American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Sinonasal Disease**

Variant 1: **Acute (<4 weeks) and subacute (4-12 weeks) uncomplicated rhinosinusitis.**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses without contrast	5	Most episodes are managed without imaging as this is primarily a clinical diagnosis. Imaging may be indicated in cases of suspected acute frontal or sphenoid sinusitis or if diagnosis is uncertain.	☢☢
MRI head and paranasal sinuses without contrast	4	May be useful as part of a general workup for headache.	O
CT paranasal sinuses with contrast	2		☢☢
MRI head and paranasal sinuses without and with contrast	2	May be useful as part of a general workup for headache.	O
X-ray paranasal sinuses	1		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: **Acute and subacute rhinosinusitis in immunodeficient patient.**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses without contrast	7	These patients are at high risk for invasive fungal sinusitis, thus lowering the threshold for imaging.	☢☢
MRI head and paranasal sinuses without contrast	6		O
CT paranasal sinuses with contrast	4		☢☢
MRI head and paranasal sinuses without and with contrast	4	See statement regarding contrast in text under “Anticipated Exceptions.”	O
X-ray paranasal sinuses	1		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 3: **Acute and subacute rhinosinusitis with associated orbital complications and/or neurologic deficit.**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses and orbits without contrast	9	MRI and CT are complementary examinations.	☢☢
MRI head and paranasal sinuses without and with contrast	9	MRI and CT are complementary examinations. See statement regarding contrast in text under “Anticipated Exceptions.”	O
CT paranasal sinuses and orbits with contrast	8	If this is the only study that can be obtained, it would be appropriate.	☢☢
MRI head and paranasal sinuses without contrast	7	If patient unable to tolerate gadolinium.	O
X-ray paranasal sinuses	1		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Sinonasal Disease**

Variant 4: **Recurrent acute or chronic rhinosinusitis (possible surgical candidate).**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses without contrast	9	Consider using surgical planning protocol.	☢☢
CT paranasal sinuses with contrast	4		☢☢
MRI head and paranasal sinuses without and with contrast	3	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head and paranasal sinuses without contrast	2		O
X-ray paranasal sinuses	1	May be indicated for planning frontal sinus obliteration.	☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 5: **Sinonasal polyposis (if unilateral see variant 6).**

Radiologic Procedure	Rating	Comments	RRL*
CT paranasal sinuses without contrast	9		☢☢
MRI head and paranasal sinuses without and with contrast	6	If unilateral disease, see variant 6. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI head and paranasal sinuses without contrast	5		O
CT paranasal sinuses with contrast	4		☢☢
X-ray paranasal sinuses	1		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 6: **Sinonasal obstruction, suspected mass lesion.**

Radiologic Procedure	Rating	Comments	RRL*
MRI head and paranasal sinuses without and with contrast	9	MRI and CT are complementary examinations. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT paranasal sinuses without contrast	8	MRI and CT are complementary examinations.	☢☢
CT paranasal sinuses with contrast	5		☢☢
MRI head and paranasal sinuses without contrast	5	If patient unable to tolerate gadolinium.	O
Arteriography craniofacial	4	Appropriate in selected cases (eg, vascular involvement, vascular lesion).	☢☢
X-ray paranasal sinuses	1		☢
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

Introduction/Background

Sinonasal imaging is performed in two major clinical scenarios: inflammatory rhinosinusitis or a suspected mass lesion.

Rhinosinusitis is defined as inflammation of the nasal cavity and adjacent paranasal sinuses. Acute sinusitis refers to symptom duration <4 weeks, subacute 4-12 weeks, and chronic >12 weeks. Complicated sinusitis refers to symptoms suggesting spread of disease into adjacent structures, including orbital or intracranial complications [1].

Rhinosinusitis is one of the most commonly diagnosed diseases in the United States and appears to affect more than 16% of the U.S. population annually [2]. It poses an immense economic burden, accounting for more than 26 million outpatient visits annually and costing more than $4.3 billion annually in direct medical expenses [3,4]. The indirect costs of rhinosinusitis also appear to be staggering, with the number of annual work-loss days estimated at 12.5 million [5-7]. Studies performed in the 1990s found there were 73 million restricted-activity days related to chronic sinusitis over a 2-year period [3,8,9].

The diagnosis of rhinosinusitis is based on clinical grounds. In 1997 the Task Force of Rhinosinusitis developed major and minor symptomatic criteria for diagnosing rhinosinusitis. Major criteria include nasal drainage, nasal congestion, facial pain or pressure, postnasal drip, and olfactory dysfunction. Minor criteria include fever, cough, fatigue, dental pain, and ear fullness or pressure. Clinical judgment combined with history and physical examination is usually sufficient to diagnose sinusitis in most cases of uncomplicated acute and subacute rhinosinusitis. Imaging studies should be reserved for the patients who develop recurrent acute sinusitis, complicated sinusitis, or chronic sinusitis, or to define sinus anatomy prior to surgery [1,10-18].

Imaging Modalities

Computed tomography (CT) is the imaging method of choice for the paranasal sinuses [19]. Coronal CT imaging gives the best overall anatomic detail of the paranasal sinuses and can be achieved either with prone direct coronal imaging or can be reformatted from thin-slice axial images. Contrast enhancement is not generally needed for routine sinus imaging. Sinus radiographs are inaccurate in a high percentage of patients and have been supplanted by CT imaging [20].

Sinusitis cannot be diagnosed on the basis of imaging findings alone. Findings on CT scans should be interpreted in conjunction with clinical and endoscopic findings [21-28]. Up to 40% of asymptomatic adults have abnormalities on sinus CT scans, as do more than 80% of those with minor upper respiratory tract infections [7,29,30].

Fungal Sinusitis

Fungal sinusitis can be seen in both immunocompetent and immunocompromised patients. Immunocompetent patients with chronic sinusitis may develop a superimposed fungal colonization. This is a noninvasive form of fungal disease and may manifest as either a fungus ball (mycetoma) or allergic fungal sinusitis. Invasive fungal sinusitis is a rapidly progressive disease seen in immunosuppressed patients and poorly controlled diabetics. In this patient population a high index of suspicion should be maintained. Invasive fungal sinusitis has a very high morbidity and mortality rate and requires prompt diagnosis and treatment. In this patient population both CT and magnetic resonance imaging (MRI) may be needed to fully define the extent of orbital or intracranial extension of disease. CT with contrast may be used to help define orbital and intracranial complications, though more accurate evaluation will be obtained with MRI without and with contrast [31-33].

Sinonasal Polyposis

In patients with known or suspected sinonasal polyposis (including cystic fibrosis patients) sinus CT without contrast is the study of choice. However, in selected cases evaluation with MRI or contrast-enhanced sinus CT may help to differentiate polypoid mucosal hypertrophy from superimposed sinus fluid and also help to exclude a true underlying soft-tissue mass causing sinus obstruction.

Suspected Sinonasal Mass

In patients with a suspected sinonasal mass seen on sinus CT or with persistent symptoms of pain, nasal

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obstruction, or epistaxis, complete evaluation of the extent of disease will often require both sinus CT and MRI evaluation. CT imaging will best define the pattern of bone erosion/destruction as well as any formation of cartilaginous or bone matrix. MRI without and with contrast will best differentiate soft-tissue mass from postobstructive secretions as well as delineating evidence of orbital, skull base, or intracranial extension of tumor [31,32,34]. In some instances craniofacial catheter angiography may be indicated for preoperative planning, for preoperative embolization of a vascular mass, or to treat severe epistaxis [31,35-37].

Image-guided functional endoscopic sinus surgery (FESS) has become widely used. Preoperative CT scanning techniques will be vendor-specific depending on the image-guided system being used.

Summary

- Most cases of uncomplicated acute and subacute rhinosinusitis are diagnosed clinically and should not require any imaging procedure.
- CT of the sinuses without contrast is the imaging method of choice in patients with recurrent acute sinusitis, or chronic sinusitis, or to define sinus anatomy prior to surgery.
- Immunodeficient patients are at high risk for invasive fungal sinusitis. A high index of suspicion for complicated sinusitis should be maintained.
- In patients with suspected sinonasal mass, or suspected orbital and/or intracranial complication of sinusitis, MRI and CT are complementary studies.

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* [38].

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 Contrast Information
- Evidence Table

References

1. Lanza DC, Kennedy DW. Adult rhinosinusitis defined. *Otolaryngol Head Neck Surg* 1997; 117(3 Pt 2):S1-7.
2. Fagnan LJ. Acute sinusitis: a cost-effective approach to diagnosis and treatment. *Am Fam Physician* 1998; 58(8):1795-1802, 1805-1796.
3. Anzai Y, Weymuller EA, Jr., Yueh B, Maronian N, Jarvik JG. The impact of sinus computed tomography on treatment decisions for chronic sinusitis. *Arch Otolaryngol Head Neck Surg* 2004; 130(4):423-428.
4. Ray NF, Baraniuk JN, Thamer M, et al. Healthcare expenditures for sinusitis in 1996: contributions of asthma, rhinitis, and other airway disorders. *J Allergy Clin Immunol* 1999; 103(3 Pt 1):408-414.
5. Batra PS. Radiologic imaging in rhinosinusitis. *Cleve Clin J Med* 2004; 71(11):886-888.
6. Murphy MP, Fishman P, Short SO, Sullivan SD, Yueh B, Weymuller EA, Jr. Health care utilization and cost among adults with chronic rhinosinusitis enrolled in a health maintenance organization. *Otolaryngol Head Neck Surg* 2002; 127(5):367-376.
7. Okuyemi KS, Tsue TT. Radiologic imaging in the management of sinusitis. *Am Fam Physician* 2002; 66(10):1882-1886.
8. Anand VK. Epidemiology and economic impact of rhinosinusitis. *Ann Otol Rhinol Laryngol Suppl* 2004; 193:3-5.
9. Anzai Y, Yueh B. Imaging evaluation of sinusitis: diagnostic performance and impact on health outcome. *Neuroimaging Clin N Am* 2003; 13(2):251-263, xi.

10. Arango P, Kountakis SE. Significance of computed tomography pathology in chronic rhinosinusitis. *Laryngoscope* 2001; 111(10):1779-1782.
11. Bhattacharyya N. Test-retest reliability of computed tomography in the assessment of chronic rhinosinusitis. *Laryngoscope* 1999; 109(7 Pt 1):1055-1058.
12. Bhattacharyya N. Clinical and symptom criteria for the accurate diagnosis of chronic rhinosinusitis. *Laryngoscope* 2006; 116(7 Pt 2 Suppl 110):1-22.
13. Bhattacharyya N, Fried MP. The accuracy of computed tomography in the diagnosis of chronic rhinosinusitis. *Laryngoscope* 2003; 113(1):125-129.
14. Stewart MG, Donovan DT, Parke RB, Jr., Bautista MH. Does the severity of sinus computed tomography findings predict outcome in chronic sinusitis? *Otolaryngol Head Neck Surg* 2000; 123(1 Pt 1):81-84.
15. Stewart MG, Sicard MW, Piccirillo JF, Diaz-Marchan PJ. Severity staging in chronic sinusitis: are CT scan findings related to patient symptoms? *Am J Rhinol* 1999; 13(3):161-167.
16. Tahamiler R, Canakcioglu S, Ogreden S, Acioglu E. The accuracy of symptom-based definition of chronic rhinosinusitis. *Allergy* 2007; 62(9):1029-1032.
17. Zinreich SJ. Imaging for staging of rhinosinusitis. *Ann Otol Rhinol Laryngol Suppl* 2004; 193:19-23.
18. Rosenfeld RM, Andes D, Bhattacharyya N, et al. Clinical practice guideline: adult sinusitis. *Otolaryngol Head Neck Surg* 2007; 137(3 Suppl):S1-31.
19. Sonkens JW, Harnsberger HR, Blanch GM, Babbel RW, Hunt S. The impact of screening sinus CT on the planning of functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 1991; 105(6):802-813.
20. Aalokken TM, Hagtvedt T, Dalen I, Kolbenstvedt A. Conventional sinus radiography compared with CT in the diagnosis of acute sinusitis. *Dentomaxillofac Radiol* 2003; 32(1):60-62.
21. Basu S, Georgalas C, Kumar BN, Desai S. Correlation between symptoms and radiological findings in patients with chronic rhinosinusitis: an evaluation study using the Sinonasal Assessment Questionnaire and Lund-Mackay grading system. *Eur Arch Otorhinolaryngol* 2005; 262(9):751-754.
22. Bhattacharyya N. A comparison of symptom scores and radiographic staging systems in chronic rhinosinusitis. *Am J Rhinol* 2005; 19(2):175-179.
23. Bhattacharyya T, Piccirillo J, Wippold FJ, 2nd. Relationship between patient-based descriptions of sinusitis and paranasal sinus computed tomographic findings. *Arch Otolaryngol Head Neck Surg* 1997; 123(11):1189-1192.
24. Cousin JN, Har-El G, Li J. Is there a correlation between radiographic and histologic findings in chronic sinusitis? *J Otolaryngol* 2000; 29(3):170-173.
25. Devaiah AK. Adult chronic rhinosinusitis: diagnosis and dilemmas. *Otolaryngol Clin North Am* 2004; 37(2):243-252, v.
26. Hwang PH, Irwin SB, Griest SE, Caro JE, Nesbit GM. Radiologic correlates of symptom-based diagnostic criteria for chronic rhinosinusitis. *Otolaryngol Head Neck Surg* 2003; 128(4):489-496.
27. Kenny TJ, Duncavage J, Bracikowski J, Yildirim A, Murray JJ, Tanner SB. Prospective analysis of sinus symptoms and correlation with paranasal computed tomography scan. *Otolaryngol Head Neck Surg* 2001; 125(1):40-43.
28. Wabnitz DA, Nair S, Wormald PJ. Correlation between preoperative symptom scores, quality-of-life questionnaires, and staging with computed tomography in patients with chronic rhinosinusitis. *Am J Rhinol* 2005; 19(1):91-96.
29. Gwaltney JM, Jr., Phillips CD, Miller RD, Riker DK. Computed tomographic study of the common cold. *N Engl J Med* 1994; 330(1):25-30.
30. Holbrook EH, Brown CL, Lyden ER, Leopold DA. Lack of significant correlation between rhinosinusitis symptoms and specific regions of sinus computer tomography scans. *Am J Rhinol* 2005; 19(4):382-387.
31. Momeni AK, Roberts CC, Chew FS. Imaging of chronic and exotic sinonasal disease: review. *AJR* 2007; 189(6 Suppl):S35-45; quiz S46-38.
32. Rao VM, el-Noueam KI. Sinonasal imaging. Anatomy and pathology. *Radiol Clin North Am* 1998; 36(5):921-939, vi.
33. Younis RT, Anand VK, Davidson B. The role of computed tomography and magnetic resonance imaging in patients with sinusitis with complications. *Laryngoscope* 2002; 112(2):224-229.
34. Yousem DM. Imaging of sinonasal inflammatory disease. *Radiology* 1993; 188(2):303-314.
35. Lai V, Wong YC, Lam WY, Tsui WC, Luk SH. Inflammatory myofibroblastic tumor of the nasal cavity. *AJNR Am J Neuroradiol* 2007; 28(1):135-137.
36. Palacios E, Restrepo S, Mastrogiovanni L, Lorusso GD, Rojas R. Sinonasal hemangiopericytomas: clinicopathologic and imaging findings. *Ear Nose Throat J* 2005; 84(2):99-102.
37. Serrano E, Coste A, Percodani J, Herve S, Brugel L. Endoscopic sinus surgery for sinonasal haemangiopericytomas. *J Laryngol Otol* 2002; 116(11):951-954.
38. American College of Radiology. *Manual on Contrast Media*. Available at: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx.