

Acute Community-Acquired Bacterial Sinusitis: Continuing Challenges and Current Management

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Acute sinusitis is one of the most common infections seen in general clinical practice. The most common cause of acute sinusitis is viral; however, many patients receive a prescription for an antibiotic. Such injudicious prescribing habits have a major impact on health care costs, contribute to the increasing prevalence of drug-resistant strains of common respiratory pathogens, and reflect many of the challenges in differentiating viral and bacterial disease. Sinus puncture and culture of the aspirate, the diagnostic reference standard in the research setting, are not appropriate for routine clinical practice. However, certain clinical signs and symptoms that do not improve or that worsen after 7–10 days are currently accepted criteria for diagnosis of bacterial sinusitis. Accurate diagnosis can select patients who would benefit most from antimicrobial use. Antimicrobial agents should be selected on the basis of local resistance patterns, and their spectrum of activity should cover the common bacterial pathogens, including resistant strains.

Sinusitis affects an estimated 32 million adults in the United States annually [1]. It is one of the most common diseases seen in primary care practice, with 11.7 million office visits and 1.2 million hospital outpatient unit visits in 2000 [1] and direct annual costs in excess of \$2.4 billion [2]. In addition, there is growing concern over the emergence of antimicrobial resistance among the most common bacterial strains known to cause sinusitis. This trend may be primarily attributed to the inappropriate prescription of antibiotics for viral respiratory tract infections.

Acute viral sinusitis is one of the common causes of respiratory tract infections and in most cases resolves spontaneously without treatment. However, published estimates indicate that 0.5%–2% of cases of acute viral sinusitis in adults are complicated by bacterial sinusitis [3, 4]. In the pediatric population, which has an average of 6–8 viral upper respiratory tract infections per child per year, secondary bacterial complications of viral up-

per respiratory tract infections are more common. It is estimated that 5%–13% of these viral infections may be complicated by secondary bacterial sinusitis [5].

Despite the fact that true acute bacterial sinusitis may occur in only a small percentage of patients with viral sinusitis, it remains a serious health issue. It is important for the clinician to be able to differentiate between bacterial and viral etiologies to appropriately diagnose sinusitis and effectively care for patients by use of appropriate and judicious antimicrobial therapy.

PATHOPHYSIOLOGY OF SINUSITIS

Irrespective of etiology, 3 key features characterize sinusitis: inflammatory edema of the sinus mucosa, obstruction of the sinus ostia, and decreased mucociliary activity. Impaired mucociliary transport fosters stagnation of secretions, decreases their pH, and lowers oxygen tension, thereby providing an environment favorable for bacterial growth [6]. The resulting infection produces an inflammatory response, which involves an influx of polymorphonuclear leukocytes and the release of cytokines, as well as other mediators of the acute inflammatory process. If this condition persists (or reoccurs frequently), the end result can be mucosal damage. Recently, nose blowing has been shown to propel nasal fluid into the sinus cavity [7]. Because, during

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a cold, nasal fluid contains viruses, bacteria, and inflammatory mediators, this may be an important event in the pathogenesis of acute sinusitis.

ETIOLOGY OF ACUTE SINUSITIS

The underlying causes of acute sinusitis are diverse and include viruses, bacteria, and allergies. As discussed above, viral infections are a common cause of acute sinusitis. It is estimated that only 0.5%–2% of cases of acute viral sinusitis are complicated by an acute bacterial infection of the sinus [4, 8]. Therefore, accurate differential diagnosis between viral and bacterial etiology of acute sinusitis is important, because antibiotic treatment is appropriate and useful in shortening the course of bacterial infections only. Acute sinusitis of viral etiology is typically self-limiting, and antibiotic use is contraindicated. Antibiotics in this case have no impact on the disease state and serve only to increase antimicrobial selection pressure.

Acute bacterial sinusitis. Many conditions and environmental factors may predispose a person to develop bacterial sinusitis (table 1) [6]. The bacterial etiology of acute sinusitis was well defined by studies conducted during the late 1940s and 1950s using sinus puncture and culture [9, 10]. Early studies consistently have shown that *Streptococcus pneumoniae* and *Haemophilus influenzae* account for >50% of acute bacterial sinusitis (table 2) [8]. More recent data show that these agents are still the most common bacterial pathogens associated with acute sinusitis.

In 1979, Hamory et al. [11] at the University of Virginia in Charlottesville studied 105 aspirate specimens collected from 81 adult patients who had been symptomatic for >7 days and experienced unilateral facial pain, as well as purulent nasal discharge. Direct needle aspiration of the maxillary sinuses was done, and the aspirates were cultured quantitatively for bacteria and viruses. A total of 59 bacterial strains were isolated in titers of $\geq 10^4$ cfu/mL, 64% of which were either *S. pneumoniae* (20 isolates [34%]) or *H. influenzae* (18 isolates [30%]). Among the other bacterial isolates recovered were anaerobes (7 isolates); *Neisseria* species (5 isolates); and 2 strains each of *Streptococcus pyogenes*, α -hemolytic streptococci, and non-group A β -hemolytic streptococci. Viruses were recovered from 11 (16%) of the 70 culture-positive specimens (rhinovirus from 6, influenza virus from 3, and parainfluenza virus from 2), and mixed infections were present in 5 sinuses [11].

In 1992, Gwaltney et al. [12], on the basis of their 15 years of experience, reported the prevalence among 226 isolates from 383 aspirates obtained from 339 patients evaluated in a similar manner [12]. *S. pneumoniae* (92 isolates [41%]) and *H. influenzae* (79 isolates [35%]) were still the predominant pathogens, followed by anaerobes (16 isolates [7%]), streptococcal species (16 isolates [7%]), *Moraxella catarrhalis* (8 isolates [4%]), and *Staphylococcus aureus* (7 isolates [3%]). Common

Table 1. Selected factors that can predispose to bacterial sinusitis.

Factor
Prior upper respiratory tract infection
Allergic rhinitis
Dental infections
Anatomic variations (e.g., tonsillar and adenoid hypertrophy, deviated septum, nasal polyps, cleft palate)
Secretory disturbances (e.g., cystic fibrosis)
Immunodeficiency
Iatrogenic factors (e.g., mechanical ventilation, nasogastric tubes, nasal packing, dental procedures)

NOTE. From [6].

viruses cultured from sinus isolates include rhinovirus, influenza virus, and parainfluenza virus (8 isolates [4%]) [12].

In 1996, Gwaltney [8] compiled etiologic data from several studies of community-acquired maxillary sinusitis, showing that the most prevalent bacterial isolates were *S. pneumoniae* and unencapsulated *H. influenzae*. On the basis of the 3 studies presented above, the most prevalent causative pathogens associated with acute bacterial sinusitis remained *S. pneumoniae* and *H. influenzae*.

Although the relative importance of the different bacterial species causing bacterial sinusitis has not changed substantially in recent years, there have been clinically significant changes in their antimicrobial susceptibilities. As reported elsewhere in this supplement [13], the trend toward increasing resistance (including multidrug resistance) among *S. pneumoniae* and other common respiratory pathogens continues and poses a growing concern to clinicians and researchers alike.

Acute sinusitis: the allergic component. Allergic disorders can also cause mucosal inflammation, ostial obstruction, and abnormalities of the mucociliary mechanisms, thereby creating an environment conducive to bacterial infection [14]. Fortunately, several clinical clues can help to distinguish an allergic sinusitis-like syndrome from a rhinovirus cold or bacterial sinusitis. One hint is that an allergic diathesis is less likely to result in purulent nasal secretions. Second, itching and sneezing are usually prominent clinical features in allergies. Last, allergies usually present in a more chronic or relapsing pattern and can predispose the patient to develop bacterial sinusitis.

BACTERIAL SINUSITIS: DIAGNOSIS

The differential diagnosis of bacterial sinusitis versus viral (or noninfectious) sinusitis is challenging in patients who present with the typical signs and symptoms of an upper respiratory tract infection. The differentiating clinical features of bacterial sinusitis can be subtle, and other causes of an upper respiratory tract infection (including the common cold) can confound diagnosis and treatment.

Table 2. Viral and bacterial etiology of acute sinusitis.

Etiologic agent	Mean % (range) of cases involving	
	Adults	Children
Viruses		
Rhinovirus	15	...
Influenza virus	5	...
Parainfluenza virus	3	2
Adenovirus	...	2
Bacteria		
<i>Streptococcus pneumoniae</i>	31 (20–35)	36
<i>Haemophilus influenzae</i> (unencapsulated)	21 (6–26)	23
<i>S. pneumoniae</i> and <i>H. influenzae</i>	5 (1–9)	...
Anaerobic bacteria (e.g., <i>Bacteroides</i> , <i>Peptostreptococcus</i> , or <i>Fusobacterium</i> species)	6 (0–10)	...
<i>Moraxella catarrhalis</i>	2 (2–10)	19
<i>Staphylococcus aureus</i>	4 (0–8)	...
<i>Streptococcus pyogenes</i>	2 (1–3)	2
Gram-negative bacteria	9 (0–24)	2

NOTE. From [8] (used with permission).

Although sinus puncture and culture remain the diagnostic reference standard for bacterial sinusitis in the research setting, the routine use of this procedure in the office setting is not recommended [4]. Less-invasive methods for direct sampling and microbiological testing (e.g., nasopharyngeal swabs or middle meatal sampling by endoscopy) have also been used, but the degree of agreement was found to be weak compared with aspirates obtained by sinus puncture [8, 15, 16]. Therefore, in the office setting, the identification of patients with bacterial sinusitis is usually based on an assessment of the patient's medical history and clinical signs and symptoms.

Diagnosis based on signs and symptoms. Studies have been conducted to assess the predictive accuracy of clinical signs and symptoms (individually or in combination) in diagnosing sinusitis, using various imaging techniques as reference standards for bacterial sinusitis. Berg and Carenfelt [17] in 1988 evaluated 155 patients with a clinical presentation consistent with acute sinusitis (75% with duration of symptoms of <3 weeks). These investigators found that a history of purulent nasal discharge with a unilateral predominance, a history of facial pain with unilateral predominance, and findings of purulent nasal discharge and/or pus in the nasal cavity on physical examination correlated with a result of radiography positive for sinusitis. Their analysis also revealed that the predictive sensitivity for sinusitis was 81% and that the specificity was 88% in patients with 3 or 4 of these signs or symptoms. The authors concluded that this constellation of clinical findings might help predict acute bacterial sinusitis.

In another study of 247 adult men (median duration of symptoms, 11.5 days), with plain radiography as a diagnostic standard, Williams et al. [16] found 5 independent predictors

of sinusitis that included maxillary toothache, abnormal transillumination, poor response to nasal decongestants, purulent nasal secretion on examination, and history of colored nasal discharge. The predictive value of these signs and symptoms was 81% with 4 predictors present, and it was 92% with all 5 predictors present [16]. However, radiographic studies in general cannot distinguish between viral and bacterial causes of sinusitis.

In a series of studies conducted at the University of Virginia, Gwaltney and colleagues [12, 21] found that abnormal transillumination was a reasonable predictor of positive results of culture of sinus aspirates. By use of a Welch Allyn scope positioned inside the orbit, the hard palate was examined under dark-adapted conditions. This technique revealed that ~25%–35% of patients who had a noticeable side-to-side difference in transillumination had a purulent sinus aspirate and that virtually all patients who had total obliteration of transillumination in either or both sinuses had purulent aspirates. Therefore, a complete absence of transillumination may be a good predictor of the presence of mucopurulent fluid in the sinuses with a high bacterial titer.

Lindbaek et al. [18] used CT findings as the diagnostic standard in their assessment of various signs and symptoms of 201 patients with a clinical diagnosis of acute sinusitis (duration of illness not reported). A total of 127 patients (63%) met the investigators' CT criteria for acute bacterial sinusitis based on an air-fluid level or total opacification of any sinus. After logistic regression analysis, only 4 signs or symptoms were independently (and significantly) associated with a CT diagnosis of bacterial sinusitis with a high OR: purulent secretion in the cavum nasi, purulent rhinorrhea, "double sickening" (the pres-

ence of 2 phases of illness history), and an erythrocyte sedimentation rate of >10 mm. The presence of ≥ 3 of these 4 signs and symptoms provided a diagnostic sensitivity of 66% and a specificity of 81%. The authors suggest that “double sickening”—which had a high OR (2.8) in this study—may be a particularly relevant clinical finding, because it most likely reflects 2 phases in the sinus disease: common cold followed by bacterial infection.

More recently, Hansen et al. [19] performed an analysis of 174 adults in whom acute bacterial sinusitis was suspected on the basis of general clinical presentation. The patients were evaluated by CT, sinus aspiration, and culture. Of 122 patients (70%) with abnormal CT findings, only 92 (53%) met the diagnostic criteria for acute bacterial sinusitis (i.e., the presence of purulent or mucopurulent sinus aspirate). Consistent with the results of the study by Berg and Carefelt [17], certain signs and symptoms were statistically associated with a diagnosis of acute maxillary sinusitis. These included unilateral facial pain (OR, 1.9), maxillary toothache (OR, 1.9), unilateral tenderness of the maxillary sinus (OR, 2.5), and mucopurulent nasal discharge (OR, 1.6) [19].

It should be noted that none of these investigators used positive results of bacteriologic culture of sinus aspirate as a criterion for diagnosis, and thus the results should be interpreted with caution. In addition, imaging findings fail to adequately differentiate viral and bacterial sinusitis and do not contribute to the determination of the etiologic agent [20]. Collectively, the results of these studies suggest that bacterial sinusitis is characterized by a clinical profile consisting of unilateral facial pain, mucopurulent nasal discharge, unilateral tenderness of the maxillary sinuses, and maxillary toothache. However, no single clinical criterion is both sensitive and specific for the diagnosis of acute bacterial sinusitis. Although no strict diagnostic criteria have been uniformly adopted, the Task Force on Rhinosinusitis of the American Academy of Otolaryngology–Head and Neck Surgery has provided some guidance by stratifying specific diagnostic factors into major and minor categories, which are to be used selectively by the clinician. The diagnosis of acute sinusitis is based on the presence of at least 2 major factors (facial pain or pressure, facial congestion or fullness, nasal obstruction, nasal purulence or discolored post-nasal discharge, hyposmia or anosmia, or fever [acute sinusitis only]) or 1 major and 2 minor factors (headache, halitosis, fatigue, dental pain, cough, ear pain, pressure, fullness, or fever [non-acute sinusitis]) [6]. Of note, the validity of this classification is not based on the results of cultures of sinus aspirates but on signs and symptoms whose “sensitivity” and “specificity” are based on sinus imaging, which in itself is not a validated standard.

Imaging studies. Imaging studies as a primary diagnostic tool of acute sinusitis are neither recommended nor required

in the diagnosis of routine acute bacterial sinusitis. At present, patients are evaluated clinically and managed empirically. Imaging studies are reserved for cases such as those with suspected intracranial or orbital complications or persistent illness. A variety of imaging techniques, including sinus radiography [15, 21–23] and CT [24], are available and, when used for this purpose, offer a noninvasive approximation of the sinus architecture.

Duration of illness and diagnosis of bacterial versus viral sinusitis. The association between duration of illness and bacterial sinusitis was assessed in the following studies. In these studies, no objective assessment, such as sinus aspiration and culture, was used to validate the diagnosis of bacterial sinusitis.

Gwaltney et al. [25], in a 3-year study of 168 young adults with documented rhinovirus colds, showed that in about three-quarters of patients, all cold symptoms, including rhinorrhea, nasal obstruction, sneezing, and pharyngeal discomfort, resolved within 7–10 days.

In the study by Lindbaek et al. [18], 82% of the patients with CT-confirmed sinusitis had symptoms that persisted for ≥ 7 days, whereas 74% of patients without CT findings had symptoms of <7 days’ duration. Sinusitis was present in only 20% of patients with symptoms of <7 days’ duration [18]. No sinus puncture was done, and therefore bacterial infection cannot be confirmed.

The pediatric study by Ueda et al. [26] suggested that bacterial sinusitis should be suspected in children whose respiratory symptoms persist for ≥ 10 days, a delineation that has come to be referred to as the “10-day mark.” After 2013 outpatients with respiratory symptoms were screened, the “10-day mark” identified 146 children with possible acute sinusitis; 135 (92.5%) of these children had confirmed diagnoses by Waters’ projection radiography [26].

When taken together, these findings suggest that a natural break point may exist at the 7- to 10-day period and that bacterial sinusitis may be a more likely diagnosis when symptoms have not improved or have worsened after 7–10 days. If the clinical course is also characterized by early symptomatic improvement followed by worsening—particularly with the onset of purulent rhinorrhea—the predictive value of this marker may be further increased [18].

MANAGEMENT OF SINUSITIS: A CONTINUING CHALLENGE

The management of acute sinusitis presents a challenge to clinicians. Because acute bacterial sinusitis complicates ~2% of cases of viral sinusitis, it is difficult to establish exactly when antibiotic therapy should be prescribed and what degree of benefit it can be expected to confer. Controlled trials of antimicrobial treatment of acute community-acquired sinusitis—with cultures of sinus aspirates for diagnosis and proof of

cure—have never been done [27]. Some controlled trials that made use of unvalidated criteria for diagnosis and proof of cure have suggested that antimicrobial therapy can improve clinical and microbiological outcomes; others have indicated that outcomes are not improved by such therapy [27].

Several groups have recently published clinical practice guidelines to assist in diagnosis and treatment of adult and pediatric sinusitis [5, 6, 28–30]. Although there are some differences among these guidelines, the simplified algorithm shown in figure 1 is consistent with the separate recommendations presented in each [6]. For example, there is general agreement that the diagnosis of acute bacterial sinusitis is based on clinical criteria and that imaging studies are not routinely necessary for diagnosis. Given that most cases of sinusitis are viral in nature and resolve without antimicrobial treatment, it is generally recommended that antibiotic therapy be reserved for patients in whom signs and symptoms consistent with bacterial sinusitis have persisted for 7–10 days. Exceptions should be made for patients with highly specific findings or in whom serious complications are suspected (table 3) [8].

The goal of antimicrobial therapy is bacteriologic and clinical cure, characterized by eradication of the pathogen(s) and elimination of acute and/or chronic complications. Although there are no consistent recommendations regarding treatment of choice for acute bacterial sinusitis, there is general agreement that the antimicrobial agent should be active against *S. pneumoniae* and *H. influenzae*. However, there is increasing bacterial resistance, especially in *S. pneumoniae*, to commonly used antimicrobial agents (e.g., amoxicillin, trimethoprim-sulfamethoxazole, some β -lactams and macrolides), although the clinical impact of the increasing resistance to these agents has not yet been fully documented in patients with sinusitis. New agents, such as the ketolides, including telithromycin and cethromycin, have a spectrum of activity tailored to common respiratory pathogens, including those that cause acute sinusitis, with little potential to induce resistance [32]. Telithromycin is the first ketolide to undergo clinical development, and a 5-day course of 800 mg taken once per day has been shown to have a high clinical cure rate, >90%, in the treatment of acute maxillary sinusitis [33]. Similar results were seen in a recently published trial against a comparator agent [34].

The importance of optimal dosing. The clinical and microbiological response to antibiotic treatment depends on administration of the optimal dose of an appropriate agent—essentially, one that will provide a drug concentration above the MIC₉₀ for the pathogen [31, 35, 36]. In addition, the pharmacokinetic and pharmacodynamic profiles of an antimicrobial agent can help predict the degree of tissue penetration at the site of infection, an agent’s potential to induce resistance, its bactericidal or static character, and the suitability of short-course regimens based on the drug’s half-life. The importance

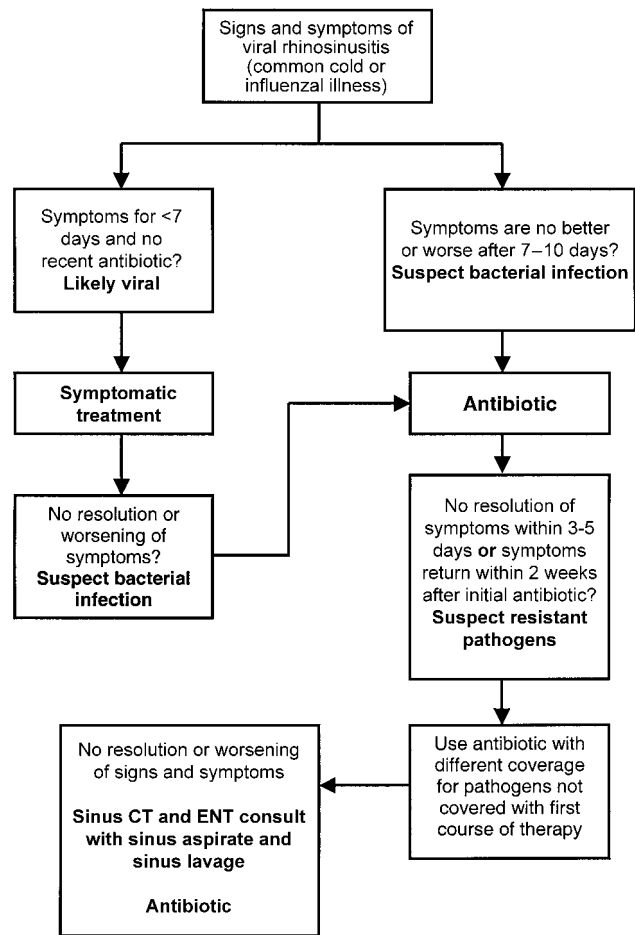


Figure 1. Algorithm for primary care management of acute sinusitis. ENT = ear, nose, throat. Modified with permission from [6].

of optimal dosing in the treatment of community-acquired bacterial sinusitis is emphasized in a review of several antibiotic trials in which cultures of sinus aspirates obtained before and after treatment were used to evaluate microbiological efficacy [8]. In this review, 2 studies showed that the bacteriologic cure rate was 90% in patients whose antibiotic concentration was greater than the MIC for the pathogen after treatment but only 45% in patients whose antibiotic concentration was less than the MIC for the organism (table 4) [8, 11, 12, 37, 38]. It also showed that in several other similarly designed studies, the bacteriologic cure rate was 93% in patients who received an appropriate dose of an appropriate drug but only 71% in those who received a suboptimal dose [8].

Optimal duration of antibiotic therapy in the treatment of sinusitis has not been systematically studied. An early study of the use of trimethoprim-sulfamethoxazole for 3 versus 10 days to treat sinusitis diagnosed on a clinical and radiographic basis showed similar clinical success rates (76% vs. 77%) [39]. However, that study was not based on results of cultures of sinus aspirates and probably contained cases of viral sinusitis. A 10-

Table 3. Sensitivity and specificity of clinical findings with acute community-acquired sinusitis.

Population	Criterion standard	Finding	Sensitivity (%)	Specificity (%)
Males with nasal discharge ^a	Positive results of sinus radiology	History of colored nasal discharge	72	52
		Cough	70	44
		Sneezing	70	34
		Poor response to decongestants	41	80
		Maxillary toothache	18	93
		Purulent secretion	51	76
		Sinus tenderness	48	65
		Temperature of >38°C	16	85
Emergency ward patients with paranasal symptoms ^b	Purulent aspirate ^c	Purulent rhinorrhea, unilateral	48	...
		Pain, unilateral	37	...
		Purulent rhinorrhea, bilateral	35	...
		Sinus tenderness on percussion	43	...
		Pus in nasal cavity	41	...

NOTE. From [8] (used with permission).

^a Data are from [1].

^b Data are from [31].

^c Bacterial culture was not done.

day regimen is still considered standard for uncomplicated cases of sinusitis [40]. However, 2 important clinical issues arise with long-term antimicrobial therapy: the issue of reduced patient compliance and the consequential development of bacterial resistance. A strong suspicion of infection with a resistant pathogen should be considered if symptoms do not resolve or improve within 3–5 days of initiation of antibiotic therapy. Current trends in short-duration antimicrobial therapy, dis-

cussed by File [41] in this supplement, may be of significant interest in the management of acute bacterial sinusitis.

SUMMARY AND CONCLUSIONS

Acute bacterial sinusitis continues to present a number of diagnostic and treatment challenges. Most cases of sinusitis seen in the office setting are caused by uncomplicated viral upper

Table 4. Comparative bacteriologic cure rates (as determined by sinus puncture) among patients with acute community-acquired bacterial sinusitis.

Reference, comment regarding treatment	No. of bacteriologic cures/no. of cases (%)
Carenfelt et al. [37]	
Antibiotic concentration was \geq MIC for causative bacteria ^a	19/21 (90)
Antibiotic concentration was <MIC for causative bacteria ^a	15/33 (45)
Hamory et al. [11]	
Appropriate antimicrobial and dosage given	47/49 (96)
Inappropriate antimicrobial given ^b	0/6
Carenfelt et al. [38]	
Appropriate antimicrobial and dosage given	105/115 (91)
Suboptimal dosage given ^c	37/50 (74)
Gwaltney et al. [12]	
Appropriate antimicrobial and dosage given	126/136 (93)
Suboptimal dosage given ^c	1/5 (20)
Suboptimal dosage given ^d	15/21 (71)

NOTE. From [8] (used with permission).

^a Antibiotic concentration in sinus aspirate after 2–3 days of treatment.

^b Clindamycin, against *H. influenzae*.

^c Cefaclor, 500 mg b.i.d.

^d Cefaclor, 500 mg t.i.d.

respiratory tract infections. Given that sinus puncture and culture—the diagnostic reference standard for this disease—is not generally feasible or indicated, except in refractory cases under the care of a specialist, the distinction between bacterial and viral (or noninfectious) sinusitis has traditionally been made on clinical grounds alone. Although imaging studies may shed light on the anatomic and pathological characteristics of the disease, they do not distinguish between the viral and bacterial etiologies of sinusitis. Therefore their routine use is not recommended. CT, the imaging procedure of choice, is reserved for patients with potentially serious complications and for whom surgery is being considered. Although there are exceptions, patients who have experienced symptoms of a cold or flu-like illness for <7 days are unlikely to have a bacterial infection.

Antibiotic therapy, when prescribed, is generally empirical and should be based on local antimicrobial resistance patterns. Treatment should begin with agents that possess activity against the most common respiratory pathogens in acute bacterial sinusitis: *S. pneumoniae*, *H. influenzae*, and *M. catarrhalis*. However, the disturbing increase in strains of these respiratory pathogens resistant to single or multiple drugs must be taken into consideration when an antibiotic is chosen, and a resistant pathogen should be suspected if a patient does not improve after appropriate antibiotic therapy for 3–5 days. This is especially true if the patient has been treated with antibiotics during the previous 30 days.

Although antimicrobial selection criteria are always based on safety and efficacy, the intrinsic properties of the agent should also be considered. Ideally, the selected antimicrobial agent for the management of acute bacterial sinusitis should penetrate tissues rapidly, be of appropriate spectrum, be rapidly bactericidal, have a low potential for resistance induction, and have a half-life appropriate for once-daily short-term dosing.

In conclusion, the management of acute bacterial sinusitis will undoubtedly continue to pose a significant challenge to the diagnostic and treatment skills of clinicians. However, the suggestions contained herein should provide some clinical guidance that can be used to facilitate decision making, thereby benefiting patients and ensuring the appropriate use of antibiotics.

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