CDI QUALITY INSTITUTE

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CDI Quality Institute PLE
Rhinosinusitis AUC
2021 Update

Appropriateness of advanced imaging procedures* in patients with rhinosinusitis and the following clinical presentations or diagnoses:

*Including MRI, MR angiography, MR venography, CT, CT angiography, CT venography, nuclear medicine, SPECT, PET

Abbreviation list:

AAAAI	American Academy of Allergy, Asthma and Immunology
AAO-HNSF	American Academy of Otolaryngology-Head and Neck Surgery Foundation
ABRS	Acute bacterial rhinosinusitis
ACAAI	American College of Allergy, Asthma and Immunology
ACR	American College of Radiology
AFIFS	Acute fulminant invasive fungal sinusitis
ARS	Acute rhinosinusitis
CRS	Chronic rhinosinusitis
CT	Computed tomography
CTA	Computed tomography angiography
CTV	Computed tomography venography
ESS	Endoscopic sinus surgery
ICSI	Institute for Clinical Systems Improvement
IDSA	Infectious Diseases Society of America
MRA	Magnetic resonance angiography
MRI	Magnetic resonance imaging
MRV	Magnetic resonance venography
RARS	Recurrent acute rhinosinusitis
SNOT-22	22-item Sino-Nasal Outcome Test
SPECT	Single-photon emission computed tomography

Appropriate Use Criteria: How to Use this Document

The CDI Quality Institute follows the recommendation framework defined by the Appraisal of Guidelines for Research & Evaluation (AGREE II), AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews) and a modified version of the QUADAS-2 (Quality Assessment of Diagnostic Accuracy Studies) to evaluate the strength of recommendations concerning advanced imaging. Considerations used to determine a recommendation are listed below.

Primary recommendation (green): A strong recommendation for initial imaging for this presentation; there is confidence that the desirable effects of imaging outweigh its undesirable effects.

Alternative recommendation (yellow): A conditional recommendation for imaging; the desirable effects of imaging likely outweigh its undesirable effects, although some uncertainty may exist. The individual patient's circumstances, preferences, and values should be considered on a case-by-case basis. This may include: contraindication to the primary recommendation, specific clinical circumstances that require use of the alternative recommendation, or the primary recommendation has results that are inconclusive or incongruent with the patient's clinical diagnosis. Case-by-case indications to consider have been noted in brackets when appropriate.

Recommendation against imaging (red): The undesirable effects of imaging outweigh any desirable effects. Additionally, the recommendation may be impractical or not feasible in the targeted population and/or practice setting(s).

Rhinosinusitis AUC Summary:

Acute rhinosinusitis, generally defined as an episode lasting less than 4 weeks, is usually diagnosed by history and physical examination, with advanced imaging tests not recommended unless the condition persists despite treatment or a complication is suspected. When the acute rhinosinusitis is **recurrent** (four or more episodes per year), imaging with CT can be useful to confirm the diagnosis, plan for surgical intervention, and/or identify suspected complications.

For cases of **chronic rhinosinusitis** (CRS), generally defined as an episode lasting more than 12 weeks, CT imaging, as opposed to plain radiography or MRI, is the radiologic modality of choice. It can be useful for confirming CRS, as an alternative to nasal endoscopy, and/or for evaluating CRS prior to surgical intervention. MRI is not considered a first-line study in this scenario because of lack of bone detail and length of imaging time.

Before surgical intervention, noncontrast CT of the paranasal sinuses is indicated for evaluation of either recurrent acute rhinosinusitis or chronic rhinosinusitis, providing the best preoperative information for endoscopic surgery, with excellent delineation of the complex ethmoidal anatomy, ostiomeatal unit, and anatomic variations.

Complications of rhinosinusitis are typically classified as orbital, intracranial, and osseous. Initial signs and symptoms can be diagnosed on CT imaging. CT is also superior to MRI for foreign body assessment, calcification detection, and osseous evaluation. MRI provides an accurate evaluation of complex sinus secretions and extension of disease into adjacent soft tissues. For intracranial complications, MRI is considered to be the "gold-standard" as it is more sensitive than CT and should be the imaging modality of choice where available. Additional imaging via CT angiography or MR angiography may be needed if there is concern for carotid/vascular invasion and pseudoaneurysm formation; however, they are not first-line examinations.

Acute uncomplicated rhinosinusitis (< 4 weeks duration*):

- **Green** –
- **Yellow** –
- **Red** – **MRI**; **CT**; **MR angiography**; **MR venography**; **CT angiography**; **CT venography**; **scintigraphy**; **PET**; **SPECT**

*Rhinosinusitis lasting between 4 and 12 weeks should be assessed on an individual clinical basis to determine if the pattern is acute or chronic, because timeline definitions are consensus- rather than evidence-based (Kirsch et al [*ACR*] 2017).

Level of Evidence: CT, MRI: moderate (for not performing imaging)

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus summary:
In acute rhinosinusitis, the diagnosis is usually made on clinical grounds (history and physical examination), and imaging tests are not recommended unless the condition persists despite treatment or a complication is suspected (Fokkens et al 2020; Orlandi et al 2020: grade B evidence; Chow et al [*IDSA*] 2012; Kirsch et al [*ACR*] 2017; Desrosiers et al 2011: moderate strength of evidence, strong recommendation; Short et al [*ICSI*] 2017; Rosenfeld et al [*AAO-HNSF*] 2015: recommendation against imaging; Peters et al [*AAAAI & ACAAI*] 2014). Imaging can potentially be useful when the diagnosis is in question (Peters et al [*AAAAI & ACAAI*] 2014). Most cases of acute bacterial rhinosinusitis (ABRS) have findings on radiographs or CT that are nonspecific and do not distinguish bacterial from viral infection (Chow et al [*IDSA*] 2012). MRI is not currently used in the workup of patients with uncomplicated rhinosinusitis (Kirsch et al [*ACR*] 2017).

Clinical and imaging notes:

- Acute rhinosinusitis (ARS) in adults is defined as sinonasal inflammation lasting less than 4 weeks and associated with the sudden onset of symptoms. Symptoms must include both: 1) nasal blockage/obstruction/congestion or nasal discharge (anterior/posterior) AND 2) facial pain/pressure or reduction/loss of smell (Orlandi et al 2020; Kirsch et al [*ACR*] 2017; Short et al [*ICSI*] 2017). By definition, uncomplicated rhinosinusitis is symptomatic inflammatory change involving the nasal cavity and paranasal sinuses without extension beyond the paranasal sinuses or nasal cavity at time of diagnosis (Kirsch et al [*ACR*] 2017; Rosenfeld et al [*AAO-HNSF*] 2015). In the past, the term “subacute” has sometimes been used to fill the gap between acute and chronic rhinosinusitis. However, a separate term to describe patients with prolonged acute rhinosinusitis is not necessary because the number of patients who have such a prolonged course is small and there are very little data on which to offer evidence-based recommendations on how to manage these patients (Fokkens et al 2020).
- Acute rhinosinusitis (ARS) of < 4 weeks is subdivided into acute bacterial rhinosinusitis (ABRS; < 10% of cases) or viral rhinosinusitis (≥ 90% of cases). The distinction is a clinical one determined by illness pattern and length of occurrence (Kirsch et al [*ACR*] 2017; Chow et al [*IDSA*] 2012).
    - In acute viral rhinosinusitis, symptoms last < 10 days without worsening (Fokkens et al 2020; Kirsch et al [*ACR*] 2017; Rosenfeld et al [*AAO-HNSF*] 2015).
    - ABRS diagnosis is made when symptoms of ARS are present without evidence of improvement for ≥ 10 days after the onset of upper respiratory symptoms, or when

symptoms recur or worsen within 10 days after initial improvement (Kirsch et al [*ACR*] 2017; Short et al [*ICSI*] 2017; Rosenfeld et al [*AAO-HNSF*] 2015; Chow et al [*IDSA*] 2012).

- Acute bacterial rhinosinusitis may also have onset of severe symptoms, characterized by high fever and purulent nasal drainage or facial pain lasting for at least 3-4 consecutive days at the beginning of illness or following a typical viral upper respiratory infection (Chow et al [*IDSA*] 2012). *The PLE expert panel consensus opinion was that fever was not an efficient discriminator between acute viral and bacterial sinusitis.* Fever has a reported sensitivity and specificity of only 50% for ABRS (Rosenfeld et al [*AAO-HNSF*] 2015).

Evidence update (2017-present): There were no new studies significantly affecting the evidence and recommendations included in the guidelines cited above.

Recurrent acute rhinosinusitis (RARS):

- Green – **CT paranasal sinuses without IV contrast**
- Green – **CT cone beam paranasal sinuses without IV contrast**
- Red – **CT without and with IV contrast**; **CT with IV contrast**; **MRI**; **MR angiography**; **MR venography**; **CT angiography**; **CT venography**; **scintigraphy**; **PET**; **SPECT**

Level of Evidence: CT: very low (insufficient for contrast); MRI: insufficient

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus summary:
Sinonasal imaging, specifically CT without IV contrast, may be indicated in patients with signs and symptoms of RARS (Kirsch et al [*ACR*] 2017; Seidman et al [*AAO-HNSF*] 2015). Imaging is an option during at least one episode of suspected RARS to appropriately confirm the diagnosis, plan for surgical intervention, identify suspected complications, and/or distinguish it from other diagnoses such as allergy exacerbation or primary headache syndromes (Kirsch et al [*ACR*] 2017; Orlandi et al 2020). Cone-beam CT may also be useful assessing paranasal anatomy and pathology, although it is limited in evaluating the adjacent soft tissues (Kirsch et al [*ACR*] 2017). CT with IV contrast does not have a role in the evaluation of patients with uncomplicated recurrent acute rhinosinusitis (PLE expert panel consensus opinion). MRI is not considered a first-line study for routine sinus imaging because of lack of bone detail and length of imaging time (Kirsch et al [*ACR*] 2017).

Clinical and imaging notes:

- If four or more episodes of acute bacterial rhinosinusitis (ABRS) occur annually, without signs or symptoms between the episodes, the term recurrent acute rhinosinusitis (RARS) is used (Fokkens et al 2020; Kirsch et al [*ACR*] 2017; Rosenfeld et al [*AAO-HNSF*] 2015; Desrosiers et al 2011; Orlandi et al 2020).
- CT examinations of the paranasal sinuses should utilize thin sections (≤1.25 mm) with sagittal reformations, coronal reformations and thick (2-3 mm) soft tissue axial reformations (PLE expert panel consensus opinion).
- CT images can also be imported into computer navigation systems for image-based guidance surgery during endoscopic sinus surgery. Imaging protocols should be aligned with any image-guided procedure requirements to eliminate redundant imaging for surgical guidance (Kirsch et al [*ACR*] 2017).
- Image-based guidance surgery provides real-time information of instrument location relative to critical structures (PLE expert panel consensus opinion).
- The CT Lund-Mackay score is a method for the staging of chronic rhinosinusitis on CT (Lund & Mackay, 1993). The reader assigns each sinus a score of:
    - 0 (no abnormality)
    - 1 (partial opacification) or
    - 2 (complete opacification)

  The sinuses are grouped into:
    - frontal sinus
    - anterior ethmoidal cells
    - posterior ethmoidal cells

- maxillary sinus
- sphenoid sinus
- ostiomeatal complex

The ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed). Each side is graded separately. A combined score of up to 24 is possible. Of note, an aplastic (absent) frontal sinus receives a score of 0.

Evidence update (2017-present):

Sohn et al (2018) conducted a retrospective study to assess clinical presentations and anatomic variants among 304 patients with recurrent acute rhinosinusitis (RARS) and chronic rhinosinusitis (CRS) - either with nasal polyps (CRSsNP) or without nasal polyps (CRSwNP). All patients completed the Sino-Nasal Outcome Test (SNOT-20) one day before and six months after endoscopic sinus surgery. No significant differences were found among the average preoperative SNOT-20 scores of the 3 groups. Patients with RARS were significantly more likely to show agger nasi cells, Haller cells, and septal deviation on CT. Those with CRSwNP had significantly smaller mean infundibular widths. All groups showed significantly improved SNOT-20 scores postoperatively (low level of evidence).

Chronic* uncomplicated rhinosinusitis (CRS):

- Green – **CT paranasal sinuses without IV contrast**
- Green – **CT cone beam paranasal sinuses without IV contrast**
- Yellow – **MRI orbit, face & neck without and with IV contrast**
- Yellow – **MRI orbit, face & neck without IV contrast**
  [patient unable to receive IV contrast]
- Yellow – **MRI orbit, face & neck with IV contrast**
  [patient with recent corresponding MRI without IV contrast]
- Yellow – **CT paranasal sinuses with IV contrast**
  [patient unable to undergo MRI]
- Red – **CT without and with IV contrast**; **MR angiography**; **MR venography**; **CT angiography**; **CT venography**; **scintigraphy**; **PET**; **SPECT**

*Rhinosinusitis lasting between 4 and 12 weeks should be assessed on an individual clinical basis to determine if the pattern is acute or chronic, because timeline definitions are consensus- rather than evidence-based (Kirsch et al [*ACR*] 2017).

Level of Evidence: CT: moderate (insufficient for contrast); MRI: insufficient

Notes concerning applicability and/or patient preferences: A patient's history of radiation exposure and preferences should be taken into account when deciding to confirm chronic rhinosinusitis (CRS) with CT. Multi-detector CT scanners and cone-beam CT can reduce the radiation dose while preserving image quality by shortening the scan time and using post-processing techniques without compromising anatomical accuracy, making them increasingly attractive (Fokkens et al (2020).

Guideline and PLE expert panel consensus summary:

CT

CT remains the gold standard in the radiologic evaluation of rhinologic disease, notably chronic rhinosinusitis (CRS) (Fokkens et al 2020), and clinical practice guidelines uniformly state that CT imaging, as opposed to plain radiography or MRI, is the radiologic modality of choice for confirming CRS, as an alternative to nasal endoscopy, and/or for evaluating CRS prior to surgical intervention (Orlandi et al 2020: grade B; Kirsch et al [*ACR*] 2017; Seidman et al [*AAO-HNSF*] 2015). CRS is diagnosed on clinical grounds, but must be confirmed by objective findings of sinus inflammation on CT (and/or sinus inflammation and/or purulence on nasal endoscopy) (Orlandi et al 2020; Desrosiers et al 2011: weak level of evidence, strong recommendation). CT imaging of the sinuses is often useful in evaluating CRS with nasal polyps, especially for unilateral polyps, concern for polyps extending outside of the nasal cavity, or other atypical presentations (Rosenfeld et al [*AAO-HNSF*] 2015). In select cases (and when patient is unable to undergo MRI), contrast-enhanced sinus CT may be needed to help differentiate polypoid mucosal hypertrophy from superimposed sinus fluid and also help to exclude a true underlying soft-tissue mass causing sinus obstruction. (Kirsch et al [*ACR*] 2017; PLE expert panel consensus opinion).

MRI

The utility of MRI for diagnosis of CRS is limited, and MRI should not be considered a first-line study for routine sinus imaging because of lack of bone detail and length of imaging time (Kirsch et al [*ACR*] 2017). MRI is generally useful only in specific instances such as for delineation of mucoceles, allergic fungal

rhinosinusitis, concerns over skull-base integrity, or tumor-associated sinonasal inflammation (Orlandi et al 2020; Kirsch et al [*ACR*] 2017).

SPECT

Even though positive SPECT in patients with chronic rhinosinusitis correlates with poor subjective response to medical treatment, this technique is generally not used in clinical practice (Kirsch et al [*ACR*] 2017). It is not readily available and exposes the patient to larger doses of radiation (PLE expert panel consensus opinion).

Clinical notes:

- Chronic rhinosinusitis (CRS) is defined when signs and symptoms of rhinosinusitis occur for 12 weeks or longer and include two or more of the following symptoms: nasal discharge, nasal obstruction and congestion, hyposmia, facial pressure or pain AND evidence of either inflammation on nasal endoscopy or computed tomography OR evidence of purulence coming from paranasal sinuses or ostiomeatal complex (Orlandi et al 2020; Kirsch et al [*ACR*] 2017; Desrosiers et al 2011; Peters et al [*AAAAI & ACAAI*] 2014).
    - CRS is divided into CRSsNP or CSRwNP based on the presence or absence of nasal polyps (Orlandi et al 2020).
- Conventional sinus radiographs are no longer indicated in chronic rhinosinusitis (Fokkens et al 2020).
- Symptoms alone have a high sensitivity but low specificity, which is why the symptoms must be accompanied by objective evidence of disease. Objective evidence is defined either by imaging evidence of sinonasal inflammation or by mucopurulent mucus, edema, or polyps on examination (Orlandi et al 2020).
- Conversely, in the absence of symptoms, diagnosis of CRS based on radiology alone is not appropriate because it is a clinical diagnosis and there is a high incidence of radiological anomalies on CT scans in normal individuals (Desrosiers et al 2011).
- Noninvasive fungal sinus disease may manifest as a fungus ball (mycetoma) or allergic fungal sinusitis. Fungus balls are a collection of fungal hyphae without allergic mucin, often occurring in maxillary and sphenoid sinuses, with etiologies postulated to occur from poor mucociliary clearance (Kirsch et al [*ACR*] 2017).
- Noninvasive fungal sinusitis may be associated with allergic rhinitis, nasal polyps, and asthma (Kirsch et al [*ACR*] 2017).
- Office endoscopy is the preferred initial method of evaluating medical problems such as nasal stuffiness and obstruction, sinusitis, nasal polyps, nasal tumors, and epistaxis (nose bleeds). Overall, nasal endoscopy is a safe and low risk procedure (Rosenfeld et al [*AAO-HNSF*] 2015; Fraczek et al 2017).

Imaging notes:

- Radiographic imaging may be useful in unilateral chronic recurrent rhinosinusitis to exclude a tumor, anatomic variants or foreign body (Kirsch et al [*ACR*] 2017; Peters et al 2014).
- CT examinations of the paranasal sinuses should utilize thin sections (≤1.25 mm) with sagittal reformations, coronal reformations and thick (2-3 mm) soft tissue axial reformations (PLE expert panel consensus opinion).
- CT images can also be imported into computer navigation systems for image-based guidance surgery during endoscopic sinus surgery. Imaging protocols should be aligned with any image-

guided procedure requirements to eliminate redundant imaging for surgical guidance (Kirsch et al [*ACR*] 2017).

- Image-based guidance surgery provides real-time information of instrument location relative to critical structures (PLE expert panel consensus opinion).
- The CT Lund-Mackay score is a method for the staging of chronic rhinosinusitis on CT (Lund & Mackay, 1993). The reader assigns each sinus a score of:
    - 0 (no abnormality)
    - 1 (partial opacification) or
    - 2 (complete opacification)

  The sinuses are grouped into:
    - frontal sinus
    - anterior ethmoidal cells
    - posterior ethmoidal cells
    - maxillary sinus
    - sphenoid sinus
    - ostiomeatal complex

  The ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed). Each side is graded separately. A combined score of up to 24 is possible. Of note, an aplastic (absent) frontal sinus receives a score of 0.

<u>Evidence update (2017-present):</u>
Zhou et al (2020) conducted a prospective study to compare the 22-item Sinonasal Outcome Test (SNOT-22) and the European Position Paper on Rhinosinusitis (EPOS: Fokkens et al 2020) in assessing symptoms of chronic rhinosinusitis to determine if either was more indicative of radiologic findings, to support decisions in telehealth. A total of 162 consecutive patients provided history, completion of the SNOT-22, and underwent CT scan within 1 month. Stepwise evaluations of sinonasal symptoms alone and combined with duration were performed. CT results were scored using the Lund-Mackay scale due to its widespread, accepted use in chronic rhinosinusitis. Results found that SNOT-22 and EPOS-defined nasal symptom assessments have similar discriminatory capability for Lund-Mackay scores when evaluated via ROC-AUC, regardless of symptom duration. Ordinal regression, however, demonstrated that the SNOT-22 nasal domain has a significant association with Lund-Mackay scores, more so than the EPOS-defined symptom set (low level of evidence).

Meng et al (2019) conducted a prospective study to compare use of CT with other clinical parameters in predicting recurrence of chronic rhinosinusitis with nasal polyps (CRSwNP) among 272 consecutive patients. Clinical parameters, including CT scores scored by 2 independent radiologists, were recorded for patients undergoing endoscopic functional sinus surgery. Average follow-up time was 24 months after the first surgery; 118 patients had CRSwNP recurrence and 112 had no recurrence. Results found that high Lund-Kennedy scores, high visual analog score of CRS, high anosmia scores, and ethmoid sinus-dominant opacification on CT scan were associated with recurrence. Additionally, the ratio of total ethmoid sinus scores for both sides and maxillary sinus score for both sides (E/M) ratio was found to be a useful predictor for recurrence of CRSwNP, with ROC analysis and linear regression suggesting that E/M ratio of the CT scan at a cut-off point of 2.55 had the highest predictive value for CRSwNP. The authors conclude that all CRSwNP adult patients should have a CT scan before surgery for determination of the E/M ratio (moderate level of evidence).

Fraczek et al (2017) conducted a cross-sectional single-blind study to assess the extent to which the use of a low-dose multidetector CT protocol affects the identification of surgically relevant anatomical

structures in patients with chronic rhinosinusitis (CRS). A total of 135 CRS patients were divided into standard-dose or low-dose CT groups. The authors found that the low-dose technique has a reasonable diagnostic value for screening CRS. However, in the context of planned surgical interventions, when knowledge of the individual anatomy becomes particularly important, its application should be well thought out. Higher mAs settings enable a more accurate evaluation of surgically relevant anatomical structures and should be considered, especially among those subjects with an initially higher chance of intraoperative difficulties (low level of evidence). *This statement may not apply to all or newer dose reduction or iterative reduction techniques* (PLE expert panel consensus opinion).

Hirsch et al (2017) conducted a retrospective cohort study to determine whether elimination of pain improves accuracy of clinical diagnostic criteria for adult chronic rhinosinusitis (CRS). History, symptoms, nasal endoscopy, and CT results were analyzed for 1,186 adults referred to an academic otolaryngology clinic with presumptive diagnosis of CRS. Clinical diagnosis was rendered using the 1997 Rhinosinusitis Taskforce (RSTF) Guidelines and a modified version eliminating facial pain, ear pain, dental pain, and headache. Applying modified RSTF diagnostic criteria, 39% lacked sinonasal inflammation by CT, 38% by endoscopy, and 24% by either modality. Using either abnormal CT or endoscopy as reference standard, modified diagnostic criteria yielded a statistically significant increase in specificity from 37.1% to 65.1%, with a nonsignificant decrease in sensitivity from 79.2% to 70.3%. The authors conclude that clinical diagnostic criteria overestimate the prevalence of CRS, and removing facial pain, ear pain, dental pain, and headache increased specificity without a concordant loss in sensitivity (low level of evidence).

Racette et al (2017) conducted a prospective multicenter study to evaluate symptoms described by patients with chronic rhinosinusitis (CRS) with polypoid changes/nasal polyps and their correlation with CT, nasal endoscopy, and intranasal biomarkers. Using logistic regression analysis, participant-rated 16-question surveys from 258 participants were assessed for correlation with nasal endoscopy scores, CT percentage of sinus occlusion, and intranasal biomarkers of fungal antigens, eosinophilic inflammation, and inflammatory cytokines. The authors found that while both nasal endoscopy and CT imaging are valid objective tools in the evaluation of CRS patients, nasal endoscopy has a stronger correlation with the two cardinal symptoms of congestion and anterior rhinorrhea in CRS patients; these correlate with biomarkers of eosinophilic inflammation (moderate level of evidence).

Yoon et al (2017) conducted a retrospective analysis of clinical records (including clinical presentations, radiological findings, management, and outcomes) of sinonasal fungus ball (FB) patients who have undergone surgery for treatment. A total of 538 cases were reviewed (mean age 58 years; approximately 2:1 female). The authors found while the most common presenting symptoms of maxillary sinus FB patients were nasal symptoms, such as postnasal drip and nasal obstruction, sphenoid sinus FB patients presented with headache mostly. On CT scans, the most common finding was intralesional hyperdensity (77.3%). There was no significant correlation between presence of FB and structural variations. The authors conclude that a preoperative CT scan is an essential tool in making diagnosis easier and faster, and that endoscopic surgery is the treatment of choice (low level of evidence).

Pre-operative evaluation for routine functional endoscopic sinus surgery (ESS):

- **Green** – **CT paranasal sinuses without IV contrast**
- **Green** – **CT cone beam paranasal sinuses without IV contrast**
- **Red** – **MRI**; **CT without and with IV contrast**; **CT with IV contrast**; **MR angiography**; **MR venography**; **CT angiography**; **CT venography**; **scintigraphy**; **PET**; **SPECT**

Level of Evidence: CT: low (insufficient for contrast); MRI: insufficient

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus summary:
Noncontrast CT of the paranasal sinuses is indicated for evaluation of recurrent acute rhinosinusitis and chronic rhinosinusitis before surgical intervention (Kirsch et al [*ACR*] 2017; Peters et al [*AAAAI & ACAAI*] 2014: recommendation strength A; Rosenfeld et al [*AAO-HNSF*] 2015). CT scanning provides the best preoperative information for endoscopic surgery, with excellent delineation of the complex ethmoidal anatomy, ostiomeatal unit, and anatomic variations, including the presence of sphenoethmoidal (Onodi) air cells, which increase the risk of injury to the optic nerves or carotid arteries (Kirsch et al [*ACR*] 2017; Seidman et al [*AAO-HNSF*] 2015). It also demonstrates abnormal mucosa and opacified sinuses (Rosenfeld et al [*AAO-HNSF*] 2015). CT should not be used as the sole criteria for determining the need for surgical intervention, but rather should be used as an objective tool for confirming the diagnosis and for surgical planning (Desrosiers et al 2011). Cone-beam CT may be useful for the assessment of paranasal anatomy and pathology in uncomplicated sinusitis, although it is limited in evaluating the adjacent soft tissues (Kirsch et al [*ACR*] 2017). MRI is not considered the first-line study for routine sinus imaging because of lack of bone detail and length of imaging time (Kirsch et al [*ACR*] 2017).

Clinical and imaging notes:

- In chronic rhinosinusitis, the goal of surgery is to re-establish sinus drainage by removing excess tissue responsible for obstruction and bony areas in narrow areas. The extent of surgery is guided by the degree of sinus involvement (Desrosiers et al 2011).
- CT examinations of the paranasal sinuses should utilize thin sections (≤1.25 mm) with sagittal reformations, coronal reformations and thick (2-3 mm) soft tissue axial reformations (PLE expert panel consensus opinion).
- CT images can also be imported into computer navigation systems for image-based guidance surgery during endoscopic sinus surgery. Imaging protocols should be aligned with any image-guided procedure requirements to eliminate redundant imaging for surgical guidance (Kirsch et al [*ACR*] 2017).
- Image-based guidance surgery provides real-time information of instrument location relative to critical structures (PLE expert panel consensus opinion).
- The CT Lund-Mackay score is a method for the staging of chronic rhinosinusitis on CT (Lund & Mackay, 1993). The reader assigns each sinus a score of:
    - 0 (no abnormality)
    - 1 (partial opacification) or
    - 2 (complete opacification)

  The sinuses are grouped into:
    - frontal sinus

- anterior ethmoidal cells
- posterior ethmoidal cells
- maxillary sinus
- sphenoid sinus
- ostiomeatal complex

The ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed). Each side is graded separately. A combined score of up to 24 is possible. Of note, an aplastic (absent) frontal sinus receives a score of 0.

Evidence update (2017-present):
Fraczek et al (2017) conducted a cross-sectional single-blind study to assess the extent to which the use of a low-dose multidetector CT protocol affects the identification of surgically relevant anatomical structures in patients with chronic rhinosinusitis (CRS). A total of 135 CRS patients were divided into standard-dose or low-dose CT groups. The authors found that the low-dose technique has a reasonable diagnostic value for screening CRS. However, in the context of planned surgical interventions, when knowledge of the individual anatomy becomes particularly important, its application should be well thought out. Higher mAs settings enable a more accurate evaluation of surgically relevant anatomical structures and should be considered, especially among those subjects with an initially higher chance of intraoperative difficulties (low level of evidence). *This statement may not apply to all or newer dose reduction or iterative reduction techniques* (PLE expert panel consensus opinion).

Julkunen et al (2017) conducted a cross-sectional study to evaluate the inter-observer agreement of structures of sinus CT scans. A total of 57 patients (mean age 43 years) with chronic rhinosinusitis (CRS) were evaluated. Lund-Mackay (LM) scores and 43 other structural parameters were analyzed, and reproducibility of findings between three blinded observers (radiologist, ENT surgeon, ENT resident) were compared. The authors found that, in general, there was moderate inter-observer agreement of the structures by Cohen's kappa coefficient. Poor reproducibility was observed in the following structures: optic nerve, insertion of the uncinated process, anterior ethmoidal artery, and Keros class (low level of evidence).

Diagnosis of complications of rhinosinusitis:

- Green – **CT paranasal sinuses without IV contrast**
- Green – **CT orbits without or with IV contrast**
- Green – **MRI orbit, face & neck without and with IV contrast**
- Yellow – **MRI orbit, face & neck without IV contrast**
  [patient unable to receive IV contrast]
- Yellow – **MRI orbit, face & neck with IV contrast**
  [patient with recent corresponding MRI without IV contrast]
  Yellow – **CT paranasal sinuses with IV contrast**
  [patient unable to undergo MRI]

- Green – **MRI brain without and with IV contrast**
- Yellow – **MRI brain without IV contrast**
  [patient unable to receive IV contrast]
- Yellow – **MRI brain with IV contrast**
  [patient with recent corresponding MRI without IV contrast]
- Yellow – **CT head without and/or with IV contrast**
  [patient unable to undergo MRI]

- Yellow – **MR angiography brain**
  [evaluate for suspected vascular complications]
- Yellow – **CT angiography head**
  [evaluate for suspected vascular complications]

- Red – **CT without and with IV contrast**; **scintigraphy**; **PET**; **SPECT**; **CT cone beam**; **MR venography**; **CT venography**

Level of Evidence: CT: moderate; MRI: moderate

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus summary:

CT paranasal sinuses

Sinonasal imaging, specifically CT scans without contrast, are indicated in patients who demonstrate initial signs and symptoms of complicated rhinosinusitis (Seidman et al [*AAO-HNSF*] 2015; Short et al [*ICSI*] 2017; Peters et al [*AAAAI & ACAAI*] 2014: strength A recommendation), as most complications can be observed with unenhanced CT imaging (Kirsch et al [*ACR*] 2017; Peters et al [*AAAAI & ACAAI*] 2014). CT remains useful when evaluating paranasal sinus inflammatory disease or bony anatomy (Policeni et al [*ACR*] 2017), and may be a complementary study that is useful for surgical planning (Kirsch et al [*ACR*] 2017).

CT orbits

If there is clinical concern for orbital complications, both MRI and CT may be necessary to better define the soft-tissue structures and/or orbital contents to guide appropriate treatment, with radiation exposure as low as reasonably achievable (Kirsch et al [*ACR*] 2017). CT of the orbits with contrast is often the initial imaging modality in the emergent setting for suspected infection. CT is superior to MRI for

foreign body assessment, calcification detection, and osseous evaluation; in patients who cannot receive contrast, a noncontrast orbit CT may still add useful information (Kennedy et al [*ACR*] 2018). In patients with acute bacterial rhinosinusitis suspected to have suppurative complications, such as orbital extension of infection, contrast-enhanced CT is recommended to localize the infection and to guide further treatment (Chow et al [*IDSA*] 2012: weak strength of recommendation, low quality of evidence). Contrast-enhanced CT may also serve as an alternative to those with MRI contraindications to evaluate for intraorbital complications or in those with suspected invasive fungal sinusitis (Kirsch et al [*ACR*] 2017). Contrast-enhanced CT or contrast-enhanced MRI are both appropriate in evaluating orbital cellulitis, uveitis, or scleritis, with CT often performed first during the initial assessment (Kennedy et al [*ACR*] 2018). CT imaging without and with contrast is not necessary (Kirsch et al [*ACR*] 2017). Cone beam CT is not recommended for the detection and evaluation of complications of rhinosinusitis, as it is unable to detect soft tissue abnormalities (PLE Multidisciplinary Committee consensus statement).

MRI orbit, face & neck

In cases of suspected invasive fungal sinusitis, MRI of the face or sinuses without and with contrast provides an accurate evaluation of complex sinus secretions and extension of disease into adjacent soft tissues (Kirsch et al [*ACR*] 2017). Orbital MRI without and with contrast is complementary to CT in evaluating intraorbital spread of infection, and should be considered if a more detailed assessment of intraorbital spread of infection is clinically warranted (Kennedy et al [*ACR*] 2018). If there is clinical concern for orbital complications, both CT and MRI may be necessary to better define the soft-tissue structures and/or orbital contents to guide appropriate treatment, with radiation exposure as low as reasonably achievable (Kirsch et al [*ACR*] 2017). Contrast-enhanced MRI is appropriate in evaluating orbital cellulitis, uveitis, or scleritis (Kennedy et al [*ACR*] 2018). MRI is the mainstay for examining the olfactory apparatus (Policeni et al [*ACR*] 2017). Pathology affecting the olfactory nerve is best evaluated with contrast-enhanced MRI; the protocol should be tailored to the anterior cranial fossa (Policeni et al [*ACR*] 2017).

Intracranial imaging (MRI brain or CT head)

For intracranial complications of ABRS, a CT scan with contrast, as a minimum, is required for diagnosis as it allows for precise definition of osseous tissue involvement (Fokkens et al 2020). However, MRI is considered to be the "gold-standard" as it is more sensitive than CT and should be the imaging modality of choice where available; further it has additional diagnostic value to exclude or confirm cavernous sinus thrombosis and also in cases with soft tissue involvement (Fokkens et al 2020; Peters et al [*AAAAI & ACAAI*] 2014; Chow et al [*IDSA*] 2012; Kirsch et al [*ACR*] 2017). MRI may better depict intracranial complications in cases of aggressive sinus infection as well as differentiating soft-tissue masses from adjacent T2-hyperintense inflammatory mucosal disease (Kirsch et al [*ACR*] 2017). Brain MRI without and with contrast may be complementary to help characterize any intracranial spread beyond the field of view of the sinus examination (Kirsch et al [*ACR*] 2017). In patients with suspected invasive fungal sinusitis, CT with contrast may be used to help define intracranial complications and can be used in cases when a patient is unable or unwilling to have an MRI (Kirsch et al [*ACR*] 2017). If there is clinical concern for intracranial complications, CT and MRI may both be necessary to delineate soft-tissue structures, brain, cavernous sinus, and bony dehiscence (Kirsch et al [*ACR*] 2017).

Vascular imaging (CT angiography or MR angiography)

Because fungal sinusitis in the sphenoid can result in cavernous sinus invasion and involvement of the cavernous carotid artery, additional imaging via CT angiography or MR angiography may be needed if there is concern for carotid/vascular invasion and pseudoaneurysm formation; however, they are not first-line examinations (Kirsch et al [*ACR*] 2017; Kennedy et al [*ACR*] 2018). MR angiography may be

performed without and/or with contrast (Kennedy et al [*ACR*] 2018).

Clinical notes:

- Complications of ABRS are typically classified as orbital (approximately 60-80%), intracranial (approximately 15-20%), and rarely osseous (approximately 5%), though occasionally some unusual complications can develop (Fokkens et al 2020).
    - Periorbital complications include preseptal cellulitis, orbital cellulitis, and subperiosteal or intraorbital abscess. Prompt recognition is vital in order to avoid long-term morbidity and mortality (Fokkens et al 2020).
    - Intracranial complications include epidural or subdural empyema, brain abscess, meningitis, encephalitis, and superior sagittal and cavernous sinus thrombosis. They may present with non-specific signs and symptoms and diagnosis requires high clinical suspicion from practitioners (Fokkens et al 2020).
    - Osseous complications result from osteomyelitis and may present as a subperiosteal frontal bone abscess (Pott's Puffy tumor) or a frontocutaneous fistula (Fokkens et al 2020).
- Infection from the ethmoid sinus can spread through the perforations of the lamina papyracea and cribriform plate; through the valveless veins, which extend to the cavernous sinus; and via direct extension in osteomyelitis (Kirsch et al [*ACR*] 2017).
- Symptoms such as periorbital edema, displaced globe, diplopia, ophthalmoplegia, reduced visual acuity, severe unilateral or bilateral frontal headache, frontal headache, neurological signs, or reduced consciousness are indicative of an emergency or severe disease and require urgent referral to an ENT physician or to the emergency department (Fokkens et al 2020).
- Immunosuppressed patients are much more vulnerable to complications of acute rhinosinusitis, and a more aggressive diagnostic approach is required (Fokkens et al 2020).
- Invasive fungal sinusitis occurs when fungal hyphae involve the paranasal sinus mucosa, submucosa, blood vessels, or bones and may be further subdivided into acute fulminant invasive fungal sinusitis (AFIFS) and chronic invasive fungal sinusitis (Kirsch et al [*ACR*] 2017).
    - Acute fulminant invasive fungal sinusitis (AFIFS) is rapidly progressive, with a time course of < 4 weeks, and is associated with a high morbidity and mortality of 50% to 80%. Because of this high morbidity and mortality in patients who are immunosuppressed or leukemic, have poorly controlled diabetes, or are transplant patients on high-dose steroid treatment, a high index of suspicion should be maintained when these patients present with a fever and symptoms of sinonasal inflammation (Kirsch et al [*ACR*] 2017).
    - Chronic invasive fungal sinusitis is progression of fungal deposition over months to years, with invasion of the paranasal sinus mucosa, submucosa, vessels, and bones, and may also result in significant mortality and morbidity (Kirsch et al [*ACR*] 2017).

Imaging notes:

- Orbital radiographs are insufficient to detect orbital cellulitis. Radiographs have largely been supplanted by CT when imaging is necessary (Kennedy et al [*ACR*] 2018).
- CT examinations of the paranasal sinuses should utilize thin sections (≤1.25 mm) with sagittal reformations, coronal reformations and thick (2-3 mm) soft tissue axial reformations (PLE expert panel consensus opinion).
- CT images can also be imported into computer navigation systems for image-based guidance surgery during endoscopic sinus surgery. Imaging protocols should be aligned with any image-

guided procedure requirements to eliminate redundant imaging for surgical guidance (Kirsch et al [*ACR*] 2017).

- Image-based guidance surgery provides real-time information of instrument location relative to critical structures (PLE expert panel consensus opinion).
- The CT Lund-Mackay score is a method for the staging of chronic rhinosinusitis on CT (Lund & Mackay, 1993). The reader assigns each sinus a score of:
    - 0 (no abnormality)
    - 1 (partial opacification) or
    - 2 (complete opacification)

  The sinuses are grouped into:
    - frontal sinus
    - anterior ethmoidal cells
    - posterior ethmoidal cells
    - maxillary sinus
    - sphenoid sinus
    - ostiomeatal complex

  The ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed). Each side is graded separately. A combined score of up to 24 is possible. Of note, an aplastic (absent) frontal sinus receives a score of 0.
- Postcontrast T1-weighted fat-saturation [MRI] sequences should be included if there is concern for abscess formation or extrasinus extension (Kirsch et al [*ACR*] 2017).
- In the setting of cavernous sinus thrombosis, a contrast-enhanced MRA may provide additional information not provided by a traditional noncontrast MRA examination (Kennedy et al [*ACR*] 2018).

<u>Evidence update (2017-present):</u> There were no new studies significantly affecting the evidence and recommendations included in the guidelines cited above.

Exclusions:

- Acute trauma;
- Pediatric patients;
- Pregnant patients;
- Suspected neoplasm;
- Chronic sinus disease associated with systemic illness (cystic fibrosis, immotile cilia syndrome, granulomatosis with polyangiitis (Wegener's granulomatosis), Churg-Strauss vasculitis etc.).

AUC Revision History:

Revision Date:	New AUC Clinical Scenario(s):	Posting Date:	Approved By:
02/23/2021	n/a	03/02/2021	CDI Quality Institute's Multidisciplinary Committee

Information on our evidence development process, including our conflicts of interest policy is available on our website at **https://www.mycdi.com/ple**

Provider Led Entity

Appropriateness of Advanced Imaging in Patients with Rhinosinusitis Bibliography

02/23/2021

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