Guideline for

Administered by the Alberta Medical Association

The Diagnosis and Management of Acute Bacterial Sinusitis

This clinical practice guideline was developed by an Alberta Clinical Practice Guideline working group. This guideline does not apply to the following patients:

- *Less than 6 weeks old*
- *Immunocompromised or severe underlying systemic disease e.g., cystic fibrosis*
- *Complications of acute bacterial sinusitis*
- *Hospital acquired sinusitis*

DEFINITIONS

- **Sinusitis**: Inflammation of one or more of the paranasal sinus cavities, the cause of which may be allergic, viral, bacterial, or rarely fungal:
  - **Acute**
    - sinusitis lasting 4 weeks or less
  - **Recurrent**
    - 4 or more episodes of acute sinusitis per year each lasting 10 days or more **and**
    - absence of symptoms between episodes
  - **Chronic**
    - sinusitis lasting 12 weeks or more with or without treatment

- **Rhinitis**: inflammation of the nasal mucosa, the most common cause of which is viral or allergic.

- **Rhinosinusitis:** inflammation of the nasal mucosa and lining of the sinuses, the most common cause of which is viral or allergic.

Note: Rhinitis and rhinosinusitis are often misdiagnosed as sinusitis.

ISSUES

- Accurate differentiation between bacterial sinusitis and viral upper respiratory tract infection (URTI) can be difficult.
- Differentiation between acute and chronic sinusitis has clinical significance.
- The overuse of antibiotics in ill-defined URTI has led to increasing antibiotic resistance.
- Sinusitis can occur at any age:
  - Paediatric sinusitis is a difficult diagnosis

PRACTICE POINT

An understanding of sinus development is very helpful (see Figure 1)

- Maxillary/ethmoid sinuses exist in infants and toddlers
- Frontal sinuses are not present in pre-school age children

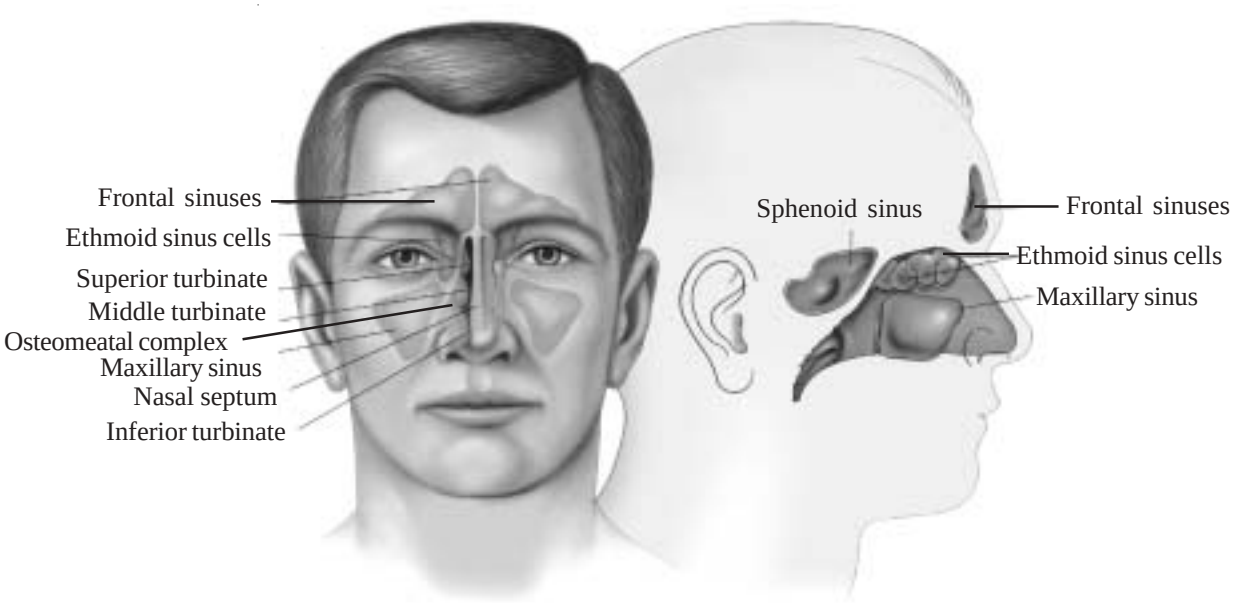
GOALS

- To increase the accuracy of the diagnosis of bacterial sinusitis
- To optimize the appropriate use of laboratory and diagnostic imaging services
- To optimize the management of sinusitis
- To reduce antibiotic use in ill-defined URTI

PREVENTION

- Limit the spread of viral infections (e.g., hand washing)
- Avoid environmental tobacco smoke
- Reduce environmental allergen exposure

Figure 1



Note: The frontal and sphenoid sinuses are not well developed in young children.

DIAGNOSIS

- The diagnosis of bacterial sinusitis relies on history and physical examination
- Although the gold standard for diagnosis is aspiration of the sinus contents, this procedure is invasive, not practical and not routinely recommended[1]
- Nasal/nasopharyngeal cultures are NOT recommended due to poor correlation with sinus pathogens
- Differentiation of bacterial sinusitis from viral URTI is largely determined by duration and severity of symptoms

PRACTICE POINT

Viral rhinosinusitis occurs up to 200 times more commonly than bacterial sinusitis

History

Table 1: Bacterial Sinusitis in Children

Common Presentation

- Persistent symptoms of URTI without improvement after 10 to 14 days

with both:

- **purulent nasal discharge**

and

- **continued unwell state**

+/–

- fever
- cough
- irritability
- lethargy
- facial pain

Severe Presentation*

- Severely ill child

with:

- fever ≥ 39^0 (unresponsive to appropriately dosed antipyretics)

and

- purulent nasal discharge

usually associated with:

- cough
- headache
- facial swelling
- sinus tenderness

***Notes:**
- ***Less common presentation in children***
- ***Maintain a high degree of suspicion of intracranial/suppurative complications***

Table 2: Bacterial Sinusitis in Adolescents/Adults

Common Presentation

- Persistent symptoms of URTI without improvement after 10 to 14 days or worsening after 5 days

with both:

- **nasal congestion/purulent nasal discharge**

and

- **facial pain**

+/-

- fever
- maxillary toothache
- facial swelling

Other Concurrent Symptoms

- headache
- halitosis
- hyposmia/anosmia
- ear pain/pressure/fullness
- fatigue
- cough
- facial pain made worse on bending forwards

Physical Examination: Children/Adolescents/Adults

The following physical features may be present and should be assessed when sinusitis is suspected:

- **Face**
  - Swelling and/or erythema over the symptomatic area
  - Tenderness on palpation or percussion of the paranasal sinuses

Note: ***Transillumination of the sinuses has limited value in adult patients and no diagnostic value in children.***

- **Eyes**
  - Periorbital swelling

Note: ***Extraocular muscle dysfunction or decreased visual acuity should result in immediate referral.***

- **Nose**
  - Mucopurulent secretions
  - Erythema and swelling of nasal mucosa
  - Anatomical anomalies (e.g., deviated septum, polyps, large turbinates)
  - Foreign bodies

Note: ***Nose may be examined using a short, wide speculum on a handheld otoscope.***

- **Mouth and Pharynx**
  - Post nasal drip
  - Maxillary tooth tenderness

- **Ears**
  - Concomitant otitis media in children

- **Neck**
  - Lymphadenopathy

PRACTICE POINT

Facial pain **alone** is not diagnostic of bacterial sinusitis.

Investigations

- Nasal/nasopharyngeal cultures are NOT recommended due to poor correlation with sinus pathogens

- Plain sinus X-rays and CT scans are not routinely recommended in the diagnosis of sinusitis:
  - Plain X-rays are not recommended in children and might only have a very limited role in supporting the clinical diagnosis in adults
  - CT scan is recommended for:
    - complications of acute sinusitis
    - chronic sinusitis not responding to treatment
    - severe presentations where diagnosis is suspected but not clear
  - MRI is not routinely recommended in the investigation of sinusitis (poor bone definition)

- Consider allergy assessment for patients with chronic sinusitis

PRACTICE POINT

Plain X-ray will not distinguish between sinus abnormalities associated with viral URTI and bacterial sinusitis.

MANAGEMENT

- Studies indicate that up to 60% of cases of acute sinusitis will resolve spontaneously without antibiotics

Acute Sinusitis

- Pain/fever may be controlled with oral analgesics/antipyretics
- Irrigation of the nasal cavity with saline might be of benefit
- Inhalation of steam might be of benefit
- Short duration, topical or systemic decongestants* might be useful adjuncts in the treatment of acute sinusitis
- **Antibiotic therapy should be reserved for those with acute bacterial sinusitis as defined by history and physical examination.** For specific antibiotic recommendations, see Tables 3A and 3B

PRACTICE POINT

Antihistamines have no proven benefit in acute bacterial sinusitis but might have a role in chronic bacterial sinusitis where a clear allergic component is demonstrated.

Recurrent Sinusitis

- Manage as acute bacterial sinusitis:
  - If less than 6 weeks between episodes recommend second-line agents (see Tables 4A and 4B)
  - If 6 weeks or more between episodes recommend first-line agents (see Tables 3A and 3B)

Chronic Sinusitis

- **Adjunctive therapy is as important as antibiotic therapy**
  - Topical nasal steroids might be of benefit
  - Oral and topical decongestants* are of limited benefit
  - Irrigation of the nasal cavity with saline might be of benefit
  - Antihistamines might have a role where a clear allergic component is demonstrated

Note:** **Prolonged use (>5 days) of topical decongestants may result in local complications and are not recommended. Oral decongestants containing phenylpropanolamine (PPA) are not advised for use.

- A prolonged course of antibiotics has value in chronic sinusitis (symptoms lasting more than 12 weeks). See Table 5.

PRACTICE POINT

Repeated courses of antibiotics are not usually indicated in chronic sinusitis.

COMPLICATIONS

- Complications of bacterial sinusitis include:
  - Periorbital/orbital cellulitis
  - Meningitis
  - Intracranial abscess
  - Intracranial venous thrombosis
  - Sepsis

FOLLOW-UP

- A follow-up exam at completion of treatment is not routinely required
- If patient shows no improvement at 72 hours following treatment with adjunctive therapy and first-line antibiotics, see Tables 4A and 4B
- If patient is deteriorating at any time, follow-up is recommended to reassess patient for:
  - Acute complications of sinusitis
  - Other diagnoses
  - Adherence to treatments

INDICATIONS FOR REFERRAL TO ENT

- Anatomical anomalies
- Development of complications
- Four or more episodes per year of bacterial sinusitis
- Chronic sinusitis not responding to medical therapy (adjunctive and antibiotic)

BACKGROUND

Epidemiology

Sinusitis is one of the most common conditions that primary care physicians encounter.[2] On average, adults have 3 to 4 colds per year, while children have 6 to 10 colds per year.[3] Rarely, colds are complicated by bacterial sinusitis. Making a diagnosis of bacterial sinusitis is challenging but critical as viral rhinosinusitis occurs up to 200 times more commonly.[4-7]

Pathophysiology

During a URTI, both the nasal and sinus mucosa become inflamed. Sinusitis is usually the result of an obstruction of the sinus ostia. Contributing factors include inflammation from viral infections or allergens. Sinusitis occurs not only when the sinus ostia are obstructed but also if the nasal cilia are rendered immotile by viruses and/or environmental tobacco smoke. Fluid and bacteria are trapped in the sinus cavities and the bacteria may proliferate.

Sinusitis can develop at any age. The maxillary and ethmoid sinuses are present in infancy. The frontal sinuses expand into the frontal bone to be well evident by the fifth year, but continue to develop into adolescence. The sphenoidal sinuses are apparent by 3 years and are fully developed by age 12.[8]

Predisposing Factors

The cause of bacterial sinusitis is often multifactorial but the most common predisposing factors are viral URTI and allergies.[9,10] There are 5 factors that have been described as predisposing to sinusitis:[11]

1. Medical conditions (e.g., respiratory infections, allergic rhinitis, cystic fibrosis, immunodeficiency, Wegener's syndrome, Kartaganer's syndrome)
2. Irritants (e.g., environmental tobacco smoke, air pollution, chlorine)
3. Anatomic (e.g., deviated septum, adenoidal hypertrophy, immotile cilia, polyps, tumors and foreign bodies)
4. Medications (e.g., overuse of topical decongestants, cocaine abuse)
5. Trauma (e.g., dental procedure, diving)

Etiology

The paranasal sinuses are normally sterile. Streptococcus pneumoniae and unencapsulated strains of Haemophilus influenzae are implicated in over 50% of acute sinusitis cases in both adults and children. Although rare in adults, Moraxella catarrhalis is the third most common pathogen in children, accounting for up to 20% of cases. As many as 10% of acute cases in adults may be due to mixtures of anaerobic bacteria (Bacteroides spp, Prevotella spp, Porphyromonas spp, Fusobacterium spp, Peptostreptococcus spp). Polymicrobial anaerobic infections of the sinuses are often associated with concurrent dental disease. Anaerobic infections are rare in children. Staphylococcus aureus, Streptococcus pyogenes and other Streptococcal species may occasionally cause acute sinusitis in adults and children. Rarely (<5%), aerobic gram-negative bacilli such as Pseudomonas aeruginosa, Klebsiella spp and E. coli are recovered in cases of acute sinusitis.[12]

Although both Mycoplasma pneumoniae and Chlamydia pneumoniae have been implicated in acute sinusitis, their role in this condition has not been substantiated.

Fungal organisms (Aspergillus spp, Zygomyces, Phaeohyphomyces) have been recovered in patients with acute sinusitis. In the immunocompetent host their role is unclear, and antifungal therapy is not routinely recommended. In immunocompromised hosts, especially those with diabetic ketoacidosis, recovery of these organisms might require immediate surgical and medical management.[13]

Respiratory viruses, such as Rhinovirus, Influenza and Parainfluenza viruses are found alone or in combination with bacteria in 20% of cases of acute sinusitis. It is not clear whether the presence of viral organisms precedes, or happens concurrently to, invasion with bacteria.

Although the major bacterial pathogens of acute sinusitis are predictable, the same cannot be said for their susceptibility to antibiotics. A sharp increase in penicillin resistant Streptococcus pneumoniae has been reported in Canada over the last decade. In Alberta, 20 to 25% of isolates demonstrate reduced susceptibility to penicillin. Many of these strains exhibit resistance to other antibiotics including

trimethoprim/sulfamethoxazole (~22%), macrolides (~12%), tetracyclines (~9%), clindamycin (~4%) and ceftriaxone/cefotaxime (~2%). Haemophilus influenzae resistance in Alberta has stabilized in the last few years. Currently, 17% of isolates are resistant to amoxicillin and 20% are resistant to trimethoprim/sulfamethoxazole.[14] The vast majority of Moraxella catarrhalis isolates produce β-lactamase and are resistant to amoxicillin and first generation cephalosporins. Overuse of antibiotics in ill-defined URTI is thought to be a major contributor to this resistance.

The etiology of chronic sinusitis is less clear. Although recurrent episodes of acute sinusitis predispose to chronic sinusitis, underlying immunological or structural abnormalities are almost always present. In chronic sinusitis, Staphylococcus aureus is found more frequently than in acute sinusitis.[15] In several studies the most common organisms recovered were coagulase negative Staphylococcal species, however, it has not been demonstrated whether these organisms play a direct pathogenic role. Aerobic gram-negative bacilli may rarely be present in patients with chronic sinusitis. Anaerobes are thought to play an important role in the etiology of chronic sinusitis.[15] Aspirates of sinuses often indicate polymicrobial flora with a predominance of anaerobes. The pathogenic role of these organisms remains somewhat controversial.[16]

Fungal species may colonize the sinuses without causing infection. This colonization in some individuals might predispose to chronic sinusitis by mechanisms that have not yet been established. The presence of tenacious, thick, brown nasal secretions should heighten the suspicion of a fungal infection.

Diagnosis

The diagnosis of bacterial sinusitis is dependent on the duration of symptoms and the location of disease.[6] Acute sinusitis primarily presents as pain over the infected area with or without headache. The patient may have an associated viral URTI. Tenderness may be elicited from the maxillary, and frontal sinuses anteriorly whereas bitemporal or vertex headaches are more evident with the posterior ethmoid and sphenoid sinuses. There is often a greenish or yellow discharge from the nose, which may be bilateral and associated with fever and malaise.[6]

Patients with chronic sinusitis typically complain of purulent nasal discharge, post nasal drip and nasal obstruction accompanied by facial pain. Symptoms can mimic the pain of atypical and typical migraine, dental disease, and tension headaches.[17] Acute sinusitis can be superimposed on chronic sinusitis, and it is sometimes found that these patients have pansinusitis.

Physical Examination

The physical inspection of the face should focus on looking for periorbital edema or other facial swelling. Occasionally there is tenderness as the examiner palpates over, or percusses the paranasal sinuses. As insidious orbital complications can occur it is imperative to assess change in extraocular movements and visual acuity. Physical assessment should involve examination of the nasal mucosa using a short, wide speculum mounted on an otoscope.[3,18] A topical vasoconstrictive agent is often helpful in visualization of the posterior nasal cavity.[19] Anterior rhinoscopy findings suggestive of bacterial sinusitis include:

- Erythematous nasal mucosa which may show moderate injection
- Mucopurulent discharge
- Pus coming from the middle meatus
- Predisposing anatomic anomalies (e.g., polyps, deviated nasal septum etc.)

Five to 10% of bacterial sinusitis is secondary to dental infection.[3] Therefore, the maxillary teeth should be tapped with a tongue depressor to check for tenderness.[20] The cervical lymph nodes are usually not significantly enlarged or tender. Malodorous breath (in the absence of pharyngitis, poor dental hygeine, or a nasal foreign body) may suggest bacterial sinusitis.

In most children under 10 years of age, a combination of history and physical examination is needed to make a specific diagnosis of bacterial sinusitis.[21,22] Physical findings may include mucopurulent nasal discharge, hypertrophied nasal turbinates, and occasionally intranasal polyps. The latter are seen principally in association with allergy or cystic fibrosis.

Transillumination

A study comparing maxillary and frontal transillumination with sinus CT scans showed that only 55% of patients with positive radiographic findings had abnormal transillumination. With transillumination of the maxillary sinus, intraobserver reproducibility is low (60%), although it was higher when assessing frontal sinuses (90%). Transillumination is controversial in adults but may have marginal benefits, and is of no value in diagnosing sinusitis in children.[1,3,20] Failure to transilluminate does not establish a diagnosis of acute sinusitis.

Radiology

The most common radiographic finding diagnostic of bacterial sinusitis is an air fluid level in, or complete opacification of, the sinus cavity.

Radiography should only be used if the clinical diagnosis of sinusitis is in doubt, however, a plain radiograph is estimated to be only up to 54% reliable in diagnosing sinusitis in adults.[4] Unfortunately, an air fluid level may be an incidental finding in radiographs taken for other reasons. Using a plain X-ray, a mucosal width of >5mm in adults increases the probability of bacterial sinusitis, however, the specificity of this is low. Plain sinus films have little diagnostic utility in children under 12 years of age.[5,23]

Basic radiographic examination of the paranasal sinuses includes 4 views. The Waters view (occipitomental) is used to evaluate the maxillary sinuses. The Caldwell view (angled posteroanterior) is used to evaluate the ethmoid and frontal sinuses and to confirm disease in the paired maxillary, ethmoid and frontal sinuses. The submentovertex view is used to evaluate the sphenoid and ethmoid sinuses. This last view is also useful for examining the lateral walls of the maxillary sinuses.[1,3,24,25,26] All radiographs are done with the patient erect in order to evaluate air-fluid levels.[25]

CT scans of the sinuses are more sensitive at identifying sinus infection than plain films.[23] They should not be used routinely in diagnosing acute bacterial sinusitis as up to 87% of adults with early cold symptoms have some sinus abnormality on CT scan.[27] CT scans might be indicated when complications are suspected or in the evaluation of chronic sinusitis not responding to medical treatment.[28]

MRI use is limited due to its inability to delineate bony anatomy. It might have some use in diagnosing fungal sinusitis.[29]

Treatment

The goal of treatment for both acute and chronic sinusitis is drainage of the congested sinus and elimination of the pathogenic bacteria. The mechanism of achieving resolution differs somewhat between acute and chronic sinusitis.

Local treatment with steam, humidifiers and nasal saline spray may be of benefit in both acute and chronic sinusitis.[30] Nasal and oral decongestants may also be beneficial in both diseases.[30] Caution should be used with topical decongestant sprays as extended use may predispose to rhinitis medicimentosa. Due to recent information, oral decongestants containing phenylpropanolamine (PPA) are not advised for use in acute bacterial sinusitis.[31]

Antihistamines should be avoided in acute sinusitis because of their tendency to cause excessive dryness with thickening of secretions and crusting which can aggravate sinusitis.[32] The second-generation antihistamines may, however, have a role in chronic sinusitis where a clear allergic component is demonstrated.[30]

The use of nasal corticosteroid sprays is controversial in acute sinusitis. They might be beneficial in chronic sinusitis by their ability to decrease nasal edema and inflammation and thus promote drainage.[33]

Studies show that up to 60% of acute sinusitis will resolve without antibiotic treatment.[33] The goals of antibiotic therapy are to achieve clinical cure and prevent complications.

Amoxicillin remains the antibiotic of choice for acute bacterial sinusitis for the following reasons[34]:

- Adequate coverage for organisms involved in acute sinusitis
- Best activity of all β-lactam agents against penicillin intermediate Streptococcus pneumoniae

- Relatively few adverse effects
- Lower potential to induce resistance
- No other antibiotic agent has been proven superior to amoxicillin in clinical trials

Amoxicillin at doses of 40 mg/kg/day given TID should be considered as the first line oral therapy for low risk children (no previous exposure to antibiotics in the last 3 months and not attending daycare centres).[35] Amoxicillin at doses of 500 mg given TID should be considered as the first line oral therapy for adults.

Data extrapolated from otitis media literature indicates that amoxicillin at doses of 90 mg/kg/day given TID might be considered in the management of high risk children (those who have received antibiotics in the past 3 months **and** who are attending daycare centres) with acute bacterial sinusitis.

The choice of agent remains uncertain in cases where amoxicillin fails. There are many reasons why treatment appears to fail, including viral infection, incorrect diagnosis, poor compliance, inadequate antibiotic dosage or frequency, or persistence of resistant bacteria. If the patient fails standard dose therapy, potential pathogens include viruses, β-lactamase producing organisms (Haemophilus influenzae, Moraxella catarrhalis) or penicillin resistant Streptococcus pneumoniae.[29] In these cases, in children, amoxicillin **plus** amoxicillin-clavulanate is recommended to provide coverage for these organisms. Achieving a high dose of amoxicillin (90 mg/kg/day) using the amoxicillin-clavulanate preparation would be ideal, however, the resulting amount of clavulanate would result in unacceptably high rates of GI side effects. Studies indicate that the combination of amoxicillin and amoxicillin-clavulanate does not result in the same unacceptably high rates of gastrointestinal side-effects.[36]

In children who have failed high dose amoxicillin therapy, β-lactamase producing organisms are more likely pathogens, and amoxicillin clavulanate alone is recommended.[5] Cefuroxime axetil is also an option for children who have failed amoxicillin therapy, however, poor palatability limits its use. Cefprozil may be an alternative in this case, however, compared to cefuroxime, it has inferior coverage of Haemophilus influenzae and penicillin intermediate Streptococcus pneumoniae.

In adults, when amoxicillin fails, amoxicillin-clavulanate or cefuroxime axetil are recommended as second-line agents.[30]

In penicillin allergic patients, TMP/SMX has been recommended.[30] Because of increased resistance, erythromycin-sulfisoxasole may be preferred over TMP/SMX in children, especially those who attend daycare and have received antibiotics in the last 3 months.

For both children and adults who are penicillin allergic, cefuroxime-axetil is an acceptable second-line agent if the allergy is not severe. In severe β-lactam allergy, azithromycin and clarithromycin are options. However, because resistance to macrolides continues to increase, the routine use of these agents for sinusitis is not recommended.

Quinolones might play a role in the management of acute bacterial sinusitis in adults. Levofloxacin and moxifloxacin provide excellent coverage for the pathogens involved, but because of their broad spectrum and potential for increasing resistance in Streptococcus pneumoniae, they should be reserved for patients with β-lactam allergy or those who have failed recent antibiotic therapy.[30] Ciprofloxacin does not have adequate coverage of Streptococcus pneumoniae and should not be used routinely in the management of acute bacterial sinusitis.

The standard duration of antibiotic therapy for acute sinusitis is 10 days.[34,35]

Amoxicillin-clavulanate or clindamycin are recommended for chronic sinusitis to provide coverage for Staphylococcus aureus and anaerobes. Patients with chronic disease require at least a 21-day course.[34]

Referral

Referral should be considered if a patient: experiences 4 or more episodes of bacterial sinusitis per year; has chronic sinusitis that is not responding to medical therapy (adjunctive and antibiotic); has anatomical anomalies; or develops complications.

ADVICE TO PATIENTS

The Alberta Clinical Practice Guidelines Program supports the right of the patient to make an informed decision about his/her health care options. It is paramount that patients recognize that the success of antibiotic therapy rests on compliance with treatment recommendations and that the opportunity for treatment failure and antibiotic resistance increases with poor compliance.

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THE ALBERTA CLINICAL PRACTICE GUIDELINES PROGRAM

The Alberta Clinical Practice Guidelines Program promotes appropriate, effective and quality medical care in Alberta by supporting the use of clinical practice guidelines. The program is administered by the Alberta Medical Association under the direction of a multi-stakeholder steering committee.

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TO PROVIDE FEEDBACK

The Alberta CPG Working Group for Antibiotics is a multi-disciplinary team composed of family physicians, infectious diseases specialists, internal medicine, pediatricians, microbiologist, otolaryngologist, hospital and community pharmacists, epidemiologist, consumers, and Alberta Health and Wellness representative. The team encourages your feedback. If you have difficulty applying this guideline, if you find the recommendations problematic, or if you need more information on this guideline, please contact:

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Table 3A: 1st-Line Agents in the Treatment of Acute Bacterial Sinusitis in Children

Recommended Therapy and Dose	Duration	Comments
Standard Dose Amoxicillin 40 mg/kg/day PO div tid	10 days	♦ Amoxicillin retains best coverage of oral β-lactam agents against *Streptococcus pneumoniae* (including intermediate strains)
or		
High Dose Amoxicillin 90 mg/kg/day PO div tid	10 days	♦ Higher dose (90 mg/kg/day) might be considered in high risk children (i.e., recent (<3 months) antibiotic exposure **and** daycare centre attendance)
β-Lactam Allergy Erythromycin-sulfisoxazole 40 mg/kg/day PO div tid (based on erythromycin)	10 days	♦ Preferred in β-lactam allergy
or		
TMP/SMX (co-trimoxazole) 6-10 mg/kg/day PO div bid (based on TMP)	10 days	♦ Increased resistance is reported. ♦ Not recommended in high risk children (i.e., recent (<3 months) antibiotic exposure **and** daycare centre attendance)

Agents Not Routinely Recommended in Acute Bacterial Sinusitis

Cephalexin:	– poor activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – no activity against *Haemophilus/Moraxella*
Cefaclor:	– no activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – marginal activity against *Haemophilus*
Cefixime:	– no activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – excellent activity against *Haemophilus*
Ceftriaxone:	– routine use of this agent is not recommended in sinusitis due to potential for increased resistance to third generation cephalosporins – may be an option in severe cases who have failed therapy. Three days of IM/IV therapy are recommended. (Single dose not as effective in eradicating penicillin resistant *Streptococcus pneumoniae*)
Erythromycin:	– poor activity against *Haemophilus/Moraxella*
Clindamycin:	– not routinely recommended for acute bacterial sinusitis (no activity against *Haemophilus/Moraxella).* – may have a role in chronic sinusitis
Ciprofloxacin:	– suboptimal coverage of *Streptococcus pneumoniae*

Table 3B: 1st-Line Agents in the Treatment of Acute Bacterial Sinusitis in Adults

Recommended Therapy and Dose	Duration	Comments
Amoxicillin 500 mg PO tid	10 days	♦ Amoxicillin retains best coverage of oral β-lactam agents against *Streptococcus pneumoniae* (including intermediate strains)
β-Lactam Allergy TMP/SMX (co-trimoxazole) 1 DS tab PO bid	10 days	♦ Please note: • More than 25% of isolates of *Streptococcus pneumoniae* are resistant to TMP/SMX • If there has been antibiotic exposure within the last 3 months, use second-line agents

Agents Not Routinely Recommended in Acute Bacterial Sinusitis

Cephalexin:	– poor activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – no activity against *Haemophilus/Moraxella*
Cefaclor:	– no activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – marginal activity against *Haemophilus*
Cefixime:	– no activity against penicillin intermediate/resistant *Streptococcus pneumoniae* – excellent activity against *Haemophilus*
Ceftriaxone:	– routine use of this agent is not recommended in sinusitis due to potential for increased resistance to third generation cephalosporins – may be an option in severe cases who have failed therapy. Three days of IM/IV therapy are recommended. (Single dose not as effective in eradicating penicillin resistant *Streptococcus pneumoniae*)
Erythromycin:	– poor activity against *Haemophilus/Moraxella*
Clindamycin:	– not routinely recommended for acute bacterial sinusitis (no activity against *Haemophilus/Moraxella).* – may have a role in chronic sinusitis
Ciprofloxacin:	– suboptimal coverage of *Streptococcus pneumoniae*

Table 4A: 2nd-Line Agents in the Treatment of Acute Bacterial Sinusitis in Children

Recommended Therapy and Dose	Duration	Comments
Failure of Amoxicillin (standard dose) Amoxicillin-clavulanate 40 mg/kg/day PO div tid (based on amoxicillin) PLUS Amoxicillin 40 mg/kg/day PO div tid	10 days	Rationale (extrapolated from the *Guideline for the Diagnosis and Treatment of Acute Otitis Media in Children*) ♦ Adding amoxicillin-clavulanate to amoxicillin is needed to: • provide coverage for penicillin intermediate *Streptococcus pneumoniae* and β-lactamase producing organisms • allow for an increased dose of amoxicillin without an increased dose of clavulanate thus avoiding side-effects (especially diarrhea)[37] ***Note: If patient has failed high dose amoxicillin therapy, amoxicillin-clavulanate alone is adequate to cover β-lactamase producing organisms:*** • ***ratio of amoxicillin-clavulanate should be 7:1*** • ***due to time dependent killing of amoxicillin, the working group recommends TID dosing of amoxicillin-clavulanate***
or		
Cefuroxime axetil 40 mg/kg/day PO div bid	10 days	♦ Provides best coverage of all oral cephalosporins against penicillin intermediate strains of *Streptococcus pneumoniae* and provides good coverage of *Haemophilus/Moraxella/Staphylococcus aureus* ♦ Due to poor taste of suspension recommend tablets if possible: • can crush tablets and put in palatable fluid ♦ If cefuroxime suspension/tablets not tolerated, cefprozil (30 mg/kg/day PO div bid) can be considered. Compared to cefuroxime, it has a better taste but inferior coverage of *Haemophilus* and penicillin resistant *Streptococcus pneumoniae*.
β-Lactam Allergy Erythromycin-sulfisoxazole 40 mg/kg/day PO div tid (based on erythromycin)	10 days	
or		
Azithromycin 10 mg/kg PO first day then 5 mg/kg PO daily	1 day 4 days	♦ Macrolide use should be restricted for the following reasons: • macrolide resistance is increasing in Alberta • macrolides have been shown, in acute otitis media, to be less efficacious against *Haemophilus influenzae* and *Streptococcus pneumoniae* than amoxicillin-clavulanate
or		
Clarithromycin 15 mg/kg/day PO div bid	10 days	

Table 4B: 2nd-Line Agents in the Treatment of Acute Bacterial Sinusitis in Adults

Recommended Therapy and Dose	Duration	Comments
Cefuroxime axetil 500 mg PO bid	10 days	♦ Provides best coverage of all oral cephalosporins against penicillin intermediate strains of *Streptococcus pneumoniae* and provides good coverage of *Haemophilus/Moraxella/Staphylococcus aureus*
or		
Amoxicillin-clavulanate 500 mg PO tid	10 days	
β-Lactam Allergy		
Azithromycin 500 mg PO first day then 250 mg PO daily	1 day 4 days	♦ Macrolide use should be restricted for the following reasons: • macrolide resistance is increasing in Alberta • macrolides have been shown, in acute otitis media, to be less efficacious against *Haemophilus influenzae* and *Streptococcus pneumoniae* than amoxicillin-clavulanate
or		
Clarithromycin 500 mg PO bid	7-10 days	
or		
Levofloxacin 500 mg PO daily	7-10 days	♦ Due to broad spectrum and potential for increased resistance, this should be reserved for patients with β-lactam allergy or those who have failed previous antibiotic therapy.
or		
Moxifloxacin 400 mg PO daily	7-10 days	♦ Due to broad spectrum and potential for increased resistance, this should be reserved for patients with β-lactam allergy or those who have failed previous antibiotic therapy.
or		
Gatifloxacin 400 mg PO daily	7-10 days	♦ Due to broad spectrum and potential for increased resistance, this should be reserved for patients with β-lactam allergy or those who have failed previous antibiotic therapy.

Table 5: Antibiotic Agents in the Treatment of Chronic Bacterial Sinusitis

Recommended Therapy	Paediatric Dose	Duration*	Adult Dose	Duration*
Amoxicillin-clavulanate	40 mg/kg/day PO div tid	3 weeks	500 mg PO tid	3 weeks
or				
Clindamycin	40 mg/kg/day PO div tid or qid	3 weeks	300 mg PO tid or qid	3 weeks

Note: Longer duration for paediatric and adult patients may be required in exceptional circumstances.