Winter will be upon us soon, and with winter comes upper respiratory infections. Children have six to eight URIs a year, and rhinosinusitis (RS) is thought to complicate about 5-10 percent of cases. You have likely been asked by parents: How can you tell the difference between a cold and a sinus infection? When should I bring my child in to be seen? Why does my child seem more prone to sinus infections?

Acute rhinosinusitis (ARS) is defined as:

- An acute URI with persistent illness or daytime cough or both lasting more than 10 days without improvement
- A worsening cough after initial improvement
- Severe onset concurrent fever (≥ 39 degrees Celsius) and purulent nasal discharge for at least three consecutive days
Primary symptoms of ARS include fever, nasal discharge, cough and halitosis. Otitis media may be present in up to 50 percent of children with acute sinusitis. The most common pathogens include Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis (Table 1).

**Chronic rhinosinusitis (CRS)** is a more indolent infection that lasts beyond three months, with symptoms including nasal congestion, cough, halitosis, behavioral problems, headache and nasal discharge. In addition to S. pneumoniae, H. influenzae and M. catarrhalis, anaerobic bacteria (Peptococcus, Peptostreptococcus, Bacteroides) and Staphylococcus aureus are implicated in CRS.

**Recurrent acute rhinosinusitis (RARS)** implies recurrent infections lasting fewer than 30 days with relatively asymptomatic periods in between that last at least 10 days.

**Physical examination**

Anterior rhinoscopy is the most common way to evaluate the nasal passages in the office. Position the speculum of the otoscope beyond the vibrissae of the nostril to visualize the middle meatus. You should use caution to avoid contact with the septum, which may cause pain and lead to reduced cooperation from the patient. The presence of purulent secretions in the region of the middle meatus is highly suggestive of sinusitis. With the rise in antibiotic resistance, you may want to perform a culture to direct antibiotic therapy; there is a reported 85.7 percent correlation between culture from the middle meatus and maxillary sinus. You may use nasal endoscopy to visualize the middle meatus and adenoid pad and assess for polyps or masses.

**Imaging studies**

You should not obtain imaging on a child with acute sinusitis, as it will not add diagnostic value, except when you’re concerned about a complication of ARS. Contrast-enhanced CT scan of the paranasal sinuses should be obtained when you suspect orbital or central nervous system complications. Other indications for imaging include children refractory to therapy or for operative planning.

Plain film radiography under- and overestimates the amount of disease compared with CT scanning and is not a reliable screen for sinus disease. Additionally, a full series of sinus plain films may not provide additional cost savings over obtaining a limited CT of the sinuses. A lateral neck film, however, is helpful in determining adenoid hypertrophy in a child with persistent rhinorrhea and nasal obstruction.

**Causative factors**

The ostiomeatal complex (OMC) is located in the middle meatus under the middle turbinate and is the confluence of drainage points for the maxillary, anterior ethmoid and frontal sinuses. Inflammation or obstruction of the OMC and disruption of ciliary motility contribute to the pathophysiology of RS (Figure 1).

Most sinus infections in children develop following a viral URI. Inflammation of the sinus ostia causes stasis of secretions and poor ventilation of the affected sinus. This leads to absorption of oxygen and the development of a relatively negative pressure or vacuum within the sinus. Reflux of intranasal contents and nasopharyngeal bacteria into the sinus cavity incites RS. Viruses can have a direct inhibitory effect on ciliary function contributing to stasis of secretions.
| Table 1 |
|-----------------|-----------------|
| **Organisms**   |                 |
| • Streptococcus pneumoniae | • Streptococcus pneumoniae |
| • Haemophilus influenzae | • Haemophilus influenzae |
| • Moraxella catarrhalis  | • Moraxella catarrhalis  |
| • Anaerobic bacteria  | (Peptococcus, Peptostreptococcus, Bacteroides) |
| • Staphylococcus aureus |                 |

<table>
<thead>
<tr>
<th><strong>Antibiotic therapy</strong></th>
<th><strong>Imaging</strong></th>
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<tr>
<td>Amoxicillin ± clavulanate</td>
<td>Not indicated unless concern for complication of ARS</td>
</tr>
<tr>
<td>Amoxicillin with clavulanate</td>
<td>Judicious use</td>
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**Figure 1**

- **Bacterial infection**
- **Retention of secretions**
- **Injury to cilia and epithelium**
- **CF/PCD**
- **Ostium is closed**
- **Reduced ventilation stasis of secretions**
- **pH drops**
- **Anatomic Variant Allergy Viral**
- **Viral Allergy GERD**
- **Mucosal inflammation**
More than 80 percent of children with RS have a family history of allergy, compared with a general population allergy frequency of 15 percent. Allergy contributes to sinusitis with edema secondary to inflammatory mediator release and subsequent sinus outflow obstruction. Research shows that immunotherapy can decrease the incidence of RS in children with known allergies and improve health-related quality of life.

The adenoid pad contributes to RS in children by serving as an obstructive outlet for secretions or as a bacterial reservoir. Cultures of the adenoid core have demonstrated organisms similar to those seen in RS. Removal of the adenoid may improve RS in up to 80 percent of children.

Primary immunodeficiency disease can predispose children to CRS, and the overall incidence in children is 0.5 percent. An immunodeficient child with a humoral immune deficiency may have RARS or CRS as the only manifestation. Patients with T-cell or neutrophil dysfunction will usually present with a more severe infection.

Primary ciliary dyskinesia is a rare disorder of ciliary structure or function that can occur alone or as part of Kartagener’s syndrome. Electron microscopy of mucosal biopsies from the nose or trachea show an abnormal 9+2 microtubule structure or a decrease in dynein arm count. Functional abnormalities, such as decreased ciliary beat frequency, may occur despite normal architecture.

Cystic fibrosis occurs in 1 out of 3,200 newborns. CRS in the CF population is often severe and refractory to therapy. CF patients have a higher likelihood of requiring sinus surgery; this should be reserved for patients whose pulmonary status is worsened by RS, complications of RS, or for chronic nasal obstruction or headache. If you see polyps upon examining a child with RS, you should evaluate for cystic fibrosis. Traditionally, CF is diagnosed with a sweat test, however, genetic testing is more sensitive.

There are many opinions about the relationship between gastroesophageal reflux disease (GERD) and RS in children. Double-lumen pH probe testing has shown that esophageal reflux can extend to the nasopharynx, and a retrospective study suggested that GERD therapy could prevent sinus surgery in almost 90 percent of children with refractory CRS. However, controlled studies are lacking, and children with CRS should be treated for GERD only if there are clear clinical indications.

Environmental pollutants can have direct irritant effects on the nasal and sinus mucosa. The most significant irritant in RS is environmental tobacco smoke. Less commonly, structural anomalies of the sinus and nasal cavities are implicated in RS. These include septal deviation, concha bullosa, hypoplastic maxilla, paradoxical middle turbinate, and infraorbital (Haller) cells.

Antibiotic therapy

The mainstay of therapy for RS continues to be antibiotics (Table 1). The ideal antibiotic should combine high susceptibility, clinical effectiveness, safety and tolerability. There is an increased resistance to amoxicillin resulting from beta lactamase production by approximately 60 percent of H. influenzae and 100 percent of M. catarrhasis; an alteration in penicillin-binding proteins occurs in about 50 percent of S. pneumoniae.
Young children with mild to moderate ARS should be treated with a high dosage of amoxicillin (75-90 mg/kg/day). If a child is allergic to amoxicillin, you may use cephalosporin such as cefdinir, cefuroxime and cefpodoxime. Severely allergic patients should be treated with a macrolide such as clarithromycin or azithromycin. Children who do not respond to first-line therapy, who have more severe initial disease and who are considered high-risk for resistant S. pneumoniae (those who recently have used antibiotics or attend daycare) should be treated with high-dose amoxicillin/clavulanate (90 mg/kg of amoxicillin component). The optimal duration of treatment has not been determined, but treatment should last a minimum of 10 days or for five days beyond resolution of symptoms.

For children with CRS, amoxicillin/clavulanate (90 mg/kg/day) and second-generation cephalosporins are recommended. For those allergic to amoxicillin, refer to the previous antibiotic recommendations. Clindamycin may be used if S. pneumoniae is the suspected organism or if there is no response to other antibiotics. Antibiotic therapy in CRS is extended for three to six weeks.

**Adjuvant therapy**

Other medical therapies have not been proven to be effective by randomized controlled trials, but they may provide symptomatic relief. Saline irrigations improve mucociliary clearance. If significant nasal mucosal edema is present, you may use oxymetazoline for three days. Nasal steroids help decrease inflammation and should be used in children with allergies. In CRS, oral steroids may be beneficial in decreasing mucosal inflammation. You’ll want to address control of underlying causative factors, such as allergy, GERD, daycare exposure or environmental pollutants. The conjugated pneumococcal vaccine (Prevnar) may be beneficial to reduce RS related to this specific bacteria.

**Surgical therapy**

Adenoidectomy as a first-line surgical therapy if medical therapy has failed may provide improvement in up to 80 percent of children. The addition of maxillary sinus lavage or middle meatal culture allows for culture-directed antibiotics.

Functional endoscopic sinus surgery is considered if all other measures have failed. FESS involves the removal of obstructive components, typically the uncinate process and anterior ethmoid air cells, and widening the maxillary ostia. In properly selected children, improvement should be expected in 80 percent to 90 percent. If a child is being considered for FESS, you should consider causative factors, such as allergy, immunodeficiencies, primary ciliary dyskinesia or cystic fibrosis.

**Summary**

- Acute rhinosinusitis presents as persistent symptoms of an URI more than 10 days without improvement, a worsening cough after initial improvement, or severe onset concurrent fever (≥ 39 degrees Celsius) and purulent nasal discharge for at least three consecutive days.
- First-line therapy for ARS is amoxicillin ± clavulanate.
- Imaging studies are not indicated in ARS, except when you suspect orbital or central nervous complications.
- Adenoidectomy is the first-line surgical treatment for sinusitis.
References


To refer a patient
Visit chw.org/refer or call (414) 266-2460 or toll-free (800) 266-0366.

To make an appointment
Call Central Scheduling at (414) 607-5280 or toll-free (877) 607-5280.

For more information
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