# Acute Bacterial Sinusitis in Adults: Management in the Primary Care Setting

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**Abstract**

Sinus disease is inherently associated with viral upper respiratory tract infections and occurs in 90% of individuals with the common cold. Acute bacterial sinusitis occurs in 0.5 to 2% of these individuals. Although the diagnosis of acute bacterial sinusitis is usually based on physical findings, no one sign or symptom is either sensitive or specific for sinusitis. The predictive power can be significantly improved when all signs and symptoms are combined into a clinical impression. Imaging studies have not been shown to be cost effective in the initial assessment and treatment of patients in the primary care setting. Simple plain films may be indicated to resolve the diagnosis in patients with an equivocal history or to follow patients admitted to hospital with severe sinus disease. The initial management of acute sinusitis should be directed toward the relief of symptoms with a 7-day course of decongestants and mucoevacuents. For patients who fail to improve with symptomatic treatment, a 10-day course of amoxicillin is recommended. Second line antibiotics should be initiated if improvement is not seen within 72 to 96 hours.

**Sommaire**

La maladie sinusale est intimement associée à l'infection virale des voies respiratoires supérieures et se manifeste chez 90% des individus avec un rhume. La sinusite bactérienne aigue se développera chez 0.5 à 2% de ces individus. Bien que le diagnostic de la sinusite bactérienne est habituellement basé sur la clinique, aucun signe ou symptôme seul n'est sensible ou spécifique. L'acuité clinique peut être augmentée significativement quand tous les signes et symptômes sont combinés en une impression clinique. On n'a pas réussi à démontrer que les épreuves d'imagerie soient efficientes dans l'évaluation initiale et le traitement de la sinusite en première ligne. Les films simples peuvent servir à résoudre le dilemme diagnositic quand l'histoire est équivoque ou pour suivre un patient admis à l'hôpital avec une maladie sinusienne grave. Le traitement initial se concentre sur le soulagement des symptômes avec un essai de 7 jours de décongestionnants et de "mucoévacuants." En cas d'échec au traitement symptomatique, 10 jours d'amoxicilline est recommandé. Un antibiotique de deuxième ligne est indiqué si une amélioration n'est pas notée en 72–96 heures.

**Key words:** acute bacterial sinusitis, antibiotics, management

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Acute sinusitis is one of the most common conditions treated in the outpatient setting in North America and is thought to affect everyone at least once in their lifetime.[1–4]

Sinus disease, that is, inflammation and/or mucosal thickening, is inherently associated with viral upper respiratory tract infections and occurs in 90% of individuals with the common cold, although the vast majority are viral and not considered clinically relevant.[4–10] Acute bacterial infections occur in 0.5 to 2% of these individuals, of which 90% is localized to or includes the maxillary sinus.[4,10,11] Adults average two to three colds per year and children six to eight per year; thus, the absolute number of people who may

develop signs and symptoms compatible with sinusitis annually is high.[5–7]

The initial Canadian guidelines on the management and treatment of acute sinusitis were published in 1997.[12] Since then, new studies have been published on the management of acute sinusitis, changing antimicrobial resistance patterns have occurred, and several new agents have been approved for use in the treatment of sinusitis. Therefore, the intent of this document is to provide an update for the management of this common problem. The scope of this review will be limited to acute bacterial sinusitis in otherwise healthy individuals and will not address patients who are immunocompromised or have underlying comorbidity or chronic sinusitis.

## Definition and Classification

Historically, the term "acute sinusitis" has been used to identify what is considered a bacterial infection of the sinus. However, sinus changes are known to occur with the common cold.[13] Thus, the term "rhinosinusitis" may be more accurate in defining the disease. In this review, the term acute bacterial sinusitis is considered synonymous with acute rhinosinusitis. Although there is no universally accepted classification of rhinosinusitis, it is clear that in any classification scheme, both the pathophysiologic features and the duration of the sinus infection should be considered. Most investigators consider sinusitis to be acute if the duration of symptoms lasts less than 4 weeks and if inflammatory changes resolve either spontaneously or with appropriate medical management.[10,14–16] Subacute sinusitis is defined as symptoms lasting between 4 and 12 weeks and is thought to represent the natural progression of the acute disease. The histopathology of subacute sinusitis is similar to the acute disease. Recurrent acute sinusitis may be defined as the occurrence of sinusitis symptoms three or more times per year, with complete resolution of symptoms between attacks.[17,18] It is generally accepted that a disease-free interval of greater than 8 weeks between episodes should be demonstrated before a diagnosis of acute recurrent sinusitis is made. Chronic sinusitis is defined as a disease process lasting more than 12 weeks and is associated with established inflammatory changes documented by imaging techniques at least 4 weeks after initiating appropriate medical therapy. Acute sinusitis can also be superimposed on a chronic condition.[19]

Because viral and bacterial sinusitis may be difficult to differentiate and confound the assessment of therapeutic management, only bacterial infections documented by antral puncture will be defined as "acute bacterial sinusitis." Sinusitis otherwise diagnosed clinically or with the aid of imaging studies will be termed "acute sinusitis."

## Anatomy and Pathophysiology

The paranasal sinuses comprise four paired air-filled cavities contained within the framework of the skull: the frontal, maxillary, ethmoid, and sphenoid sinuses.[20–24] The ethmoid sinuses are arranged like a honeycomb and are contained within the ethmoid bones. The posterior ethmoid sinus opens into the superior meatus, whereas the anterior ethmoid sinus opens into the ostiomeatal complex.[22,25] The ostiomeatal complex is composed of the middle meatus, the ostium of the maxillary sinus, the middle turbinate, the infundibulum, and the uncinate process. This complex is crucial for the normal functioning of the sinuses and is the center of drainage and aeration for the anterior ethmoid sinus, the maxillary sinus, and the frontal sinuses. The maxillary sinuses are the largest of the paranasal sinuses and are contained within the maxillary bones, bilaterally. They are bounded medially by the lateral nasal wall and inferiorly by the palatal bone. The frontal sinuses are contained within the frontal bone and are separated from the intacranial cavity by a relatively thin posterior bony wall. The frontal sinuses are contiguous with the ethmoid sinuses inferiorly. The frontal sinuses are not present in young children and begin to develop at approximately 5 years of age. Until fully developed at around 12 years of age, they may appear opacified on plain films even in the absence of disease. The sphenoid sinuses are the last to develop, appearing at around age 7 years. The sphenoid sinuses are located centrally, behind the ethmoid sinuses and at the base of the skull.

The sinuses and nasal cavity are lined with ciliated pseudostratified columnar epithelium. This area is rich in goblet cells that secrete mucus onto the surface of the epithelium, serving both a functional and a protective role. This blanket of mucus covers the respiratory cilia of the sinus and is moved constantly along predetermined pathways to the sinus ostia. The mucus blanket exists in two discrete layers, a deep and a superficial layer. The first or deep layer is thinner and acts as a lubricant for the cilia, whereas the role of the second superficial layer is to trap inhaled particles. The superficial layer floats on the first layer and is actively transported by the cilia.[26,27]

Obstruction of sinus drainage is thought to be the fundamental event for development of sinus infection. The presence of bacteria in the absence of obstruction appears to be insufficient to cause disease.[28] Support for this hypothesis was derived from experiments in which the introduction of bacteria into the unobstructed sinus cavities of rabbits failed to produce sinusitis.[28] Numerous factors have been identified that may directly or indirectly contribute to obstruction and subsequent sinus infection: (a) mucosal swelling resulting in diminished patency of the ostia, (b) abnormalities of the cilia, (c) structural abnormalities, and (d) overproduction of secretions.[5–7,28] In addition, a preceding viral infection or damage to normal epithelium has been shown to

weaken mucosal defences and facilitate penetration of bacteria into the sinus mucosa.[29–32] Although nasal allergies also contribute to edema and swelling of the nasal mucosa, most evidence suggests that allergy plays little role in the development of acute sinusitis; however, the presence of allergic rhinitis has been identified as a risk factor for sinus disease.[30,33–35]

## Diagnosis

### History and Physical Examination

Approximately one half to two-thirds of patients who present with sinus symptoms are unlikely to have bacterial sinusitis but rather viral disease.[36,37] Several recent consensus documents state unequivocally that a diagnosis of acute bacterial sinusitis should not be entertained unless the patient's symptoms are of at least 7 days duration.[38,39] Absolute confirmation of bacterial sinusitis requires antral puncture and culture of the infected secretions, a technique neither warranted nor recommended in the primary care setting.[29,40–44]

A complete history is essential for the diagnosis of acute sinusitis. Particular attention should be paid to the patient's description of an antecedent upper respiratory tract viral infection and a poor response to decongestants.

Facial pain is often described above or below the eyes and may increase on bending forward. Palpation and percussion of the involved sinus may elicit tenderness. The site of pain may implicate infection in a specific sinus. The maxillary floor from the palate, the anterior maxillary wall from the cheek, the lateral ethmoid wall from the medial canthus, the frontal floor from the roof of the orbit, and the anterior frontal wall from the supraorbital skull should be examined by palpation.[45] Because bacterial maxillary sinusitis may be secondary to dental root infection, the maxillary teeth can be tapped with a tongue depressor to check for tenderness.[46]

Visualization of purulent secretions from the middle meatus is highly predictive of acute sinusitis.[40,46,47] This can be best accomplished by the use of a short, wide speculum mounted on a handheld otoscope.[48,49] Use of a topical vasoconstrictive agent should be employed to shrink the nasal mucosa and aid in visualization.[50] Inspection of the posterior pharynx or the use of a pharyngeal mirror may reveal posteriorly draining purulent secretions.[51]

Abnormal transillumination has been reported by Williams et al. to be an independent predictor of acute sinusitis.[46] However, much controversy exists in the literature over the usefulness of this technique. One study demonstrated only moderate agreement between examiners highly skilled in transillumination.[52] It is the opinion of these authors that transillumination is of little benefit in the primary care setting, and its use is not recommended.

Nasal swabs should not be performed as they provide no useful diagnostic information. Pathogens frequently implicated in acute bacterial sinusitis can often be recovered from the nasal passage, irrespective of disease.[29,40,41,43]

Several studies performed in the primary care setting have demonstrated that no single sign or symptom is both sensitive and specific for diagnosing acute sinusitis.[36,37,46,48,53–56] Many of the symptoms of acute sinusitis are nonspecific and may be difficult to differentiate from those of an upper respiratory tract infection or allergic rhinitis. Axelsson and Ronze found six symptoms to be significantly more common ($p < .01$) in patients with abnormal roentgenograms: preceding upper respiratory infection, any nasal or purulent nasal discharge, painful mastication, malaise, cough, and hyposmia.[53] However, no single finding was highly predictive of sinusitis. Williams et al. reported that coloured nasal discharge, cough, and sneezing had the greatest sensitivity (72%, 70%, and 70% respectively) but were not specific (52%, 44%, and 34%).[46] Maxillary toothache was highly specific (93%), but only 11% of patients reported this symptom.[49] Symptoms historically thought to make sinusitis less likely, such as sore throat (sensitivity 52%, specificity 56%), itchy eyes (sensitivity 52%, specificity 43%), and constitutional symptoms (sensitivity 56%, specificity 47%), were not discriminatory. Purulent nasal discharge and facial discomfort, predominantly on one side, were found to be the two most reliable indicators of sinusitis with an overall sensitivity of 85%, by Berg and Carenfelt.[36] Sinus puncture and culture were used to confirm the diagnosis of acute bacterial sinusitis in this study.[36] Hansen et al. found that the erythrocyte sedimentation rate and the concentration of C-reactive protein were independently associated with the diagnosis of acute bacterial sinusitis.[54] The combination of the two variables had a sensitivity of 82% and a specificity of 57%; however, these tests are impractical in the typical primary care setting. None of the general accepted signs and symptoms were independently associated with bacterial sinusitis.

The predictive power may be significantly improved when all signs and symptoms are combined into a clinical impression. Williams et al. demonstrated that three symptoms (maxillary toothache, poor response to decongestants, and a history of coloured nasal discharge) and two signs (purulent nasal secretion and abnormal transillumination) were the best predictors of sinusitis.[46] Sinusitis was unlikely in patients exhibiting none of the identified signs and symptoms (Table 1). The likelihood of acute sinusitis increased with each succeeding sign or symptom.[46,49] The Task Force on Rhinosinusitis of the American Academy of Otolaryngology-Head and Neck Surgery recently reported that the diagnosis of acute sinusitis is dependent on the presence

**Table 1** Independent Predictors of Sinusitis

| *Symptom or Sign* | *Positive Likelihood Ratio (95% CI)* | *Negative Likelihood Ratio (95% CI)* |
|---|---|---|
| Maxillary toothache | 2.5 (1.2–5.0) | 0.9 (0.8–1.0) |
| Purulent secretion | 2.1 (1.5–3.0) | 0.7 (0.5–0.8) |
| Poor response to decongestants | 2.1 (1.4–3.1) | 0.7 (0.6–0.9) |
| Abnormal transillumination* | 1.6 (1.3–2.0) | 0.5 (0.4–0.7) |
| History of coloured nasal discharge | 1.5 (1.2–1.9) | 0.5 (0.4–0.8) |

Data and table from Williams et al.[46]
*Not recommended.
CI = confidence interval.

of at least two major diagnostic factors or one major factor and two minor factors (Table 2). They also reported that the number of diagnostic factors correlates with the likelihood of a bacterial infection.[57]

### Diagnostic Imaging

Imaging studies have not been shown to be cost effective in the initial assessment and treatment of patients in the primary care setting. Simple plain films may be indicated to resolve the diagnosis in patients with an equivocal history or to follow patients admitted to hospital with severe sinus disease. As always, radiographs must be interpreted in light of clinical findings, not vice versa. Patients presenting with a suspected frontal sinusitis (pronounced frontal headaches) should have a sinus radiograph series performed. Because a relatively thin barrier exists between the frontal sinus and the central nervous system, diagnosis and appropriate treatment are crucial in these patients.[58]

Air-fluid levels and complete opacification of the sinus are useful radiograph features when present, with positive predictive values of 80 to 100% in most studies. However, the sensitivity is low; only 60% of patients with sinusitis will have opacification or air-fluid levels.[1,29,42] The sensitivity of mucosal thickening is high (> 90%) but nonspecific.[1,41,42,59,60] Mucosal thickening of at least 5 mm has been used as a threshold in an attempt to optimize predictive values; however, specificities from 36 to 76% have been observed in symptomatic patients using this cutoff point.[29,41,42,44,51]

The basic radiograph examination of the paranasal sinuses includes three to four views: the Waters view (occipitomental) is used for evaluation of the maxillary sinuses; the Caldwell view (angled posteroanterior) is used for evaluation of the ethmoid air cells and frontal sinuses; the lateral view is used for evaluation of sphenoid disease and to confirm disease in the paired maxillary, ethmoid, and frontal sinuses; and the submentovertex view is useful for examining the sphenoid and ethmoid sinuses.[12,61–63] All views are done with the patient in an erect position to evaluate air-fluid levels. One study, using the standard criteria of air-fluid levels, sinus opacity, or mucosal thickening of > 6 mm to diagnose acute sinusitis, demonstrated that a single Waters view had a high level of agreement with the complete sinus series.[8]

Computed tomography (CT) provides greater definition of the sinus cavity contents; however, CT has no place in the routine evaluation of acute sinusitis.[64] Sinus CT is highly sensitive, particularly in the demonstration of sinus abnormalities, but has a low specificity in the diagnosis of acute sinusitis.[65] Forty percent of patients undergoing CT for reasons unrelated to sinus disease show some mucosal abnormality, as do 87% of patients with community-acquired colds.[66–70]

## Etiology of Acute Bacterial Sinusitis

The vast majority of acute sinusitis is owing to a viral etiology. However, in those individuals whose sinusitis progresses to bacterial disease, the pathogens usually associated with other upper and lower respiratory tract disease are most commonly seen. Accurate information on the etiology of acute bacterial sinus infections is difficult to obtain and arises from studies in which culture specimens were obtained by direct puncture and aspiration of the sinus cavity.

Currently, no data exist to correlate bacterial infection in the frontal, ethmoid, and sphenoid sinuses with that of the maxillary sinus.[71] In general, the find-

**Table 2** Major and Minor Factors Associated with Acute Bacterial Sinusitis

| |
|---|
| Major factors |
| Facial pain or pressure |
| Facial congestion or fullness |
| Nasal obstruction |
| Nasal purulence or discoloured postnasal discharge |
| Hyposmia or anosmia |
| Fever |
| Minor factors |
| Headache |
| Halitosis |
| Fatigue |
| Dental pain |
| Cough |
| Ear pain or pressure |

Adapted from Lanza and Kennedy.[57]

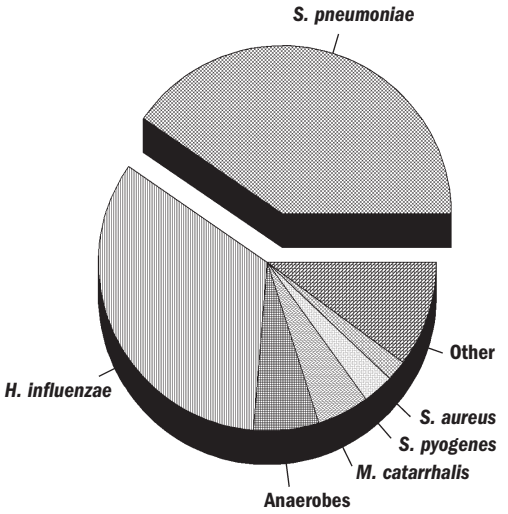


**Figure 1** The etiology of acute bacterial sinusitis. (Adapted from references 40, 43, 76, 77, and 137–139.)

ings of sinus puncture studies from different investigators have been concordant (Fig. 1).[40,44,71–75]

Typically, 70% of bacterial sinus disease is associated with *Streptococcus pneumoniae* and *Haemophilus influenzae*. *Moraxella catarrhalis* is more frequently isolated in the paediatric population.[73–80] *Streptococcus pneumoniae* and *H. influenzae* are most often isolated in pure culture (72%) but are occasionally found together or in combination with other organisms.[72] *Haemophilus influenzae* strains isolated from sinus puncture are almost exclusively unencapsulated (nontypable). Other pathogens less frequently isolated include other streptococcal species, *Staphylococcus aureus, Neisseria* spp, anaerobes, and gram-negative rods.

## Update on Antimicrobial Resistance

### *Streptococcus pneumoniae*

The prevalence of penicillin-nonsusceptible *S. pneumoniae* continues to increase, both worldwide and in Canada. In Canada, the prevalence of penicillin-nonsusceptible *S. pneumoniae* is approaching 15%.[81] However, the prevalence of penicillin non-susceptible *S. pneumoniae* can vary dramatically from region to region, ranging from approximately 7% to 20%.[81] The most dramatic change observed in Canada over the last 5 years is the ratio of intermediately resistant strains (Penicillin MIC 0.12–1 mg/L) to high-level resistant strains (Penicillin MIC ≥ 2 mg/L).[81,82] High-level strains now account for 30 to 50% of all penicillin-nonsusceptible isolates in most regions of Canada. Also disconcerting is the disproportionate loss of activity among the oral cephalosporins observed in penicillin nonsusceptible strains.[81,82]

Penicillin-resistant *S. pneumoniae* is often multidrug resistant, that is, resistant against other unrelated antimicrobial classes.[81–83] The prevalence of these multidrug-resistant strains has also steadily increased in Canada. Presently, approximately 14% of *S. pneumoniae* strains are resistant to the macrolides in vitro and 1.5% are resistant to the fluoroquinolones with enhanced activity against *S. pneumoniae*.

### *Haemophilus influenzae*

Beta-lactam resistance in *H. influenzae* is mediated through the production of a β-lactamase. In 1996, greater than 40% of *H. influenzae* produced a β-lactamase, rendering them resistant to the aminopenicillins. Since that time, the prevalence of β-lactamase producing *H. influenzae* has decreased, such that in Canada, approximately 27% of strains currently produce a β-lactamase.

### *Moraxella catarrhalis*

*Moraxella catarrhalis* is considered to be uniformly resistant to ampicillin owing to the production of a β-lactamase. In Canada, greater than 95% of all strains are β-lactamase producers.[81,82] Fortunately, with the exception of trimethoprim-sulfamethoxazole (TMP-SMX), *M. catarrhalis* is predictably susceptible to all other agents.

## Treatment of Acute Bacterial Sinusitis

### Antimicrobial Therapy

The antimicrobial treatment of patients with acute sinusitis remains controversial. In part, this is attributable to the difficulty in accurately diagnosing sinusitis and, more importantly, the inherent inability to distinguish viral sinusitis from bacterial sinusitis. Only sinus aspiration and culture can accurately determine the etiology, and in general practice, this is neither indicated nor ethical. Very few studies have been designed to address this question; most are equivalency trials designed only to compare the efficacy of several antibiotic agents. In addition, enrollment criteria for patients in many studies fail to confirm a bacterial etiology by sinus aspiration and culture but rather identify patients based on clinical findings or with the aid of radiography. Complicating this are the conflicting results of the few studies designed to compare antimicrobial treatment to placebo.

Only five published randomized controlled trials provide evidence for the effectiveness of antimicrobial agents in treating sinusitis compared to placebo. Axelsson et al.[84] compared the use of a nasal decongestant, decongestant plus sinus irrigation, and decongestant plus an 8- to 10-day course of antibiotics in 156 patients with acute maxillary sinusitis. Patients were selected for study based on both clinical and radiologic findings. Patients treated with an antibiotic were significantly improved ($p < .05$) compared with those receiving only a decongestant. Wald et al. compared a 10-day course of amoxi-

cillin and amoxicillin-clavulanate with placebo in 93 children.[85] Children were eligible for study if they had nasal discharge of any quality, or cough, or both that parents estimated had been present for at least 10 but no longer than 30 days. Clinical improvement was seen in 79% of children receiving antibiotics but only 60% in those receiving placebo. The overall 10-day cure rate in children receiving antibiotics was 67%, compared with only 43% of those receiving placebo. Clinical assessments on days 3 and 10 demonstrated that children receiving antibiotics were statistically more likely to be cured at 3 days ($p < .01$) and at 10 days ($p < .05$). Lindbaek et al. compared the effectiveness of amoxicillin and penicillin V against placebo.[86] Patients were selected on the basis of an abnormal CT scan. Both were significantly ($p < .0001$) more effective than placebo alone. Hansen et al. compared 7 days of penicillin V with placebo in 133 patients with clinical findings suggestive of sinusitis.[87] A scoring system to measure pain was used to evaluate patients on days 0, 3, and 7. Clinical cure was defined as a pain score of 0. After 3 days of therapy, significantly more patients were pain free on penicillin V compared to placebo. After completion of therapy, 71% of patients receiving antibiotics were cured versus 37% receiving placebo. Haye et al. compared a 3-day course of azithromycin with placebo in patients with clinical findings of acute sinusitis.[88] Ten to 12 days after initiating therapy, 58.1% of patients receiving azithromycin were cured versus 31.7% receiving placebo, a statistically significant finding. No significant difference in the overall cure rate was observed in patients when re-evaluated at 25 days. Finally, Williams et al. performed a meta-analysis to determine if antibiotics were beneficial in treating acute sinusitis.[89] Randomized trials were selected that compared antibiotics with control or antibiotics from different classes. Diagnostic confirmation was required by sinus aspiration or radiography. Thirty-two trials, involving 7330 patients, were analyzed. Treatment with amoxicillin did not significantly improve cure rates but did significantly improve radiographic outcomes. No significant difference was noted between different classes of antibiotics. The authors conclude that although the evidence is limited, their findings support a 7- to 14-day course of antibiotics for sinusitis diagnosed by culture or radiography.

Several placebo-controlled trials have failed to show a significant benefit for the use of antibiotics to treat acute sinusitis.[90–92] Stalman et al. randomized 192 patients with clinical symptoms of acute sinusitis to receive either a 10-day course of doxycycline or placebo.[90] All patients also received xylometazoline 0.1% nose drops and steam inhalation. After 10 and 42 days, 60% and 90% of patients were cured, respectively. No significant difference was noted between the two treatment arms. A recently completed placebo-controlled trial in the paediatric population also failed to show a difference between placebo and amoxicillin or amoxicillin-clavulanic acid treatment of acute sinusitis.[91] Patients were enrolled in the study if they had a clinical diagnosis of sinusitis and symptoms that persisted between 10 and 28 days. No significant difference in outcome was observed between those patients who received antibiotics and those who received placebo. Lastly, 214 adult patients were enrolled in a randomized trial to compare the effectiveness of amoxicillin versus placebo. All patients had radiographic abnormalities of the maxillary sinus. Two weeks after the initiation of therapy, 83% of patients receiving amoxicillin had improved compared with 77% of patients on placebo.[92]

The vast majority of trials are designed to prove equivalency and are not powered to demonstrate the superiority of one agent over another. They are, however, required by regulatory agencies to prove that newly introduced agents are at least as effective as currently indicated therapies. The initial Canadian guidelines published in 1997 reviewed numerous studies comparing the efficacy of the amoxicillin and amoxicillin-clavulanate,[85,93–101] the cephalosporins; cefaclor, cefuroxime, and cefixime,[99,101–103] the macrolides; and azithromycin and clarithromycin[95–98,104,105] and TMP-SMX.[58,106] At that time, no significant difference was noted between any of the treatment regimens for the initial empiric management of acute sinusitis. Since 1997, several more trials have been published that compare the efficacies of amoxicillin-clavulanic acid,[107–113] the second-generation cephalosporins,[111,112,114–116] the macrolides,[109,110,113,114,117–120] and the fluoroquinolones.[107,113,115,116,118–121] Again, because of design limitations inherent in equivalency trials, no significant difference between treatment regimens was observed in these later trials.

The fluoroquinolones were not reviewed in the initial Canadian guidelines. Since that time, fluoroquinolones with enhanced activity against *S. pneumoniae* have been introduced into clinical practice and have an indication for the treatment of acute bacterial sinusitis. Currently, there are three fluoroquinolones in Canada with an indication to treat acute bacterial sinusitis: moxifloxacin, gatifloxacin, and levofloxacin. Three trials compared 10 to 14 days of levofloxacin 500 mg OD with either clarithromycin 500 mg twice daily[120,121] or amoxicillin-clavulanate 500/125 mg three times daily.[107] Patients in all three trials were enrolled if they had clinical signs and symptoms of sinusitis and radiologic evidence of disease. When assessed 2 to 5 days after completion of therapy, 88 to 95% of patients treated with levofloxacin achieved clinical cure or were significantly improved, demonstrating equivalency to its comparators, clarithromycin or amoxicillin-clavulanate. Seventy-nine percent of patients remained symptom free 1 month after completion of therapy. An additional three trials examined the clinical efficacy of the

8-methoxy-fluoroquinolone, moxifloxacin, compared with amoxicillin-clavulanate,[113] cefuroxime,[116] or trovafloxacin.[121] When a 10-day course of moxifloxacin was compared with either amoxicillin-clavulanate or trovafloxacin, no significant difference between the treatment regimens was observed. Patients enrolled in these two studies required radiologic evidence of disease. Finally, Siegert et al. compared moxifloxacin and cefuroxime.[116] They found that the clinical success rate was significantly higher in those treated with moxifloxacin compared with cefuroxime when assessed at the end of treatment. No significant difference was observed in clinical success when patients were evaluated 21 to 28 days later. Sinus aspiration and culture were performed in approximately half of the enrolled patients. Bacteriologic eradication was observed in 94.5% of patients treated with moxifloxacin versus 83.5% of patients treated with cefuroxime. More recently, Sher et al. published a multicentre, randomized study comparing 5- and 10-day courses of gatifloxacin with a 10-day course of amoxicillin-clavulanate.[122] Patients (n = 445) were enrolled in the study if they had signs and symptoms for longer than 7 days duration and radiographic findings consistent with acute sinusitis. They concluded that a 5-day course of gatifloxacin was associated with comparable clinical cure rates and tolerability to those of a 10-day course of gatifloxacin or amoxicillin-clavulanate.

### Duration of Therapy

There is a paucity of data on the efficacy of short-course antimicrobial therapy for the management of acute sinusitis. The majority of clinical trials employ a treatment regimen of 10 to 14 days. There are, however, limited data to suggest that short course therapy may be adequate in some patients. Williams et al.[58] compared the outcomes of patients receiving either a 3-day or a 10-day course of TMP-SMX and a decongestant (oxymetazoline). Subjects were randomly assigned to TMP-SMX double strength, one tablet twice a day for 10 days or one tablet twice daily followed by 7 days of placebo. Patients were assessed both clinically on days 0, 7, 14, 30, and 60 and radiologically on days 0 and 14. Bacteriologic eradication was not assessed. They found no significant difference in clinical cure or improvement between patients treated for 3 days (77%) or patients treated for 10 days (76%). In addition, Klapan et al. demonstrated that a 3-day treatment course with azithromycin was as effective as 10 days of amoxicillin-clavulanate.[109] Wald et al. observed that children receiving a 10-day course of amoxicillin or amoxicillin-clavulanate were clinically cured or significantly improved by day 3 ($p < .01$). Although a greater proportion were cured by day 10, the overall clinical success rate (defined as cure or improvement) was no greater after 7 additional days of antibiotics.[41] Lastly, 5 days of gatifloxacin have been shown to be as effective as 10 days of gatifloxacin or amoxicillin-clavulanate.[122]

### Other Therapeutic Agents

**Anti-Inflammatory Agents.** The use of systemic corticosteroid therapy for the management of acute sinusitis has not been studied in a well-controlled or blinded manner. However, several recent studies suggest that the use of intranasal corticosteroids as an adjunct to antimicrobial therapy may be beneficial. Meltzer et al. compared the treatment of patients randomized to amoxicillin-clavulanate alone with those concomitantly receiving mometasone furoate nasal spray (MFNS), 400 µg twice daily. Symptom scores for headache, facial pain, congestion, purulent rhinorrhea, postnasal drip, and cough were recorded at baseline and throughout treatment.[123] Patient-recorded symptom scores showed that adjunctive treatment with MFNS resulted in a significant decrease in symptom score compared with antibiotics alone, particularly in symptoms associated with the obstruction process. Another study examined the optimal dose of MFNS in 900 patients and determined that 800 µg were superior to 400 µg for relief of sinusitis symptoms.[124] Barlan et al. examined the role of budesonide spray in children diagnosed with acute sinusitis.[125] Patients were randomized to receive amoxicillin-clavulanate and placebo or amoxicillin-clavulanate and budesonide spray, 50 µg per nostril twice daily. Patients receiving the topical corticosteroid showed a significant reduction in nasal discharge and cough. Yilmaz et al. also reported a significantly higher rate of recovery in children treated with budesonide spray and antibiotics compared with those treated with a decongestant and antibiotics.[126] Other reports studying the effectiveness of intranasal corticosteroids have reported only modest improvements in patients.[127–129]

Topical corticosteroids may function to increase the sinus ostial diameter by reducing inflammation in the area of the sinus ostia. They may also contribute to a reduction in edema and/or cellular infiltration. Since inflammation and edema may cause obstruction to sinus drainage, the use of corticosteroids may serve to promote drainage and increase aeration of the sinuses. They have also been shown to increase the time to recurrence in individuals with recurrent disease.

**Decongestants.** Few clinical data exist to support the use of decongestants to treat acute sinusitis. From a theoretical perspective, the use of decongestants and mucoevacuents may help to achieve and maintain ostial patency and therefore may be of benefit in the management of acute sinusitis.[18] Topical decongestants induce vasoconstriction in the nasal mucosa, thereby reducing tissue edema in the nasal cavity. Mucoevacuents may facilitate drainage by reducing the viscosity of nasal secretions.[130,131] Phenylephrine

hydrochloride spray (0.5%) and oxymetazoline hydrochloride nasal spray (0.05%) are topical decongestants frequently used in the treatment of acute sinusitis. Use of either agent for longer than recommended periods of time or with more frequent applications entails a risk of rebound vasodilation.[19]

Theoretically, systemic agents have the potential to act deep in the ostiomeatal complex, where topical agents may not penetrate effectively.[19] Use of these agents has been shown to improve nasal patency,[132] and Melen et al. have demonstrated that these agents can increase the functional diameter of the maxillary ostium.[47] However, no randomized, placebo-controlled trial to date has shown a significant benefit of oral agents in the treatment of acute sinusitis.

**Antihistamines.** Antihistamines have not proven to be effective in the management of acute sinusitis. Because of their anticholinergic action, antihistamines can cause dryness of mucosal membranes and may interfere with the clearance of purulent mucous secretions.[19]

**Nasal Irrigation.** Irrigation and drainage of the nasal cavity may result in dramatic relief of pain and prevent otherwise irreversible mucosal damage.[133] The most convenient means of accomplishing this is through the use of a commercial product available in squeeze spray bottles.

## Summary

### Initial Management of Acute Sinusitis

Without the benefit of sinus aspiration and culture, it is virtually impossible to distinguish between viral and bacterial sinusitis. It is known, however, that 90% of individuals with the common cold will complain of sinus symptoms, suggesting that the majority of acute sinusitis is viral in origin. Only 0.5 to 2% of these individuals will go on to develop a bacterial etiology. Therefore, in patients with a history of a preceding viral infection, it is the opinion of these authors that the initial management of acute sinusitis should be directed toward the relief of symptoms with a 7-day course of decongestants and mucoevacuents (Fig. 2). This is based on several studies that suggest that most viral disease will resolve within 7 days.[36,53,57] Viral symptoms persisting more than 7 days often establish an environment more suitable for the establishment of bacterial infections and predispose the patient to bacterial sinusitis. Thus, a diagnosis of acute bacterial sinusitis should be reserved for patients who have symptoms persisting for longer than 7 days duration.[38,39] In patients who fail to resolve or improve with symptomatic treatment, the likelihood of bacterial infection is increased. At this point, a 10-day course of first-line antibiotics is indicated (Table 3). Current evidence would suggest that despite the observed increases in antibiotic resistance, most patients will resolve on first line agents.[134] In addition to antibiotics, some patients may benefit at this time with concomitant intranasal corticosteroids. Patients who fail to resolve or improve using first-line agents should receive a course of second-line antimicrobial therapy (Table 4). Based on the experience highlighted by several recent reports, it may be prudent to switch antibiotic classes in patients fail-

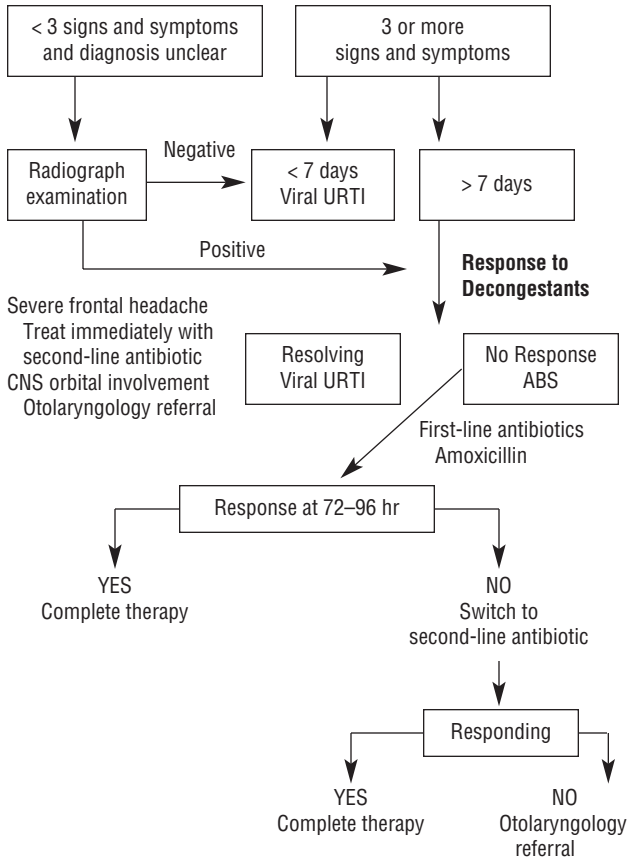


**Figure 2** Diagnosis and treatment of acute bacterial sinusitis in adults: clinical algorithm. URTI = upper respiratory tract infection; CNS = central nervous system; ABS = acute bacterial sinusitis.

**Table 3** First- and Second-Line Oral Antibiotics Approved for Use in the Treatment of Acute Bacterial Sinusitis in Adults

| | |
|---|---|
| First-line antibiotics | |
| Amoxicillin | 500 mg tid |
| Second-line antibiotics | |
| Fluoroquinolones | |
| Gatifloxacin | 400 mg qd |
| Levofloxacin | 500 mg qd |
| Moxifloxacin | 400 mg qd |
| Macrolides | |
| Clarithromycin | 500 mg bid |
| Oral β-lactams | |
| Amoxicillin-clavulanate | 500/125 mg tid or 875/125 mg bid |
| Cefixime | 400 mg qd |
| Cefprozil | 250–500 mg bid |
| Cefuroxime axetil | 250–500 mg bid |

**Table 4** Indications for Second-Line Therapy

| |
|---|
| No clinical response to first-line therapy after 72 to 96 hours |
| Frontal or sphenoid sinusitis |
| Allergy to beta-lactams |
| Patients receiving antibiotics in previous 3 months |
| Chronic underlying conditions or immunosuppression |
| Protracted symptoms |

ing therapy to minimize the development of resistance.[135,136] Patients failing second-line therapy should be referred to a specialist.

### Therapeutic Management

The following are recommendations for the therapeutic management of acute sinusitis:

1. Initial management of patients with a history of preceding viral illness should be symptomatic. The use of decongestants and mucoevacuents are recommended.
2. The diagnosis of acute bacterial sinusitis should be reserved for patients with signs and symptoms of greater than 7 days duration.
3. Patients failing to resolve/improve after 7 days should be treated with a 10-day course of amoxicillin.
4. Patients failing to resolve/improve on first-line agents should be offered a second-line antimicrobial agent.
5. The concomitant use of intranasal corticosteroids may benefit some patients. However, their major benefit will be in prevention of recurrences in individuals with recurrent episodes.

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