicine Procedure guideline for hepatic and splenic imaging 3.0, version 3.0, approved July 20, 2003, available at: http://interactive.snm.org/docs/pg_ch10_0403.pdf.

PEDAB-27~Intussusception

- ✓ Intussusception, telescoping of one bowel loop into another, is a frequent cause of abdominal pain in young children. It may be associated with bloody stool. Plain x-rays (supine and left lateral decubitus views) should be performed initially to exclude mass or bowel obstruction from other causes.
  - Ultrasound (CPT® 76700 or CPT® 76705) is indicated as an initial study if there is a strong suspicion for intussusception, but if negative, plain x-rays of the abdomen should follow.

Reference

1. Kennedy M and Liacouras CA, Intussusception, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1287-1289.

PEDAB-28~Bowel Obstruction

- ✓ Bowel obstruction imaging indications in pediatric patients are identical to those for adult patients. See **AB-20~Bowel Obstruction** for imaging guidelines.

PEDAB-29~Left Lower Quadrant Pain

Diverticulitis is the most common cause of left lower quadrant pain in adults but is extremely rare in children.

Gastroenterologist evaluation is helpful in determining the appropriate diagnostic pathway in patients with left lower quadrant pain with or without heme-positive stools or rectal bleeding, since advanced imaging is rarely helpful in the initial evaluation of these patients.

- ✓ Pelvic ultrasound (CPT® 76856) is the initial imaging study of choice for children and for females who still have ovaries or uterus intact, for detecting gynecologic abnormalities that may cause left lower quadrant pain.

References

1. Sreedharan R and Liacouras CA, Major Symptoms and Signs of Digestive Tract Disorders, *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1240-1249.
2. Sreedharan R and Liacouras CA, Functional Abdominal Pain (Nonorganic Chronic Abdominal Pain), *Nelson Textbook of Pediatrics*, eds Kliegman RM, Stanton BF, Schor NF, St. Geme JW III, and Behrman RE, 19th edition 2011, pp 1240-1249.

PEDAB-30~Celiac Disease (Sprue)

- ✓ Celiac disease imaging indications in pediatric patients are identical to those for adult patients. See **AB-24~Celiac Disease (Sprue)** for imaging guidelines.

PEDAB-31~Transplant

- ✓ Liver and kidney transplant imaging indications in pediatric patients are identical to those for adult patients. See **AB-42~Transplant** for imaging guidelines.
- ✓ For post-transplant lymphoproliferative disorder in pediatric patients, see **PEDONC-5.3~Pediatric Non-Hodgkin Lymphoma, Aggressive Mature B-Cell NHL** for imaging guidelines.

PEDAB-32~Gaucher's Disease

See: **PEDPN-4 Gaucher's Disease** for imaging guidelines.