American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Sinusitis — Child**

Variant 1: **Children with uncomplicated acute sinusitis.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray paranasal sinuses	1	One to four projections. See summary of literature review.	☢ ☢ ☢
CT paranasal sinuses without contrast	1		☢ ☢ ☢
MRI paranasal sinuses without contrast	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: **Children with persistent (acute sinusitis that does not respond to treatment), recurrent, or chronic sinusitis.**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses without contrast	9		☢ ☢ ☢
MRI paranasal sinuses without contrast	3		O
X-ray paranasal sinuses	1	One to four projections. See summary of literature review.	☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 3: **Children with sinusitis with orbital or intracranial complications.**

Radiologic Procedure	Rating	Comments	RRL*
CT head and/or orbits and paranasal sinuses with contrast	9		☢ ☢ ☢
MRI head and/or orbits and paranasal sinuses without and with contrast	7	See statement regarding contrast in text under “Anticipated Exceptions.”	O
X-ray paranasal sinuses	1	One to four projections. See summary of literature review.	☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

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Summary of Literature Review

Sinusitis is defined as inflammation of the paranasal sinuses. It is common in the pediatric population and is a common cause of morbidity and rarely results in serious complications [1-8]. The most common predisposing factor for acute bacterial sinusitis is viral upper respiratory infection that involves the nose and paranasal sinuses. It is estimated that bacterial sinusitis develops in 5%-13% of upper respiratory tract infections in young children [1]. The second most important predisposing factor for bacterial sinusitis is allergic rhinitis [1-4]. Other underlying factors that may lead to sinusitis in children include nasal airway obstruction, immunodeficiencies, ciliary dysfunction, and cystic fibrosis [1-11]. The growing number of children in day care centers has led to an increase in upper respiratory infections, which usually precede acute sinusitis [2,10].

The gold standard for diagnosis of bacterial sinusitis is recovery of high-density bacteria ($\geq 10^4$ colony-forming units/mL) from sinus aspirate. However, this method is not feasible for the primary care practitioner and is invasive, time consuming, and potentially painful [1]. Therefore, the diagnosis of bacterial sinusitis is most commonly based on clinical criteria [1].

Acute Sinusitis

The American Academy of Pediatrics (AAP) defines acute bacterial sinusitis as bacterial sinusitis that lasts less than 30 days in which symptoms resolve completely [1]. Common symptoms of acute sinusitis are upper respiratory infection with purulent nasal drainage [1-5]. Severe acute bacterial sinusitis is associated with high fever and headache that is typically above or behind the eyes [1]. The differentiation between viral and bacterial sinusitis and the decision to treat with antibiotics may be difficult [1]. Treatment is with antibiotics. Adjuvant treatment may include saline nasal irrigation, antihistamines, decongestants, mucolytic agents, and tropical intranasal steroids [1-5].

The routine use of imaging of the paranasal sinuses in children with acute bacterial sinusitis without complications is not recommended. Imaging of the paranasal sinuses is not useful to differentiate between viral and bacterial sinusitis and usually does not change management in uncomplicated acute sinusitis. A high incidence of soft-tissue findings is noted on radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) examinations in patients who have no clinical evidence of sinus disease but have undergone these examinations for other reasons. Incidences of 33%-50% have been reported [12-21]. In the majority of adults, the common cold acutely produces mucosal abnormalities in sinuses, including the ostiomeatal area and nasal passageways [22]. This incidence is even higher in infants and children and, indeed, was 97% in a study involving infants who had a cold in the 2 weeks preceding cranial CT done for other reasons [15]. MRI studies have also shown that soft-tissue changes in sinuses can last months following an acute infection [23]. Clinical correlation is critical for evaluating the significance of the imaging findings. In addition, most children with clinical diagnosis of acute sinusitis will have radiographic abnormalities correlating with sinusitis and therefore their management will remain unchanged [1-5].

Persistent, Recurrent, or Chronic Sinusitis

The AAP defines subacute bacterial sinusitis as bacterial sinusitis that lasts between 30 and 90 days, with the symptoms resolving completely. Recurrent acute bacterial sinusitis is defined by episodes of bacterial sinusitis, each lasting less than 30 days and separated by intervals of at least 10 asymptomatic days. Chronic sinusitis lasts more than 90 days and patients have persistent residual respiratory symptoms such as cough, rhinorrhea, or nasal obstruction [1]. In patients with recurrent or chronic sinusitis, one must consider the possibility that they are associated with or secondary to asthma, gastroesophageal reflux, cystic fibrosis, or allergic rhinitis [1-11]. Common symptoms of chronic sinusitis are protracted nasal secretions that may be purulent or mucoid. Drainage tends to be from the posterior nasopharynx, causing frequent coughing and an urge to clear the throat. Other symptoms may include chronic headache and intermittent fever. Young children may have malodorous breath. The most serious complication of chronic sinusitis is extension of infection into the cranium [2,24]. Management of chronic or recurrent sinusitis is mainly treated medically; however, in cases that do not respond to treatment, surgery may be required [7,8,24,25]. Fungal sinusitis is unusual in children and has variable clinical and imaging findings. It is beyond the scope of this guideline [26,27].

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Radiography

The radiograph series for evaluation of the paranasal sinuses traditionally includes up to four views (Caldwell, Waters, submentovertex, and lateral). This series is difficult to perform in young children [28]. As compared with CT scan, radiographs of the paranasal sinuses are less costly and more widely available. However, they are limited in the evaluation of the paranasal sinuses because they cannot localize the pathology well and cannot evaluate the osteomeatal complex [28]. In addition, radiographs both underdiagnose and overdiagnose soft-tissue changes in the paranasal sinuses as compared to CT scan [25,29-32]. Some have suggested using only the Waters view radiograph [33]. However, it was shown to have 32% false negative and 49.2% false positive using CT scan as the gold standard [34]. In addition, most of the abnormalities in the ethmoidal and sphenoidal sinus were not detected in the Waters radiograph [34].

Computed Tomography

CT scans are the gold standard study guiding management of sinusitis because they accurately depict the sinus anatomy, including soft-tissue changes, anatomic variations, the ostiomeatal complex, and complications, especially those involving the orbit or intracranial structures [1,8,28-30,35-46]. With the advent of multidetector CT scan volume isometric imaging, it is possible to perform axial images and reconstruct the coronal planes [47]. This is especially advantageous in young children who may not be able to cooperate for direct coronal CT study of the paranasal sinuses. In addition, radiation of the orbits may be avoided [47]. Low-dose CT scan of the paranasal sinuses has comparable doses to two radiographic views of the paranasal sinuses [48]. CT is the study of choice in children with recurrent or chronic sinusitis before functional endoscopic sinus surgery (FESS) as it provides a road map for surgery [24,43]. However, severity of preoperative CT findings does not correlate with severity of symptoms, and CT does not predict symptomatic relief after FESS [29].

If suspicion exists for complications of sinusitis — such as preseptal or postseptal cellulitis, subperiosteal abscess, orbital cellulitis or abscess, cavernous sinus thrombosis, osteomyelitis of the frontal bone, subdural empyema, epidural or brain abscess, meningitis, brain infarction, or myotic aneurysm — then cranial CT, including the brain and sinuses, is indicated [27,40,41].

Magnetic Resonance Imaging

MRI of the paranasal sinuses has several potential advantages; it can well identify mucosal thickening, and differentiate mucosal thickening from sinus secretions [23,49], and it is not associated with ionizing radiation. MRI is valuable in evaluating complications of sinusitis that extend to the cranium [50]. However, it does not well demonstrate bony detail of the ostiomeatal complex and is less sensitive for bony erosions. In addition, it has limited availability, higher costs, and frequent need for sedation in infants and children [31]. Therefore, MRI of the sinuses should not be the primary imaging for evaluation of sinusitis in children.

Summary

- The diagnosis of sinusitis should be made clinically, not on the basis of imaging findings alone.
- No imaging studies are indicated for uncomplicated acute sinusitis.
- CT of the paranasal sinuses is the imaging modality of choice in patients with persistent, recurrent, or chronic sinusitis.
- Cranial/orbit CT with contrast, to include the sinuses, is indicated for suspected orbital or cranial complications of bacterial sinusitis.
- MRI, while not as good as CT for bone details, is certainly valuable for evaluating cranial and orbital complications, such as orbital or epidural abscess and cavernous sinus spread.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [51].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

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 NS (not specified).		

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Procedure Information
- Evidence Table

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