American College of Radiology
ACR Appropriateness Criteria®
Sinonasal Disease

Variant 1: **Acute (less than 4 weeks) uncomplicated rhinosinusitis. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without and with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT cone beam paranasal sinuses without IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Not Appropriate	☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

<u>Variant 2:</u> **Acute rhinosinusitis with suspected orbital or intracranial complication. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI head without and with IV contrast	Usually Appropriate	O
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT maxillofacial with IV contrast	Usually Appropriate	☢☢
MRI head without IV contrast	May Be Appropriate	O
MRI orbits face neck without IV contrast	May Be Appropriate (Disagreement)	O
CT maxillofacial without IV contrast	May Be Appropriate (Disagreement)	☢☢
CT head with IV contrast	May Be Appropriate	☢☢☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
CT cone beam paranasal sinuses without IV contrast	Usually Not Appropriate	☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant 3: **Acute recurrent sinusitis or chronic rhinosinusitis or noninvasive fungal sinusitis or sinonasal polyposis. Possible surgical candidate for these indications or other non-neoplastic indications, including suspected silent sinus syndrome or suspected mucocele, or deviated nasal septum. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT maxillofacial without IV contrast	Usually Appropriate	☢☢
MRI orbits face neck without and with IV contrast	May Be Appropriate (Disagreement)	O
MRI orbits face neck without IV contrast	May Be Appropriate	O
CT cone beam paranasal sinuses without IV contrast	May Be Appropriate	☢☢
CT maxillofacial with IV contrast	May Be Appropriate	☢☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant 4: **Acute sinusitis with rapid progression or suspected invasive fungal sinusitis. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT maxillofacial with IV contrast	Usually Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Appropriate	☢☢
MRI head without and with IV contrast	May Be Appropriate	O
MRI head without IV contrast	May Be Appropriate	O
MRI orbits face neck without IV contrast	May Be Appropriate	O
CT head with IV contrast	May Be Appropriate	☢☢☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
CT cone beam paranasal sinuses without IV contrast	Usually Not Appropriate	☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant 5: **Suspected sinonasal mass. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT maxillofacial with IV contrast	Usually Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Appropriate	☢☢
MRI head without and with IV contrast	May Be Appropriate	O
MRI head without IV contrast	May Be Appropriate	O
MRI orbits face neck without IV contrast	May Be Appropriate	O
CT head with IV contrast	May Be Appropriate	☢☢☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
CT cone beam paranasal sinuses without IV contrast	Usually Not Appropriate	☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

<u>**Variant 6:**</u> **Suspected CSF leak. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
CT maxillofacial without IV contrast	Usually Appropriate	☢☢
MRI head without and with IV contrast	May Be Appropriate (Disagreement)	O
MRI head without IV contrast	May Be Appropriate	O
MRI orbits face neck without and with IV contrast	May Be Appropriate (Disagreement)	O
MRI orbits face neck without IV contrast	May Be Appropriate	O
CT head cisternography	May Be Appropriate	☢☢☢
DTPA cisternography	May Be Appropriate	☢☢☢
SPECT or SPECT/CT paranasal sinuses	May Be Appropriate	☢☢☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
Arteriography craniofacial	Usually Not Appropriate	☢☢☢
MRA head with IV contrast	Usually Not Appropriate	O
MRA head without and with IV contrast	Usually Not Appropriate	O
MRA head without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
CT cone beam paranasal sinuses without IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA head with IV contrast	Usually Not Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

SINONASAL DISEASE

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Summary of Literature Review

Introduction/Background

According to the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS), the term *rhinosinusitis* refers to symptomatic inflammation of the nasal cavity and paranasal sinuses and is preferred over the term *sinusitis*, because inflammation of the nasal cavity nearly always accompanies inflammation of the contiguous paranasal sinuses. Rhinosinusitis may be classified as *acute* rhinosinusitis (ARS) if symptoms last <4 weeks or as *chronic* rhinosinusitis (CRS) if symptoms last >12 weeks [1]. Patients with acute bacterial rhinosinusitis (ABRS) may develop orbital, intracranial, and vascular complications, including orbital cellulitis, subperiosteal abscess, intracranial abscess, cerebritis, cavernous sinus thrombosis, and aneurysm. Acute recurrent rhinosinusitis refers to when patients have 4 or more episodes of rhinosinusitis per year without persistent symptoms between episodes. CRS is one of the most common chronic illnesses in the United States, affecting approximately 12% to 16% of the population [2], with an overall annual economic burden estimated at $22 billion [3].

Acute invasive fungal sinusitis is a fungal infection of the paranasal sinuses with a rapid time course of <4 weeks [4] and a high mortality rate of 50% to 80% [5,6]. Affected patients are typically immunocompromised and include patients with neutropenia, hematologic malignancies, poorly controlled diabetes, acquired immunodeficiency syndrome, organ transplantation, and patients on immunosuppressive therapy including systemic steroids and chemotherapy [4]. Presenting symptoms are nonspecific and include fever, rhinorrhea, and diplopia, similar to those seen with ABRS. Clinicians should maintain a high index of suspicion for this diagnosis in immunocompromised patients with symptoms of ARS, orbital symptoms, and/or headache. [4].

Sinonasal neoplasms account for 3% of head and neck neoplasms [7]. Patients with a sinonasal mass may present with nasal congestion, nasal fullness, anosmia, rhinorrhea, and epistaxis [8,9]. Benign lesions include papilloma, respiratory epithelial adenomatoid hamartoma, pleomorphic adenoma, juvenile nasopharyngeal angiofibroma, nerve sheath tumor, and meningioma [7,8]. The most common sinonasal malignancy is squamous cell carcinoma, with other malignancies including sinonasal undifferentiated carcinoma, adenocarcinoma, lymphoma, neuroendocrine tumors, salivary gland tumors, and melanoma [7,10].

Sinonasal cerebrospinal fluid (CSF) leak is caused by an osteodural defect leading to communication between the subarachnoid space and sinonasal cavity. It may be due to skull base fractures, surgery, or skull base pathology including meningoencephalocele, tumors, and osteonecrosis. Spontaneous CSF leaks are those without an underlying lesion or history of trauma or surgery, and many of these cases are seen in patients with idiopathic intracranial hypertension [11,12]. Patients present with rhinorrhea, and the most reliable test to confirm the presence of a CSF leak is β2-transferrin analysis of the fluid [13]. Persistent CSF leak requires surgical treatment because of the risk of meningitis, and an accurate localization of the site of CSF leak is essential for successful surgical repair [12-14].

Paranasal sinus disease in the pediatric population is discussed in the ACR Appropriateness Criteria® topic on "Sinusitis-Child" [15].

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Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously in which each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant

Variant 1: Acute (less than 4 weeks) uncomplicated rhinosinusitis. Initial imaging.

ARS refers to inflammation of the nasal cavity and paranasal sinuses lasting <4 weeks' duration. Most cases are viral in origin, although 2% to 10% of cases may be bacterial in origin [6]. Cases of ABRS should be distinguished from ARS of viral etiology to determine treatment with antibiotics. Clinical suspicion of ABRS is based on the presence of symptoms including purulent nasal drainage, nasal obstruction, and localized sinus pain/pressure, persisting without improvement for at least 10 days. If symptoms worsen within 10 days after initial improvement, this is referred to as double sickening or double worsening [1,16]. Imaging can show mucosal thickening, submucosal edema, and air-fluid levels [2]. However, imaging has not been shown to accurately distinguish ABRS from ARS of viral etiology [1,17,18]. The AAO-HNS recommends that clinicians should not obtain radiographic imaging for patients with suspected uncomplicated ARS, with imaging reserved for cases with clinically suspected complication (see Variant 2) [1].

Arteriography Craniofacial

There is no relevant literature to support the use of arteriography in the evaluation of acute uncomplicated rhinosinusitis.

CT Cone Beam Paranasal Sinuses

As per clinical practice guidelines from the AAO-HNS, CT imaging of the sinuses is unnecessary for patients with a clinical diagnosis of ARS [1]. CT has not been shown to accurately distinguish ABRS from ARS of viral etiology [1,17,18]. Moreover, cone beam CT (CBCT) is limited in the evaluation of the soft tissues and is therefore not helpful in the imaging assessment of complications of sinus disease [19].

CT Head

As per clinical practice guidelines from the AAO-HNS, imaging is unnecessary for patients with a clinical diagnosis of ARS [1]. There is no relevant literature to support the use of CT head in the evaluation of acute uncomplicated rhinosinusitis.

CT Maxillofacial

As per clinical practice guidelines from the AAO-HNS, CT imaging of the sinuses is unnecessary for patients with a clinical diagnosis of ARS [1]. CT has not been shown to accurately distinguish ABRS from ARS of viral etiology [1,17,18].

CTA Head

There is no relevant literature to support the use of CT angiography (CTA) head in the evaluation of acute uncomplicated rhinosinusitis.

FDG-PET/CT Skull Base to Mid-Thigh

There is no relevant literature to support the use of fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET/CT in the evaluation of acute uncomplicated rhinosinusitis.

MRA Head

There is no relevant literature to support the use of MR angiography (MRA) head in the evaluation of acute uncomplicated rhinosinusitis.

MRI Head
As per clinical practice guidelines from the AAO-HNS, imaging is unnecessary for patients with a clinical diagnosis of ARS [1]. There is no relevant literature to support the use of MRI head in the evaluation of acute uncomplicated rhinosinusitis.

MRI Orbits, Face, and Neck
As per clinical practice guidelines from the AAO-HNS, imaging is unnecessary for patients with a clinical diagnosis of ARS [1]. There is no relevant literature to support the use of MRI of the orbits, face, and neck in the evaluation of acute uncomplicated rhinosinusitis.

Radiography Paranasal Sinuses
As per clinical practice guidelines from the AAO-HNS, imaging of the sinuses is unnecessary for patients with a clinical diagnosis of ARS [1]. Radiography lacks specificity for the identification of ABRS, because sinus fluid can also be seen with viral upper respiratory tract infections [20]. Compared with CT, radiography has been shown to have a low sensitivity of 25% to 41% for all sinus groups except the maxillary sinuses with 80% sensitivity [21]. In a meta-analysis of 6 studies, radiographs of the paranasal sinuses demonstrated a sensitivity of 76% and specificity of 79% for the diagnosis of ABRS compared with sinus puncture [22].

SPECT or SPECT/CT Paranasal Sinuses
There is no relevant literature to support the use of single-photon emission CT (SPECT) or SPECT/CT in the evaluation of acute uncomplicated rhinosinusitis.

Variant 2: Acute rhinosinusitis with suspected orbital or intracranial complication. Initial imaging.

ABRS may spread to the orbital and intracranial compartments through neurovascular foramina, areas of osseous erosion, or hematogenous spread along valveless veins [6]. Orbital complications are more common and include orbital cellulitis, subperiosteal abscess, and orbital abscess. Symptoms suggesting orbital involvement include eye swelling with or without proptosis, impaired eye movement, and decreased visual acuity [17,23]. Intracranial complications most commonly occur with frontal sinusitis and include epidural abscess, subdural empyema, cerebritis, brain abscess, and meningitis. Symptoms suggesting intracranial involvement include severe headache, photophobia, seizures, or other focal neurologic findings [6,17]. Vascular complications include cavernous sinus thrombosis and rarely pseudoaneurysm formation [2,24].

Arteriography Craniofacial
Arteriography may be performed for the evaluation of a pseudoaneurysm, although this would not be performed in the initial imaging evaluation. There is no relevant literature to support the use of arteriography in the evaluation of ARS with suspected orbital or intracranial complication.

CT Cone Beam Paranasal Sinuses
CBCT is not helpful in the imaging assessment of patients with ARS with suspected orbital or intracranial complications because of a limited evaluation of the soft-tissue structures [19,25].

CT Head
CT maxillofacial is useful as the first-line CT examination for patients with ARS with suspected intraorbital and intracranial complications, because complications adjacent to the paranasal sinuses are typically included in the field of view. MRI is overall more useful than CT for the evaluation of intracranial complications, but because CT may be the first imaging study ordered, contrast-enhanced CT head may be added to the CT maxillofacial examination for increased coverage of a suspected intracranial complication. CT head with intravenous (IV) contrast can accurately identify clinically suspected intracranial complications including epidural abscess, subdural empyema, cerebritis, and brain abscess. The accuracy for the detection of intracranial complications has been reported to be 87% for CT, compared with 97% for MRI [23], although the detection of cavernous sinus thrombosis, meningitis, and early cerebritis is more difficult on CT compared with MRI [6,17,23]. There is no relevant literature to support the use of noncontrast CT head or combined pre- and postcontrast CT imaging.

CT Maxillofacial
CT of the paranasal sinuses with IV contrast can accurately confirm paranasal sinus inflammation and identify orbital complications and adjacent intracranial complications included in the field of view [17]. Given its detailed depiction of bony anatomy, CT can also accurately demonstrate the presence of erosions of the sinus and orbital walls. Studies have demonstrated a higher accuracy of CT compared with clinical examination for detecting orbital complications, with an accuracy of 87% to 91% [23]. CT also enables surgical planning given its detailed depiction

of sinonasal anatomy and can be used for surgical image-guidance systems. Although MRI is overall more useful than CT for the evaluation of intracranial and intraorbital complications, CT is often the first imaging study ordered. A noncontrast CT may be performed for bony evaluation and surgical planning but is limited in the detection of orbital and intracranial complications. There is no relevant literature to support the use of combined pre- and postcontrast CT imaging.

CTA Head
CTA head may be performed for the evaluation of a pseudoaneurysm, but this is typically not performed in the initial imaging evaluation. There is no relevant literature to support the use of CTA head in the evaluation of ARS with suspected orbital or intracranial complication.

FDG-PET/CT Skull Base to Mid-Thigh
There is no relevant literature to support the use of FDG-PET/CT in the evaluation of ARS with suspected orbital or intracranial complication.

MRA Head
MRA head may be performed for the evaluation of a pseudoaneurysm, but this is typically not performed in the initial imaging evaluation. There is no relevant literature to support the use of MRA head in the evaluation of ARS with suspected orbital or intracranial complication.

MRI Head
MRI head without and with IV contrast can accurately identify clinically suspected intracranial complications including cavernous sinus thrombosis, epidural abscess, subdural empyema, cerebritis, brain abscess, and meningitis, with a reported 97% diagnostic accuracy compared with 87% for CT and a superior accuracy in particular for the diagnosis of meningitis [17,23]. Combined pre- and postcontrast imaging provides the best opportunity to identify and characterize potential intracranial complications. Restricted diffusion on diffusion-weighted sequences can accurately identify the presence of purulent material within extra-axial collections and brain abscesses.

MRI Orbits, Face, and Neck
MRI orbits, face, and neck without and with IV contrast can confirm paranasal sinus inflammation and identify orbital complications and adjacent intracranial complications included in the field of view [17]. This study may be done in conjunction with MRI head for suspected orbital and intracranial complications. Although noncontrast imaging can demonstrate fluid collections and edema, combined pre- and postcontrast imaging provides the best opportunity to identify and characterize potential orbital and intracranial complications.

Radiography Paranasal Sinuses
There is no relevant literature to support the use of radiography in the evaluation of ARS with suspected orbital or intracranial complication. Radiography is limited in the evaluation of soft-tissue structures.

SPECT or SPECT/CT Paranasal Sinuses
There is no relevant literature to support the use of SPECT or SPECT/CT in the evaluation of ARS with suspected orbital or intracranial complication.

Variant 3: Acute recurrent sinusitis or chronic rhinosinusitis or noninvasive fungal sinusitis or sinonasal polyposis. Possible surgical candidate for these indications or other non-neoplastic indications, including suspected silent sinus syndrome or suspected mucocele, or deviated nasal septum. Initial imaging.

CRS refers to rhinosinusitis lasting >12 weeks, and the most common symptoms of CRS include nasal obstruction, facial congestion and pressure, discolored nasal discharge, and hyposmia [26]. The presence of 2 or more of these symptoms for >12 weeks is highly sensitive for the diagnosis of CRS, but because these symptoms are nonspecific, documentation of inflammation on endoscopy or imaging is required to confirm the diagnosis [26]. Imaging findings that confirm CRS include mucosal thickening, sinus opacification, polyps or retention cysts, and sclerosis and thickening of the sinus walls [2,26].

Studies have shown variable correlation between the imaging findings and clinical symptoms of CRS. The Lund-Mackay and modified Lund-Mackay system are the most commonly used imaging staging systems, with some studies showing good correlation with disease severity and surgical outcomes [2,27,28]. Some studies have not demonstrated a correlation between symptom severity and CT findings [29-31], although correlation may be higher in patients with associated nasal polyps [29].

Functional endoscopic sinus surgery is now the standard of care for restoring patency of paranasal sinus outflow tracts, with postoperative improvement in symptoms and quality of life reported in over 75% of patients [32]. Functional endoscopic sinus surgery may be performed for CRS and other nonneoplastic indications including acute recurrent rhinosinusitis, noninvasive fungal sinusitis and fungus ball, sinonasal polyposis, silent sinus syndrome, mucocele, and deviated nasal septum. Imaging that provides anatomical detail is needed for surgical planning, in particular for the identification of anatomic variants and abnormalities that can increase the risk for intracranial, intraorbital, and vascular injury.

Arteriography Craniofacial

There is no relevant literature to support the use of arteriography in the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

CT Cone Beam Paranasal Sinuses

CBCT has been shown to have high accuracy for evaluating odontogenic and nonodontogenic sinusitis, with strong agreement between CBCT and sinus endoscopy [33]. Similar to standard multidetector CT, CBCT can confirm the diagnosis of CRS and identify anatomic variants for presurgical planning. One study showed decreased detection of intrasinus calcifications in patients with noninvasive fungal sinusitis compared with multidetector CT, although comparison between the 2 modalities was done in separate patient cohorts [34]. CBCT is limited in the evaluation of soft-tissue structures and therefore is not the imaging modality of choice if extrasinus disease is suspected [19,25].

CT Head

Given its typical incomplete coverage of the paranasal sinuses, CT head is not typically performed for the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

CT Maxillofacial

Given its excellent bony detail, multidetector CT without IV contrast is useful for confirming and evaluating CRS and for presurgical planning. Imaging findings that confirm CRS include mucosal thickening, sinus opacification, polyps or retention cysts, and sclerosis and thickening of the sinus walls [2,26]. CT has been shown to accurately identify these findings of CRS, although the findings have been shown to not necessarily correlate with the severity of symptoms [26]. CT can also evaluate the extent of disease and identify anatomic variants that narrow sinus drainage pathways [32].

CT is critical for surgical planning, in particular for the identification of anatomic variants and abnormalities that can increase the risk for intracranial, intraorbital, and vascular injury as well as for CSF leak [31,32]. Low-dose techniques have been shown to be limited in the visualization of surgically relevant anatomical structures including the cribriform plates, lamina papyracea, and anterior ethmoidal artery canal in the setting of CRS with nasal polyps and a history of sinus surgery [35]. A sinus CT protocol that can be utilized by image guidance systems is recommended [36].

Contrast-enhanced CT is not necessary to demonstrate findings of CRS or for surgical planning of paranasal sinus inflammatory disease. There is no relevant literature to support the use of combined pre- and postcontrast CT imaging.

Silent sinus syndrome is atelectasis of the maxillary sinus due to intrasinus negative pressure from chronic ostial obstruction. Both CT and MRI can demonstrate decreased maxillary sinus volume and inward bowing of the sinus walls characteristic of silent sinus syndrome, but additional findings of osseous thinning, obstruction of the infundibulum, and lateralization of the uncinate process are better delineated on CT compared with MRI [37].

Nasal septal deviation can cause symptomatic nasal obstruction and can also be a risk factor for CRS. Clinical anterior rhinoscopy and endoscopic examination is the reference standard for evaluating nasal septal deviation. CT has been shown to have limited correlation with physical examination, and CT may underestimate the degree of nasal obstruction due to septal deviation at the internal nasal valve. CT therefore should not be performed solely for the evaluation of septal deviation but rather for the evaluation of any associated symptoms of CRS [38].

CTA Head

There is no relevant literature to support the use of CTA head in the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

FDG-PET/CT Skull Base to Mid-Thigh
There is no relevant literature to support the use of FDG-PET/CT in the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

MRA Head
There is no relevant literature to support the use of MRA head in the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

MRI Head
There is no relevant literature to support the use of MRI head in the evaluation of CRS or for presurgical planning of paranasal sinus inflammatory disease.

MRI Orbits, Face, and Neck
MRI is not useful as the first-line study for routine sinus imaging because of the lack of bony detail. In addition, inspissated secretions may demonstrate a signal void that mimics air on T2-weighted sequences [39]. However, one study examined 89 adult patients imaged with both CT and MRI within a 3-month period for evaluation of pituitary disease and showed significant correlation between CT and MRI based Lund-Mackay staging scores of sinus disease; T1- and T2-weighted sequences were utilized for MRI scoring [40]. The utilization of IV contrast was not specified, and the Lund-Mackay scores were not correlated with patient symptoms in this study. In select cases, evaluation with MRI without and with IV contrast may be helpful to differentiate fluid secretions from inflamed mucosa and exclude an underlying obstructing mass [24].

Radiography Paranasal Sinuses
Detection of mucosal thickening is limited on radiography because of overlapping osseous structures [41]. CT has largely replaced radiography given its superior depiction of sinonasal anatomy and pathology and the need for greater anatomic detail for functional endoscopic sinus surgery planning [2,41].

SPECT or SPECT/CT Paranasal Sinuses
In a pilot study of 24 patients with CRS, a positive SPECT correlated with more extensive disease on CT and poor subjective response to medical treatment [42]. However, the use of SPECT remains limited in the evaluation of CRS, and this technique is generally not used in clinical practice.

Variant 4: Acute sinusitis with rapid progression or suspected invasive fungal sinusitis. Initial imaging.

Acute invasive fungal sinusitis is a fungal infection of the paranasal sinuses with a rapid time course of <4 weeks [4] and a high mortality rate of 50% to 80% [5,6]. Affected patients are typically immunocompromised and include patients with neutropenia, hematologic malignancies, poorly controlled diabetes, acquired immunodeficiency syndrome, and organ transplantation and patients on immunosuppressive therapy including systemic steroids and chemotherapy [4,5]. *Aspergillus* and *Mucoraceae* species are seen in most cases. Presenting symptoms are nonspecific and include fever, rhinorrhea, and diplopia, similar to those seen with ABRS. Clinicians should maintain a high index of suspicion for this diagnosis in immunocompromised patients with symptoms of ARS, orbital symptoms, and/or headache. Nasal endoscopy may demonstrate pale mucosa progressing to ulceration and necrosis [4]. Definitive diagnosis is made on biopsy with the identification of invasive fungi in the sinonasal mucosa, vessels, and bone [4]. Given the angioinvasive nature of the fungi, complications include thrombosis, dissection, and pseudoaneurysm formation of the intracranial arteries, thrombosis of the cavernous sinus, infarction, and hemorrhage [4,6]. Treatment typically includes both systemic antifungal medication and surgical debridement.

Arteriography Craniofacial
Arteriography may be performed for further characterization and confirmation of vascular complications of invasive fungal sinusitis detected by MRI, MRA, or CTA, including pseudoaneurysm formation, thrombosis, and dissection, although this would not be performed in the initial imaging evaluation. There is no relevant literature to support the use of arteriography in the initial evaluation of suspected acute invasive fungal sinusitis.

CT Cone Beam Paranasal Sinuses
CBCT is not helpful in the imaging assessment of patients with ARS with suspected orbital or intracranial complications because of the limited evaluation of the soft-tissue structures [19,25].

CT Head
CT head with IV contrast may be used to demonstrate intracranial complications but is less sensitive compared with MRI [6,23,43]. There is no relevant literature to support the use of noncontrast CT head or combined pre- and postcontrast CT imaging.

CT Maxillofacial
Noncontrast CT is effective in the evaluation of fungal sinusitis because it can demonstrate hyperattenuation in the involved sinus, bony erosions, and infiltration of the surrounding spaces [4,44]. Hyperattenuation within the paranasal sinuses can suggest the diagnosis but is nonspecific. Features including bone erosion and infiltration of the periantral fat have a high specificity but a limited sensitivity, particularly in the early phase of the disease, and severe predominantly unilateral nasal cavity mucosal thickening has a high sensitivity but low specificity [5,6,44]. In a retrospective study evaluating 42 patients with pathology-proven acute invasive fungal rhinosinusitis and 42 control patients from the same high-risk population, a 7-variable model was synthesized using infiltration of the periantral fat, pterygopalatine fossa, nasolacrimal duct and lacrimal sac, bone dehiscence, septal ulceration, and orbital involvement; positive findings in any 2 of the model variables demonstrated 88% sensitivity and 100% specificity [44]. Emphysematous soft tissue in the nasal cavity is also a specific sign of early invasive fungal sinusitis [5].

CT also enables surgical planning given its detailed depiction of sinonasal anatomy and can be used with surgical image-guidance systems when acquired with the appropriate protocol.

CT with IV contrast may also be used to help demonstrate orbital and intracranial complications included in the field of view. [6,23,43]. There is no relevant literature to support the use of combined pre- and postcontrast CT imaging.

CTA Head
CTA head may be performed for the evaluation of vascular complications of invasive fungal sinusitis including pseudoaneurysm formation, thrombosis, and dissection, although this would not be performed in the initial imaging evaluation. There is no relevant literature to support the use of CTA head in the initial evaluation of suspected acute invasive fungal sinusitis.

FDG-PET/CT Skull Base to Mid-Thigh
There is no relevant literature to support the use of FDG-PET/CT in the evaluation of acute invasive fungal sinusitis.

MRA Head
MRA head may be performed for the evaluation of vascular complications of invasive fungal sinusitis including pseudoaneurysm formation, thrombosis, and dissection, although this would not be performed in the initial imaging evaluation. There is no relevant literature to support the use of MRA head in the initial evaluation of suspected invasive fungal sinusitis.

MRI Head
MRI head without and with IV contrast can delineate complications involving the intracranial compartment better than CT [5,6,43]. Combined pre- and postcontrast imaging provides the best opportunity to identify and characterize potential intracranial complications. MRI head with and without IV contrast may be complementary to CT maxillofacial to identify intracranial spread beyond the field of view of the MRI orbits, face, and neck examination.

MRI Orbits, Face, and Neck
A T2 signal void from fungal concretions can be confused for a pneumatized sinus, limiting evaluation of intrasinus disease with MRI [4,5]. However, MRI without and with IV contrast provides accurate evaluation of the invasion of the surrounding soft tissues, orbits, and intracranial compartment and vascular complications. One study evaluating 17 immunocompromised patients with acute invasive fungal sinusitis and 6 controls found increased sensitivity of MRI of 85% to 86% compared with CT with a sensitivity of 57% to 69% and found extrasinus invasion to be the most sensitive imaging finding [4,45]. Lack of sinonasal mucosal and nasal turbinate enhancement, the latter described as the black turbinate sign, correlates with necrosis related to the angioinvasive nature of fungal sinusitis [4]. In a study from Korea evaluating 23 patients with acute invasive fungal rhinosinusitis, extrasinonasal extension was demonstrated in all cases on MRI, with orbital extension in 65%; lack of contrast enhancement was seen in 48% of patients and was found to be a prognostic factor for disease-specific mortality [46]. Although noncontrast imaging can demonstrate fluid collections and edema, combined pre- and postcontrast imaging provides the best opportunity to identify and characterize potential orbital, intracranial, and vascular complications.

Radiography Paranasal Sinuses
Radiography of the paranasal sinuses is considered to be of limited usefulness given a large number of false-negative results [47]. Findings of bone erosion may be seen in advanced cases, but CT is more useful for the detection of bony erosion and adjacent soft-tissue involvement.

SPECT or SPECT/CT Paranasal Sinuses
There is no relevant literature to support the use of SPECT or SPECT/CT in the evaluation of acute invasive fungal sinusitis.

Variant 5: Suspected sinonasal mass. Initial imaging.

Patients with a sinonasal mass may present with nasal congestion, nasal fullness, anosmia, rhinorrhea, and epistaxis [8,9]. Benign lesions include papilloma, respiratory epithelial adenomatoid hamartoma, pleomorphic adenoma, juvenile nasopharyngeal angiofibroma, nerve sheath tumor, and meningioma [7,8]. The most common sinonasal malignancy is squamous cell carcinoma, with other malignancies including sinonasal undifferentiated carcinoma, adenocarcinoma, lymphoma, neuroendocrine tumors, salivary gland tumors, and melanoma [7,10]. A meningoencephalocele may also present as a sinonasal mass.

Imaging may demonstrate specific features of a sinonasal mass, which can narrow a differential diagnosis and occasionally facilitate a specific diagnosis. Ultimately, very few imaging features are pathognomonic and most sinonasal neoplasms require histologic sampling for a specific diagnosis [7,24]. The main role of imaging in these cases is to delineate the extent of disease for treatment planning.

Arteriography Craniofacial
Catheter angiography is typically not useful in the initial imaging evaluation of a sinonasal mass. It may be useful for preoperative planning, preoperative embolization of a vascular mass, or to treat severe epistaxis [43,48-50].

CT Cone Beam Paranasal Sinuses
CBCT is not useful in the workup of patients with sinonasal mass because of the limitations in assessing soft-tissue structures.

CT Head
CT best depicts osseous changes, although it is limited in determining soft-tissue and intracranial extent. Although MRI is useful for evaluating intracranial extension of a sinonasal mass, contrast-enhanced CT can also be useful for evaluating the soft-tissue and intracranial extent of the mass [51]. CT maxillofacial is useful as the first-line CT examination for suspected sinonasal mass, but contrast-enhanced CT head may be added if increased coverage of the intracranial component of a mass and its associated mass effect of the intracranial structures is required. There is no relevant literature to support the use of noncontrast CT head or combined pre- and postcontrast CT imaging.

CT Maxillofacial
CT best depicts osseous changes and can help distinguish bony remodeling that is more typical of slow growing or benign masses from lytic destruction seen with more aggressive malignancies [7,51]. CT can demonstrate lesion mineralization, including the osseous matrix of osteomas, the chondroid matrix of cartilaginous tumors, and the ground glass density of fibro-osseous lesions. CT also best depicts invasion of the surrounding osseous structures, although it is limited in determining soft-tissue and intracranial extent and in distinguishing tumor from sinonasal inflammation.

CT and MRI are complementary imaging modalities in the evaluation of sinonasal masses, localizing and characterizing lesions and determining their extent for treatment planning. If an MRI is also planned or performed, the CT can be performed without IV contrast because the main purpose of the CT is to evaluate osseous involvement. Although MRI is superior for evaluating the soft tissues, contrast-enhanced CT can also be useful for evaluating the soft-tissue and intracranial extent of the mass [51].

CT maxillofacial also enables surgical planning given its detailed depiction of sinonasal anatomy and can be used with surgical image-guidance systems when acquired with the appropriate protocol.

CTA Head
CTA head is typically not useful in the initial imaging evaluation of a sinonasal mass. It may be useful for preoperative planning of a vascular mass [43,48-50].

FDG-PET/CT Skull Base to Mid-Thigh
FDG-PET/CT is not useful for the initial evaluation of a sinonasal mass but can be used to detect regional and distant metastases in the staging workup of malignant neoplasms [7].

MRA Head
MRA head typically is not useful in the initial imaging evaluation of a sinonasal mass. It may be useful for preoperative planning of a vascular mass [43,48-50].

MRI Head
MRI head may be performed in addition to the MRI maxillofacial examination if increased coverage of the intracranial component of a mass and its associated mass effect of the intracranial structures is required. Combined pre- and postcontrast imaging provides the best opportunity to identify intracranial extension and to characterize potential intracranial complications.

MRI Orbits, Face, and Neck
MRI without and with IV contrast can best characterize the soft-tissue components of a mass and can occasionally demonstrate signal characteristics suggestive of specific pathology. For example, MRI can demonstrate the convoluted cerebriform pattern of inverted papillomas on T2-weighted and contrast-enhanced T1-weighted MRI; the intrinsic T1 hyperintensity of melanotic melanomas; and peritumoral intracranial cysts, which are suggestive of, but not specific for, esthesioneuroblastoma [7,8]. Decreased T2 signal and apparent diffusion coefficient correlate with increased cellularity of tumors [9]. Perfusion MRI can also potentially provide diagnostic information of sinonasal masses [52,53].

For tumor mapping, MRI is more helpful than CT for soft tissue contrast and can better distinguish tumors from the more T2 hyperintense sinus inflammatory changes and retained secretions. MRI can also best identify intracranial and perineural involvement important for staging and presurgical planning [7,24]. Compared with CT, MRI can also better detect osseous marrow invasion.

CT and MRI are complementary imaging modalities in the evaluation of sinonasal masses, localizing and characterizing lesions, and determining their extent for treatment planning.

Radiography Paranasal Sinuses
Radiography is not considered to be part of the imaging workup of sinonasal neoplasms [51].

SPECT or SPECT/CT Paranasal Sinuses
There is no relevant literature to support the use of SPECT or SPECT/CT in the evaluation of a sinonasal mass.

Variant 6: Suspected CSF leak. Initial imaging.
Sinonasal CSF leak is caused by an osteodural defect leading to communication between the subarachnoid space and the sinonasal cavity. It may be due to skull base fractures, surgery, or skull base pathology including meningoencephalocele, tumors, and osteonecrosis. Spontaneous CSF leaks are those without an underlying lesion or history of trauma or surgery, and many of these cases are seen in patients with idiopathic intracranial hypertension [11,12]. Patients present with rhinorrhea, and the most reliable test to confirm the presence of a CSF leak is β2-transferrin analysis of the fluid [12]. Persistent CSF leak requires surgical treatment because of the risk of meningitis, and accurate localization of the site of CSF leak is essential for successful surgical repair [12-14].

CSF leak into the tympanomastoid cavity may also present with rhinorrhea in patients with an intact tympanic membrane, with CSF draining through the eustachian tube into the nasopharynx and nasal cavity. CSF leaks of the temporal bone are included in the ACR Appropriateness Criteria® topic on "Head Trauma" [54].

Arteriography Craniofacial
There is no relevant literature to support the use of arteriography in the evaluation of sinonasal CSF leak.

CT Cone Beam Paranasal Sinuses
There is no relevant literature regarding the use of CBCT paranasal sinuses in the evaluation of sinonasal CSF leak.

CT Head Cisternography
CT head cisternography is performed by spinal injection of intrathecal contrast, with images performed before and after contrast administration. Interval contrast pooling adjacent to an osseous defect can be identified with demonstration of a 50% or greater increase in Hounsfield units between the pre- and postcontrast scans [12]. CT head cisternography is primarily used in the setting of multiple osseous defects on high-resolution CT (HRCT) to

determine the specific site of the leak [12]. CT cisternography has a reported sensitivity of 33% to 100% and a specificity of 94% [12,13,55-58]. The primary limitation of CT cisternography is that the patient needs to have an active CSF leak at the time of this examination for the study to be potentially diagnostic. Studies comparing CT cisternography with MRI have demonstrated CT cisternography to have a lower sensitivity of 33% to 72% versus 67% to 93% for MRI with a heavily T2-weighted sequence (MR cisternogram) and 80% for contrast-enhanced MR cisternogram [13,59,60].

CT Head
Given its typical incomplete coverage of the paranasal sinuses, CT head is not typically performed for the evaluation of sinonasal CSF leak.

CT Maxillofacial
HRCT of the paranasal sinuses without IV contrast with inclusion of the tympanomastoid cavities is useful as the first study of choice given its high spatial resolution and superior bony detail. HRCT has a reported sensitivity of 88% to 95% in identifying a skull base defect after CSF leak is confirmed by β2-transferrin analysis [12,55]. An evidence-based review of 16 studies relevant to HRCT reported a sensitivity of 44% to 100% and a specificity of 45% to 100%, with the majority being in the higher end of the spectrum; of the 2 studies reporting low sensitivity/specificity, one did not clearly report use of HRCT versus standard CT, and the other only examined patients with an inactive leak [13,55,57,58,61,62].

HRCT also enables surgical planning given its detailed depiction of sinonasal anatomy and can be used with surgical image-guidance systems when acquired with the appropriate protocol. HRCT can identify the skull base defect even in the absence of an active leak; however, it is limited in identifying a specific site of the leak if the patient has multiple osseous defects because it is not clear which defect is the source of the leak [12]. A combination of HRCT and MRI with a heavily T2-weighted sequence has a reported sensitivity of 90% to 96% [13,55,61]. HRCT alone is sufficient if only 1 osseous defect is identified and corresponds with the clinical symptoms [12]. HRCT may also be the only study required in patients with iatrogenic CSF leaks for preoperative planning, because the surgical site of leak is known [12].

There is no relevant literature to support the use of contrast-enhanced CT or combined pre- and postcontrast CT in the evaluation of CSF leak.

CTA Head
There is no relevant literature to support the use of CTA head in the evaluation of sinonasal CSF leak.

DTPA Cisternography
Radionuclide diethylenetriamine pentaacetic acid (DTPA) cisternography is performed by spinal injection of radiotracer and placement of pledgets throughout the nasal cavity. After 24 to 48 hours, the radioactivity of each pledget is measured and compared with baseline serum levels. This study can confirm the presence of CSF leak, but it is limited for accurate localization because the pledgets and secretions may move around the nasal cavity [12,13]. Sensitivity for the presence of a CSF leak ranges from 76% to 100% with a specificity of 100% [13,58]. This study is generally reserved for cases in which sufficient fluid cannot be collected for β2-transferrin testing to confirm the presence or absence of leak [13].

FDG-PET/CT Skull Base to Mid-Thigh
There is no relevant literature to support the use of FDG-PET/CT in the evaluation of sinonasal CSF leak.

MRA Head
There is no relevant literature to support the use of MRA head in the evaluation of sinonasal CSF leak.

MRI Head
MRI with the inclusion of heavily T2-weighted images is often referred to as an MR cisternogram and is considered the second choice of study and should be done only in conjunction with HRCT [12,55,61]. The heavily T2-weighted sequence covering the roof of the sinonasal cavity in the coronal plane can be included in either an MRI head examination or an MRI orbits, face, and neck examination. A 3-D isotropic heavily T2-weighted sequence should be obtained to provide submillimeter high spatial and contrast resolution and allow for reformats in multiple planes. The site of the CSF leak can be demonstrated on MRI with identification of CSF extending from the subarachnoid space into the sinonasal space through an osseous defect seen on a concurrent or prior CT examination, with or without an associated cephalocele. Sensitivity of 56% to 94% and specificity of 57% to 100% have been reported

for the identification of the site of the CSF leak [12-14,55,58,61,63]. Given its superior soft-tissue contrast, MRI can also identify the contents of a cephalocele if present.

MRI without IV contrast with inclusion of heavily T2-weighted images is typically sufficient for the evaluation of CSF leak. However, MRI without and with IV contrast may be useful for identifying dural enhancement and distinguishing a meningoceles from sinus secretions [11].

Imaging findings of idiopathic intracranial hypertension that may associated with a spontaneous CSF leak is outside of scope of this study and can be found in the ACR Appropriateness Criteria® topic on "Headache" [64].

MRI Orbits, Face, and Neck

MRI with the inclusion of heavily T2-weighted images is often referred to as an MR cisternogram and may be considered the second choice of study and should be done only in conjunction with HRCT [12,55,61]. The heavily T2-weighted sequence covering the roof of the sinonasal cavity in the coronal plane can be included in either an MRI head examination or an MRI orbits, face, and neck examination. A 3-D isotropic heavily T2-weighted sequence should be obtained to provide submillimeter high spatial and contrast resolution and to allow for reformats in multiple planes. The site of the CSF leak can be demonstrated on MRI with identification of CSF extending from the subarachnoid space into the sinonasal space with or without an associated cephalocele. Sensitivity of 56% to 94% and specificity of 57% to 100% have been reported for the identification of the site of the CSF leak [12-14,55,58,61,63]. Given its superior soft-tissue contrast, MRI can also identify the contents of a cephalocele if present.

MRI without IV contrast with inclusion of heavily T2-weighted images is typically sufficient for the evaluation of a CSF leak. However, MRI without and with IV contrast may be useful for identifying dural enhancement and distinguishing a meningoceles from sinus secretions [11].

Contrast-enhanced MR cisternogram is performed by spinal injection of intrathecal gadolinium, with thin-section T1-weighted images obtained before and after contrast injection. The postinjection images can be obtained immediately after contrast administration or at delayed intervals up to 24 hours after contrast administration. This technique allows for detection of both high-flow and slow-flow leaks and allows for simultaneous evaluation of cephaloceles that may be present. Sensitivity up to 100% has been reported for high-flow leaks and 60% to 70% for slow-flow leaks [12,65]. Studies have demonstrated contrast-enhanced MR cisternogram to have a higher sensitivity of 80% when compared with 33% to 72% of CT cisternogram [13,60]. Intrathecal administration of gadolinium contrast is not currently approved by the US Food and Drug Administration and requires off-label use consent [12].

Radiography Paranasal Sinuses

There is no relevant literature to support the use of radiography in the evaluation of a sinonasal CSF leak.

SPECT or SPECT/CT Paranasal Sinuses

Three studies evaluating the efficacy of SPECT cisternography after the intrathecal injection of radiotracer reported a sensitivity of 94% with SPECT planar imaging and 94% to 100% for SPECT/CT fusion imaging for localization [13,66]. This study is not typically useful in the initial imaging evaluation of a CSF leak. It may be performed if the HRCT fails to show a defect or if CT shows multiple defects and for slow-flow leaks if the CT cisternogram fails to identify the source of leak.

Summary of Recommendations

- **Variant 1**: Imaging is usually not appropriate for the initial imaging of patients with acute (<4 weeks) uncomplicated rhinosinusitis.
- **Variant 2**: MRI head without and with IV contrast or MRI orbits, face, and neck without and with IV contrast or CT maxillofacial with IV contrast is usually appropriate for the initial imaging of patients with ARS with suspected orbital or intracranial complication. The use of CT and MRI can be complementary. The MRI head and MRI orbits, face, and neck procedures can be complementary or can be equivalent alternatives and can be selected based on the clinically suspected extent of disease. The panel did not agree on recommending MRI orbits, face, and neck without IV contrast or CT maxillofacial without IV contrast. There is insufficient medical literature to conclude whether or not these patients would benefit from CT maxillofacial without IV contrast or MRI orbits, face, and neck without IV contrast. These procedures in this patient population is controversial but may be appropriate.

- **Variant 3**: CT maxillofacial without IV contrast is usually appropriate for patients with acute recurrent sinusitis or CRS or noninvasive fungal sinusitis or sinonasal polyposis who are a possible surgical candidate for these indications or other nonneoplastic indications, including suspected silent sinus syndrome or suspected mucocele or deviated nasal septum. The panel did not agree on recommending MRI orbits, face, and neck without and with IV contrast. There is insufficient medical literature to conclude whether or not these patients would benefit from MRI orbits, face, and neck without and with IV contrast. This procedure in this patient population is controversial but may be appropriate.
- **Variant 4**: MRI orbits, face, and neck without and with IV contrast or CT maxillofacial with IV contrast or CT maxillofacial without IV contrast is usually appropriate for the initial imaging of patients with acute sinusitis with rapid progression or suspected invasive fungal sinusitis. These procedures are equivalent alternatives (ie, only one initial procedure will be ordered to provide the clinical information to effectively manage the patient's care). The use of CT and MRI, however, can be complementary.
- **Variant 5**: MRI orbits, face, and neck without and with IV contrast or CT maxillofacial with IV contrast or CT maxillofacial without IV contrast is usually appropriate for patients with suspected sinonasal mass. The CT procedures are equivalent alternatives (ie, only one initial procedure will be ordered to provide the clinical information to effectively manage the patient's care). The use of CT and MRI however is often complementary.
- **Variant 6**: CT maxillofacial without IV contrast is usually appropriate as initial imaging for patients with suspected CSF leak. The panel did not agree on recommending MRI head without and with IV contrast or MRI orbits, face, and neck without and with IV contrast. There is insufficient medical literature to conclude whether or not these patients would benefit from MRI head without and with IV contrast or MRI orbits, face, and neck without and with IV contrast. These procedures in this patient population is controversial but may be appropriate.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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, because of both 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 with 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 [67].

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."

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