

Table 10: Evidence Regarding Overuse of Imaging for the Evaluation of Children with Afebrile, Atraumatic Seizures

Type of Evidence	Key Findings	Level of Evidence (USPSTF Ranking*)	Citations
Evidence-based review	<p>Members of the Quality Standards Subcommittee of the American Academy of Neurology conducted an evidence-based review of the literature to develop practice parameters for evaluation of children with first nonfebrile seizure. They found few CT studies of children with first nonfebrile seizure have abnormalities that require intervention (0 to 7%). The yield of CT scans to identify an abnormality when the neurologic examination and EEG were normal was 5% to 10%. Up to one-third of children who underwent MRI in one class I study had an abnormality, none required intervention. In another class I study of children with newly diagnosed epilepsy, 86% had neuroimaging and none had abnormalities that required immediate treatment. Emergent neuroimaging was recommended in children who exhibit post-ictal deficit not quickly resolving, or who have not returned to baseline within several hours after the seizure.</p>	II	<p>Hirtz D, Ashwal S, Berg A, et al. Practice parameter: Evaluating a first nonfebrile seizure in children: Report of the quality standards subcommittee of the American Academy of Neurology, The Child Neurology Society and the American Epilepsy Society. <i>Neurology</i> 2000; 55(5):616-623.</p>
Clinical guideline	<p>International League Against Epilepsy (ILAE) guidelines for neuroimaging studies in the evaluation of children with recent-onset epilepsy acknowledge that neuroimaging is important in the initial evaluation and management to detect structural lesions related to the seizure disorder. They also outline situations where imaging may not be necessary, including idiopathic focal or generalized epilepsy. When available, MRI is preferred to CT because of its superior resolution, versatility, and lack of radiation. However, CT is more widely available than MRI, is less expensive, and less likely to require sedation for younger patients.</p>	III	<p>Gaillard WD, Chiron C, Cross JH et al. Guidelines for imaging infants and children with recent-onset epilepsy. <i>Epilepsia</i> 2009; 50(9):2147-2153.</p>

Type of Evidence	Key Findings	Level of Evidence (USPSTF Ranking*)	Citations
Appropriateness criteria	The ACR has completed multiple comprehensive, evidence-based reviews of radiologic literature, clinical practice literature, and expert consultation. In summary, the ACR has advised that atraumatic seizures usually do not require imaging evaluation with CT. MRI is preferred, as it provides greater detail of brain structures. There is added benefit in that MRI does not use ionizing radiation.	III	American College of Radiology (ACR) Expert Panel on Pediatric Imaging: Dory CE, Coley BD, Karmazyn B, et al. ACR Appropriateness Criteria: Seizures —Child. American College of Radiology, revised 2012. Available at: http://www.acr.org/Quality-Safety/Appropriateness-Criteria/Diagnostic/~media/ACR/Documents/AppropriatenessCriteria/Diagnostic/SeizuresChild.pdf ; accessed July 16, 2015.
Retrospective study	This was a retrospective review of children presenting to a single emergency department between July 1993 and June 1994 who underwent a CT for evaluation of a first seizure. Of 99 children with a CT scan obtained, 19 had brain abnormalities. Of the 19 children with abnormal CT findings, seven required further investigation or treatment. In the 6 months after the CT scan, 33 children had an MRI. MRI findings were identical to CT scan findings in 18.	III	Garvey MA, Gaillard WD, Rusin JA, et al. Emergency brain computed tomography in children with seizures: Who is most likely to benefit? <i>J Pediatr</i> 1998; 133(5):664-669.
Retrospective study	This was a retrospective cross sectional study of 319 pediatric patients presenting between October 1995 and March 2012 to an urban pediatric tertiary care emergency department who underwent neuroimaging within 24 hours for evaluation of a first-time non-febrile seizure with focal manifestations. Emergent CT was obtained in 262 children, both CT and MRI were obtained in 42, and MRI alone was obtained in 15. Only 13 children had a finding of clinically urgent intracranial pathology. Sixty two percent of the cases (n=163) underwent subsequent MRI within 72 hours of presentation. Of the 252 children whose initial emergent imaging study was a CT scan, 81% (n=205) underwent delayed MRI. Of	III	Aprahamian N, Harper MB, Prabhu SP. Pediatric first time non-febrile seizure with focal manifestations: Is emergent imaging indicated? <i>Seizure</i> 2014; 23(9):740-745.

Type of Evidence	Key Findings	Level of Evidence (USPSTF Ranking*)	Citations
	these 28% (58/205) had an abnormal finding. Among children with an abnormal finding on delayed MRI, 29% (17/58) were not identified on initial CT scan.		
Retrospective study	This was a retrospective review of 66 pediatric patients presenting during the 1995 calendar year to a children's hospital emergency department who underwent a CT scan prior to ED discharge for evaluation of a first seizure. Abnormal CT findings were present in 14 children (21%). Twenty patients also underwent MRI, two of whom were noted to have a discrepancy between CT and MRI findings. One patient had a normal CT with an abnormal MRI, the other patient had an abnormal CT and a normal MRI.	III	Maytal J, Krauss JM, Novak G et al. The role of brain computed tomography in evaluating children with new onset of seizures in the emergency department. <i>Epilepsia</i> 2000; 41(8):950-954.
Retrospective study	This was a retrospective case series of 203 children who presented from January 1992 to December 1994 to the emergency department of a tertiary care children's hospital who underwent head CT as a part of an emergency department evaluation for seizure. Head CT findings were abnormal in 25 patients (12%).	II	Warden CR, Brownstein DR, DelBeccaro MA. Predictors of abnormal findings on computed tomography of the head in pediatric patients presenting with seizures. <i>Ann Emerg Med</i> 1997; 29(4):518-523.
Retrospective study	Five hundred consecutive cases of new-onset atraumatic seizures as seen in the emergency department of a tertiary care children's hospital between October 1996 and July 1998 were reviewed. Neuroimaging was obtained in 95% and CT was the initial study performed in 91%. Nearly all (92%) of subjects underwent neuroimaging while in the ED and 5% underwent neuroimaging more than 72 hours after the ED visit. Most children had normal neuroimaging results (83%), with 9% having clinical insignificant findings and 8% having clinically significant abnormalities. Trauma and vascular and structural lesions were the most common findings among children with clinically significant abnormalities.	III	Sharma S, Riviello JJ, Harper MB, Baskin MM. The role of emergent neuroimaging in children with new-onset afebrile seizures. <i>Pediatrics</i> 2003;111(1):1-5.

Note: USPSTF criteria for assessing evidence at the individual study level are as follows: I) Properly powered and conducted randomized controlled trial (RCT); well-conducted systematic review or meta-analysis of homogeneous RCTs. II) Well-designed cohort or case-control analytic study. III) Opinions of respected authorities, based on clinical experience; descriptive studies or case reports; reports of expert committees.

Figure 1

Date of origin: 1995
Last review date: 2012

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Seizures — Child

Clinical Condition: Seizures — Child

Variant 6: First generalized seizure (neurologically normal).

Radiologic Procedure	Rating	Comments	RRL*
MRI head without contrast	5		O
MRI head without and with contrast	4	See statement regarding contrast in text under “Anticipated Exceptions.”	O
CT head without contrast	4		☼☼☼
CT head without and with contrast	2		☼☼☼☼
CT head with contrast	2		☼☼☼
SPECT head	1		☼☼☼
FDG-PET/CT head	1		☼☼☼☼
US head	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Figure 2

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☼	<0.1 mSv	<0.03 mSv
☼☼	0.1-1 mSv	0.03-0.3 mSv
☼☼☼	1-10 mSv	0.3-3 mSv
☼☼☼☼	10-30 mSv	3-10 mSv
☼☼☼☼☼	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.		

From: American College of Radiology (ACR) Expert Panel on Pediatric Imaging: Dory CE, Coley BD, Karmazyn B, et al. ACR Appropriateness Criteria: Seizures—Child. American College of Radiology, revised 2012. Available at: <http://www.acr.org/Quality-Safety/Appropriateness-Criteria/Diagnostic/-/media/ACR/Documents/AppCriteria/Diagnostic/SeizuresChild.pdf>. Accessed May 15, 2015.

Reprinted with permission of the American College of Radiology. No other representation of this material is authorized without expressed, written permission from the American College of Radiology. Refer to the ACR website at [ACR Appropriateness Criteria® - American College of Radiology](http://www.acr.org/Quality-Safety/Appropriateness-Criteria) for the most current and complete version of the ACR Appropriateness Criteria®.