Health Policy & Clinical Effectiveness Program

Evidence-Based Care Guideline

For management of

Acute Bacterial Sinusitis

in children 1 to 18 years of age [1]

Original Publication Date: 04-27-01
Revision Publication Date: 7-7-06
New search August, 2006 (see Development Process section)

Target Population

Inclusions: These guidelines are intended primarily for use in children 1 to 18 years of age with suspected acute bacterial sinusitis (ABS).

Exclusions: These guidelines do not address all considerations needed to manage children:

- under 1 year of age
- with chronic sinusitis
- with identified or suspected periorbital, orbital or intracranial abscess
- with cystic fibrosis
- with underlying anatomic paranasal abnormalities
- with ciliary dyskinesia
- with immune deficiencies

Target Users

Includes but is not limited to (in alphabetical order):

- allergists
- clinicians caring for inpatients
- emergency medicine physicians
- ophthamologists [2]
- otolaryngologists [3]
- patient care staff
  - nurse practitioners
  - nurses
  - pharmacists
- patients and families
- physicians in training
- primary care providers
- radiologists

Introduction

References in parentheses ( ) Evidence strengths in [ ] (See last page for definitions)

Little new evidence on the management of acute bacterial sinusitis (ABS) in children has been published since the original publication of this guideline. Changes for this revision include:

- the guideline recommendations have been updated to reflect current antibiotic prescribing patterns
- stronger evidence is cited to support recommendations regarding:
  - the lack of benefit of over-the-counter cough preparations, and
  - the need to discuss parental and physician views and expectations for the office visit in the management of ABS
- a new appendix listing likelihood ratios (LRs) for clinical signs and symptoms and diagnostic studies for ABS in children, and an introduction to the use of these LRs.

ABS is a bacterial infection of the paranasal sinuses lasting less than 30 days in which symptoms resolve completely *(Wasserfallen 2004 [S], AAP 2001 [S])*. It is a disorder that frequently presents in the primary care setting *(AAP 2001 [S], Brook 2000 [S,E], Dowell 1998a [E])*. See Table 1 for clinical signs and symptoms consistent with a diagnosis of ABS.

Sinusitis accounted for 9% of all pediatric antibiotic prescriptions written in 2002. Studies of the epidemiology and natural history of the condition suggest that spontaneous resolution of ABS ranges from 30% to 80% *(Anon 2004 [S,E])*.

A variety of conditions affecting the upper respiratory tract can confound the accurate diagnosis and appropriate treatment of ABS. An accurate differentiation of the more common upper respiratory infections (URIs) from sinusitis will reduce inappropriate use of antibiotics in children with URIs

[1] Please cite as: **Acute Bacterial Sinusitis Guideline Team, Cincinnati Children's Hospital Medical Center:** Evidence-based care guideline for medical management of Acute Bacterial Sinusitis in children 1 through 17 years of age, http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/sinus.htm , Guideline 16, pages 1-17, July 7, 2006.

[2] ophthalmologist = eye physician

[3] otolaryngologist = ENT, ear/nose/throat physician

Table 1: Clinical Signs and Symptoms Consistent With a Diagnosis of Acute Bacterial Sinusitis

Acute bacterial sinusitis	Acute severe bacterial sinusitis
Characterized by: • persistence of upper respiratory symptoms for greater than 10 days without improvement *(Wald 1984 [B], Wald 1981 [B], Brook 2000 [S,E], Isaacson 1996 [S], Wald 1994 [S])* AND • nasal congestion and nasal discharge of any quality (i.e., may be either thin and milky or thick and purulent) *(Wald 1984 [B], Wald 1981 [B], Aitken 1998 [C], Kogutt 1973 [D], McLean 1970 [D], Gungor 1997 [S], Wald 1994 [S], Williams 1993 [S], Fireman 1992 [S], Ott 1991 [S], Dowell 1998a [E])* • persistent cough which is often more severe at night is often present *(Wald 1984 [B], Wald 1994 [S])* **Note:** Less common complaints may include: • low-grade fever *(Wald 1984 [B], Aitken 1998 [C], McLean 1970 [D])* • sore throat or ear discomfort *(Brook 2000 [S,E], Zacharisen 1998 [S])* • fatigue *(Brook 2000 [S,E], Zacharisen 1998 [S])* • malodorous breath *(Wald 1991 [C], Lusk 1997 [S])* • intermittent periorbital edema or facial swelling *(Zacharisen 1998 [S], Wald 1994 [S])* • facial or tooth pain *(Wald 1991 [C], Zacharisen 1998 [S], Isaacson 1996 [S], Wald 1994 [S])*	A less common presentation and may present with the same symptoms described to the left but is differentiated from ABS by severity, rather than persistence, of symptoms: • ill-appearing child *(AAP 2001 [S], Fireman 1992 [S])* AND • fever higher than 39° C (102.2° F) *(Wald 1984 [B], AAP 2001 [S], Wald 1994 [S], Fireman 1992 [S])* AND • purulent nasal discharge, typically 3 to 4 days duration *(AAP 2001 [S], Wald 1994 [S], Fireman 1992 [S])*
Other conditions that present with symptoms similar to ABS to be considered in the differential diagnosis include: recurrent viral URI; allergic rhinitis; cough-variant asthma; enlarged adenoids deviated nasal septum; choanal atresia; nasal foreign body; neoplasm *(Williams 1993 [S])* gastroesophageal reflux disease; nasal polyp *(Isaacson 1996 [S], Williams 1993 [S])*	

(Anon 2004 [S,E], Dowell 1998b [E], Dowell 1998a [E]). See Table 1. Risk of serious bacterial complications must also be considered *(Oxford 2005 [D])*.

The amount of quality evidence for diagnosis and treatment of pediatric ABS is limited compared to the frequency of its occurrence *(Nyquist 1998 [D], Wasserfallen 2004 [S], Contopoulos-Ioannidis 2003 [S], Lau 1999 [S])*. As the causative organisms in pediatric ABS and otitis media are identical, where evidence was minimal or non-existent, literature from pediatric otitis media studies was extrapolated for use in treatment recommendations *(Parsons 1996 [E])*. In the absence of quality evidence, expert local consensus was used. Because scant evidence exists concerning the management of a child less than 1 year of age with ABS, this guideline is limited to children 1 year of age and older.

Areas of uncertainty offering challenges in the management of ABS include:

- clinical criteria for defining ABS in children;
- specific parameters for effective antibiotic management of ABS in children.

The objectives of this guideline are to:

- improve the recognition of clinical signs and symptoms consistent with the diagnosis of ABS
- improve the use of appropriate radiologic studies in the diagnosis of ABS
- improve the judicious use of antibiotics in the treatment of ABS
- outline parameters for appropriate referral to and integration of subspecialty services.

Etiology

Acute bacterial sinusitis is an inflammation of the paranasal sinus mucous membrane caused by bacterial overgrowth in a closed cavity. The pathogens most commonly isolated in studies that have included maxillary sinus aspirate in children are listed in Table 2. Due to various parameters which affect prevalence, current surveillance monitoring in the local community might demonstrate a different distribution.

Table 2: Pathogens in Pediatric Acute Bacterial Sinusitis

Organism	Proportion (%)
Streptococcus pneumoniae	25 to 30%
Haemophilus influenzae	15 to 20%
Moraxella catarrhalis	15 to 20%
Streptococcus pyogenes	Up to 5%
No identified organism	30%

(Wald 1984 [B], Wald 1981 [B])

Note: Pathogens may be different in individuals with chronic sinusitis and in those with underlying chronic conditions such as cystic fibrosis *(Brook 1981 [C], Muntz 1991 [D])*.

Incidence

Children two to five years of age average six to eight URIs per year. Up to 7% of these pediatric URIs become complicated by ABS *(Wald 1991 [C])*. It is estimated that antibiotic treatment exclusively for sinusitis accounts for 5% of office visits by preschool children seen during winter months *(Aitken 1998 [C])*.

Local experience in one practice of 20 pediatricians indicates that 10% of total office visits seen in a single year were related to sinusitis (acute, chronic or follow-up) *(Group Health Associates 2004 [O])*.

Predisposing Factors:

The most common predisposing factors are viral URIs, allergic inflammation *(Wald 1981 [B])*, and exposure to smoke *(Kakish 2000 [C])*.

Guideline Recommendations

Assessment and Diagnosis

See Table 1 for clinical signs and symptoms consistent with a diagnosis of ABS.

Clinical Assessment

1. It is recommended that the diagnosis of ABS be made clinically in the presence of a constellation of signs and symptoms of **at least 10 days duration without improvement** *(Wald 1984 [B], Wald 1981 [B], Aitken 1998 [C], Wald 1991 [C])*. No single symptom or sign is specific for the diagnosis of ABS. See Appendix 1 for likelihood ratios for clinical signs and symptoms.

   Note 1: The 10-day duration is suggested because it has been shown that, in most children with uncomplicated URI, improvement is seen on average by 10 days *(Wald 1984 [B], Wald 1981 [B], Wald 1991 [C])*.

   Note 2: A less common presentation, acute severe bacterial sinusitis, represents a more toxic form of ABS in which severity of symptoms, rather than persistence of symptoms, is consistent with the diagnosis *(Wald 1994 [S], Fireman 1992 [S])*. See Table 1.

2. It is recommended that the character of the nasal discharge **not** be used to make a diagnosis or as an indication for antibiotic treatment. The quantity, quality, and color of nasal discharge are not helpful in differentiating ABS from other upper respiratory illnesses (e.g. common cold, allergic rhinitis) *(Wald 1981 [B], Aitken 1998 [C], McLean 1970 [D], Gungor 1997 [S], Wald 1994 [S])*.

   Note: Physical exam is likely to reveal purulent nasal discharge and/or posterior oropharyngeal drainage. These findings, however, are non-specific and of little diagnostic usefulness *(Wald 1981 [B], McLean 1970 [D], Williams 1993 [S], Fireman 1992 [S])*.

Radiologic Assessment

3. It is recommended that radiologic studies **not** be routinely obtained in the initial management of patients with suspected uncomplicated ABS *(Engels 2000 [M], Schwartz 2001 [C], AAP 2001 [S], McAlister 2000 [E], Diament 1992 [E])*. See Appendix 1 for likelihood ratios for radiologic studies.

   Note 1: Abnormalities of the paranasal sinuses are found frequently on conventional radiographs and computed tomography (CT) scans in children **without** clinical evidence of sinusitis (see Table 3) *(Rak 1991 [C], Glasier 1989 [C], Diament 1987 [C], Glasier 1986 [C], Odita 1986 [C], Shopfner 1973 [C], Maresh 1940 [D])*.

   Note 2: The presence of a URI alone (without sinusitis) can result in mucosal thickening and abnormal findings in the paranasal sinuses on plain radiographs and CT scans *(Glasier 1989 [C], Glasier 1986 [C], Shopfner 1973 [C], Gwaltney 1994 [D])*.

   Note 3: Imaging findings may persist well after symptoms improve. CT abnormalities with the common cold may last up to two weeks after symptomatic improvement *(Gwaltney 1994 [D])*. Magnetic resonance imaging (MRI) changes in patients with symptoms of ABS may last more than eight weeks *(Leopold 1994 [C])*.

   Note 4: "Limited" sinus CT lacks sensitivity in identifying air-fluid levels *(Gross 1991 [C])*, suboptimally visualizes the osteomeatal complex 30% of the time, and misses 20 to 30% of the findings found on full CT *(Wippold 1995 [C])*.

4. It is recommended, for older children with persistent clinical findings after unsuccessful therapy, or for children with clinical evidence of orbital or intracranial complications of ABS, that the decision to perform radiologic studies be made in collaboration with the consulting ophthalmologist or otolaryngologist *(Oxford 2005 [D], Vazquez 2004 [D], AAP 2001 [S], Local Expert Consensus [E])*. See Table 4 for radiologic modalities and Table 5 for description of complications.

   Note 1: An otolaryngology or ophthalmology consultation prior to obtaining radiologic studies in this patient population may reduce the need for an early study and limit repeat radiation exposure *(Local Expert Consensus [E])*.

   Note 2: A clear or normal Water's view (occipitomental) may be helpful in ruling out significant maxillary sinus disease *(Ros 1995 [D], Lau 1999 [S], Wald 1988 [E])*.

Table 3: Abnormal Imaging in Children without Upper Respiratory Symptoms

Age Range	Imaging Mechanism	% Abnormal
*6 mo to 15yrs	Plain films	15 to 57%
**Infants and children	CT scan	18 to 67%
***15 to 85yrs	MRI	80%

**(Diament 1987 [C], Odita 1986 [C], Shopfner 1973 [C], Maresh 1940 [D])*
***(Glasier 1989 [C], Glasier 1986 [C])*
****(Rak 1991 [C])*

Table 4: Radiologic Modalities for Suspected Complications of Acute Bacterial Sinusitis

Indication	Modality
Suspected subperiosteal or orbital abscess	Contrast enhanced CT scan of orbits (thin section)
Suspected intracranial complications	Contrast enhanced CT or MRI of brain

(Vazquez 2004 [D], AAP 2001 [S], McAlister 2000 [E], Local Expert Consensus [E])

Laboratory Assessment

5. It is recommended that routine laboratory testing such as a complete blood count (CBC) or nasopharangeal culture **not** be obtained in the initial evaluation in children with uncomplicated ABS *(Clement 1998 [E])*. See Appendix 1 for likelihood ratios for laboratory studies.

   Note: Organisms recovered from nasopharyngeal washings and throat culture do not reflect the organisms found in sinus aspirate *(Wald 1981 [B])*.

6. It is recommended that sinus aspiration and bacterial culture **not** be obtained for use in the initial evaluation and management of the child with uncomplicated ABS. They are recognized as the "gold standard" for definitive diagnosis of bacterial sinusitis and may need to be considered under the following situations *(Wald 1981 [B])*:
   - severe illness or toxic-looking child
   - immunocompromised child
   - presence of suppurative or intracranial complications.

Management

General

The treatment of pediatric ABS is best considered in light of the duration and severity of symptoms and the increasing prevalence of resistant strains of a common sinus pathogen, *Streptococcus pneumoniae*. The treatment recommendations for this guideline were developed with a focus on antimicrobial activity against *S. pneumoniae* in an era of increasing penicillin resistance. It is prudent for clinicians to consider use of the most narrow-spectrum agent that is active against the likely pathogens for the initial antimicrobial treatment of ABS in children *(Dowell 1998a [E])*.

See Appendix 2 for antibiotic dosages.

Antibiotic Treatment

7. It is recommended that high-dose amoxicillin (80 to 90 mg / kg / day) or amoxicillin-clavulanate (with high-dose amoxicillin component) be first-line therapy for most patients with pediatric ABS *(Wald 1986 [B], AAP 2001 [S], Nash 2001 [S], Dowell 1999 [E], Friedland 1994 [E], Local Expert Consensus [E])*. Treatment duration is 10 to 14 days to minimize the development of bacterial resistance *(Morris 2005 [M], Local Expert Consensus [E])*. See Appendix 2.

   Note 1: Approximately 65% of the *S. pneumoniae* isolated from non-sterile sites of children in Cincinnati in outpatient settings are resistant to penicillin *(Cincinnati Children's Hospital Medical Center 2005 [O])*.

   Note 2: It is recognized that the rates of *S. pneumoniae* resistance to penicillin are increasing nationally and locally *(Butler 1996 [C], Breiman 1994 [C])* and failure with amoxicillin is likely to be due to resistant *S. pneumoniae*, *H. influenzae*, or *M. catarrhalis* *(Whitney 2000 [D])*. Resistance of *S. pneumoniae* to penicillin (including amoxicillin) is mediated through alterations in the penicillin-binding proteins. Using high doses of amoxicillin saturates the

penicillin-binding proteins, and is therefore considered a reasonable antibiotic option *(Schrag 2001 [A], Dagan 2001 [C], Dowell 1999 [E])*. The clavulanic acid component of amoxicillin-clavulanate is active against resistant *H. influenzae* and *M. catarrhalis* (*β*-lactamase enzyme) *(Dagan 2000 [A], Wald 1986 [B])*.
Note 3: Toxic-appearing children who demonstrate poor tolerance of oral intake may require initial parenteral therapy either as an outpatient or a short inpatient stay. Reassessment after initial stabilization may avoid unnecessary imaging and referral early in the course of therapy *(Local Expert Consensus [E])*.

8. It is recommended that cefuroxime, cefpodoxime, and cefdinir be second-line therapy for pediatric ABS *(Pichichero 1997 [C], Felmingham 2005 [D], Jacobs 2003 [D], Jacobs 1999 [D], Anon 2004 [S,E], Dowell 1999 [E])*. Treatment duration is 10 to 14 days to minimize the development of bacterial resistance *(Morris 2005 [M], Local Expert Consensus [E])*. See Appendix 2.

9. It is recommended, if clinical failure with a second-line agent occurs, that alternative agents or combination therapy be considered:
   - IM ceftriaxone (5 days)
   - combination therapy with adequate gram-positive and -negative coverage, such as clindamycin plus cefixime

   (Anon 2004 [S,E], AAP 2001 [S], Local Expert Consensus [E]). See Appendix 2.

10. It is recommended, in the penicillin-allergic patient, that the following be used:
    - non-type I [d]: cefdinir, cefuroxime, or cefpodoxime
    - type I [e]: clarithromycin or azithromycin

    (AAP 2001 [S], Local Expert Consensus [E]). See Appendix 2.

    Note: Macrolides, azilides, and sulfa containing agents are not considered standard therapeutic agents due to either a lack of efficacy data, increasingly resistant *S. pneumoniae* or both *(Dagan 2000 [A], Nelson 1994 [C], Wu 2004 [D], Gay 2000 [D], AAP 2001 [S])*.

Symptomatic Treatment

11. It is recommended that common agents for symptomatic treatment of cough or congestion (i.e. reduction in frequency or severity), **not** be used in the routine management of patients with ABS *(Schroeder 2004 [M], Bernard 1999 [B], Davies 1999 [B], Chang 1998 [B], McCormick 1996 [B], Taylor 1993 [B], Gadomski 1992 [O], Local Expert Consensus [E])*.

    Note 1: Studies measuring a decrease in frequency, severity, and time to resolution of cough or congestion in children with symptoms from URI found no significant difference between any of the therapeutic interventions and placebo. The therapies evaluated were antitussives, mucolytics, inhaled steroids, inhaled and oral beta$_2$-agonists, antihistamines / decongestants (brompheniramine, phenylephrine, phenylpropanolamine, dextromethorphan/ guaifenesin, oxymetolazine or "afrin"), and morphine derivatives (codeine) *(Schroeder 2004 [M], Paul 2004 [A], Bernard 1999 [B], Davies 1999 [B], Chang 1998 [B], McCormick 1996 [B], Taylor 1993 [B], Gadomski 1992 [O])*.
    Note 2: One previously common ingredient (phenylpropanolamine) of symptomatic treatment preparations has been associated with stroke, and most antihistamines, decongestants, and antitussives have not been FDA approved in children *(Kernan 2000 [D], AAP 1997 [S,E])*.
    Note 3: Although hypertonic and normal saline and balanced physiological saline nasal washes are commonly used in postoperative patients and in children with chronic sinusitis *(Shoseyov 1998 [B], Pigret 1996 [B], Nuutinen 1986 [C])* there is no evidence for their effectiveness in pediatric ABS.

Follow up

12. It is recommended that follow-up assessment for expected clinical response occur by 72 hours of antimicrobial therapy. A lack of expected clinical improvement may indicate that a change of antibiotic is necessary *(Wald 1986 [B], Dowell 1999 [E], Local Expert Consensus [E])*.

Consults and Referrals

Although children with the complications discussed below (see Table 5) are listed as exclusions to this guideline, recommendations are included here to assist the practitioner in decisions regarding consultation to specialists for these key complications.

[d] Non-type I penicillin allergy: more common; characterized by symptoms such as maculopapular, polymorphous rash, arthralgia, or emesis.
[e] Type I penicillin allergy: IgE-mediated; rare; anaphylactic reactions result in urticaria, pruritis, laryngeal edema, bronchospasm, cardiovascular collapse, and, potentially, death.

13. It is recommended that an otolaryngology and/or ophthalmology consultation be sought when signs of impending suppurative complications of ABS are present *(AAP 2001 [S], Local Expert Consensus [E])*. Such complications are rare but very serious and often result from orbital or intracranial spread of infection *(Oxford 2005 [D], Rosenfeld 1994 [D])*.

    Note 1: Preseptal cellulitis, involving only tissue anterior to the orbital septum, manifests as lid edema/erythema, conjunctivitis, and fever. It may be treated with oral antibiotics and close follow up except where toxicity or specific symptoms preclude adequate antimicrobial effectiveness by mouth *(AAP 2001 [S])*.

    Note 2: Consultation prior to imaging limits repeat radiation exposure *(Local Expert Consensus [E])*.

14. It is recommended that otolaryngology consultation be considered in cases of a moderately to severely ill child with suspected acute frontal or sphenoid sinusitis because of the potential for intracranial spread. Infection arising in either site will generally occur in a relatively older age group (>6 years), and based on the developmental anatomy of these sinuses, the clinical presentation is likely to be more severe *(Oxford 2005 [D], Herrmann 2004 [D], Wolf 1993 [F])*.

    Note 1: Acute frontal sinusitis manifests as an intense frontal headache with tenderness over the sinus itself. Spread of infection anteriorly produces periosteal edema and osteomyelitis and may manifest as doughiness of the forehead skin, known as Pott's puffy tumor. Spread of infection to the cranial vault results in meningitis or intracranial abscess *(Oxford 2005 [D])*.

    Note 2: Acute isolated sphenoid sinusitis is rare, with an estimated incidence of <1% of all sinusitis cases *(Hnatuk 1994 [S], Fearon 1979 [S], Wyllie 1973 [S])*. Acute sphenoid sinusitis represents an elusive diagnosis *(Myer 1982 [S], Sellars 1975 [S], Postma 1995 [E])*, as signs and symptoms are more variable and non-specific than those of frontal sinus disease. Nasal symptoms may be absent. Headache is severe, deep-seated and worse at night, with the pain radiating to any craniofacial region *(Myer 1982 [S], Sellars 1975 [S])*. Suppurative complications may involve any of the vital juxtaposing structures, including the cavernous sinus, intracranial cavity, orbit, pituitary gland, or abducens nerve.

Table 5: Complications of Pediatric Acute Bacterial Sinusitis

Complication	Signs and Symptoms	Intervention
Orbital cellulitis	Fever, lid edema/erythema, conjunctivitis, chemosis, altered acuity, proptosis, ophthalmoplegia, pain with eye movement, tenderness to palpation	IV antibiotics Consult: • otolaryngology and/or ophthalmology Imaging: • decision to image made in collaboration with consulting specialist
Subperiosteal abscess	Above, with proptosis and ophthalmoplegia prominent features; +/- globe displacement laterally or superiorly	
Orbital abscess	Same as for orbital cellulitis, with proptosis and chemosis prominent features; severe impairment of vision	
Cavernous sinus thrombosis and/or Intracranial infection	Spiking fevers, cranial neuropathy, mental status changes	In addition to above: Consult: • neurosurgery • infectious diseases

(Oxford 2005 [D], Vazquez 2004 [D], AAP 2001 [S])

Parental Expectations and Education

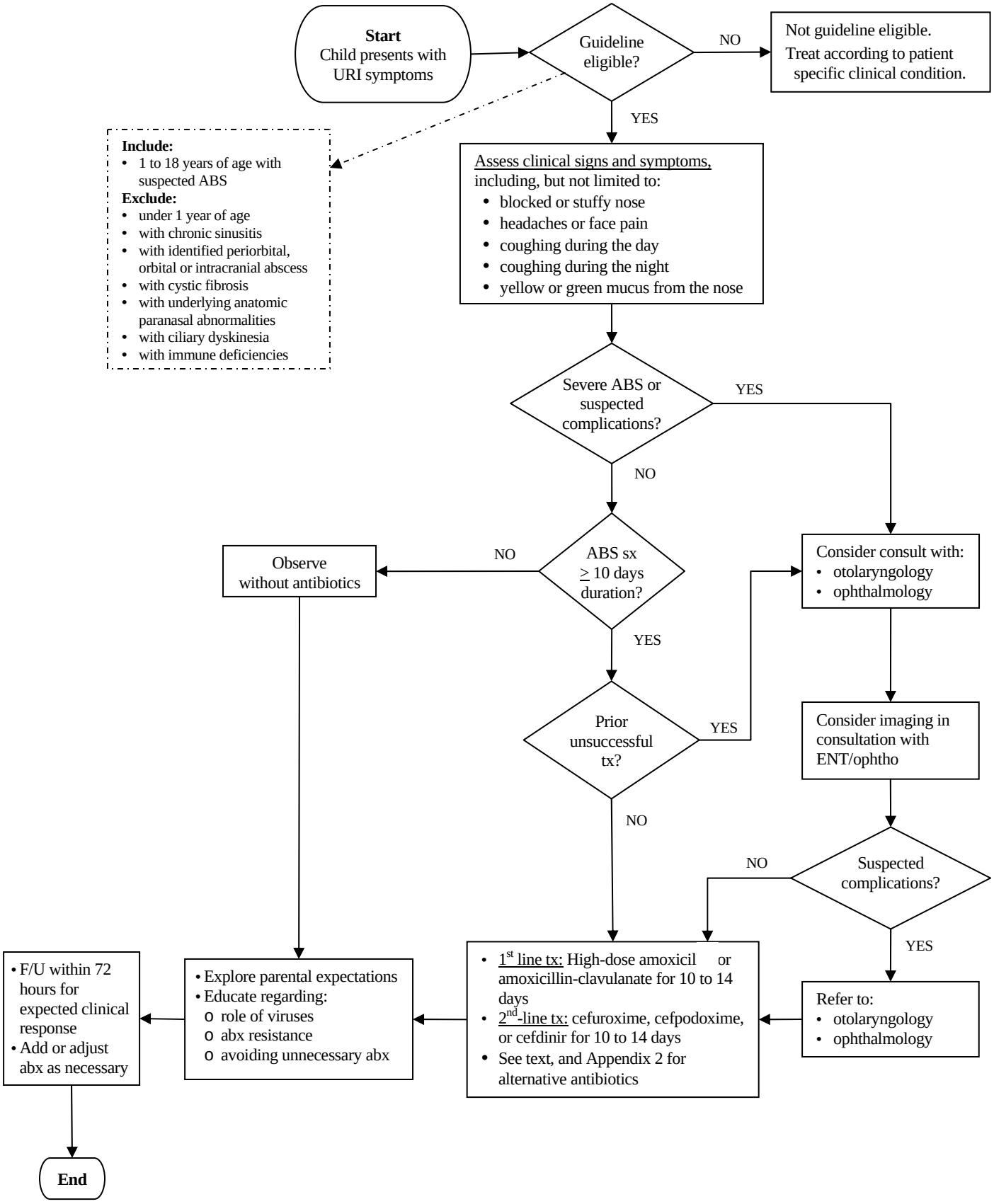
15. It is recommended that, for a child with ABS, physicians explore parental expectations concerning the office visit, parental knowledge regarding respiratory infections, and preventive behavior *(Mangione-Smith 1999 [C], Barden 1998 [C], Macfarlane 1997 [C], Varonen 2004 [O], Local Expert Consensus [E])*. Topics for discussion may include:
    - the natural history of URIs / ABS *(Roberts 1983 [A], Hamm 1996 [C])*
    - diagnostic uncertainty *(Varonen 2004 [O])*
    - viral and bacterial sources of ABS
    - role of antibiotics *(Hamm 1996 [C])*
        - appropriate use of antibiotics *(Mangione-Smith 1999 [C], Barden 1998 [C], Macfarlane 1997 [C])*
        - persistent or severe infections *(Garbutt 2001 [B], Wald 1986 [B])*
    - bacterial resistance *(Trepka 2001 [C])*
    - lack of proven efficacy for over-the-counter medications for symptom relief *(Schroeder 2004 [M])*
        - managing cough symptoms
    - observation for complications of ABS
    - prevention of URIs may decrease risk of ABS
        - handwashing *(Morton 2004 [A], Roberts 2000 [A])*
        - annual influenza vaccination *(Loughlin 2003 [D])*.

Future Research Agenda

It has been noted in a recent meta-analysis that there is a paucity of high quality primary data in the area of diagnosis and management of children suspected to have ABS *(Ioannidis 2001 [M])*. Following are some clinical questions related to guideline recommendations and of potential interest to CCHMC investigators:

1. In children with suspected ABS, what clinical signs and symptoms are most useful in identifying children most likely to benefit from antibiotics?
2. In children with suspected ABS < 10 days duration, what clinical signs and symptoms are most useful in the diagnosis of acute severe bacterial sinusitis?
3. In children with ABS, what criteria define judicious use of antibiotics, given high spontaneous cure rates for ABS and increasing global antibiotic resistance?
4. In the local community, what is the relative prevalence of *S. pneumoniae* and *H. influenzae* in children with ABS, and what is the antibiotic resistance profile of these pathogens?
5. How do clinical signs and symptoms and radiologic imaging correlate with bacterial and viral cultures from sinus puncture?

Treatment Algorithm for Acute Bacterial Sinusitis (ABS)



Appendix 1: Likelihood Ratios (LR)

A. Definition

When a health care provider evaluates a patient, he/she determines their own **"best guess"** for how likely a disease is present (or not present) at that time.
This "best guess" is dependent on:

- the disease prevalence in the community,
- the patient's underlying medical status and current presentation, and
- the health care provider's experience and knowledge of the literature.

This best guess is actually the **pre-test probability**.

What health care providers are looking for is a test which will increase (or decrease) the **likelihood** of disease in that patient, thus allowing them to decide to treat, not treat, or pursue further diagnostic work up. This change in "best guess" after diagnostic testing results in the **post-test probability** of disease.

Finding the post-test probability is done easily with **likelihood ratios** (see next page) and a **nomogram** (see figure)**.**

> What the likelihood ratio nomogram actually does is change pre-test probability to pre-test odds, multiply by the LR to get post-test odds, then change post-test odds back to post-test probability…all without having to manually perform complex calculations.

Fortunately, likelihood ratios (**LR**s) are determined by inherent properties of the diagnostic test, not the prevalence of disease in the population. By knowing the likelihood ratio(s) for any or all given tests, health care providers can determine which test is most informative and appropriate to use.

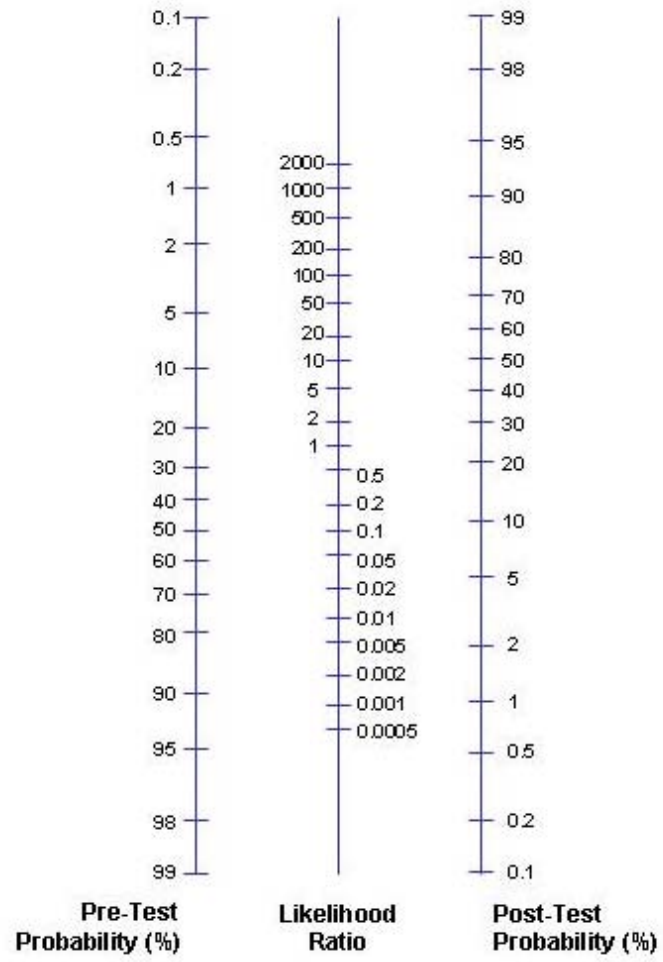


Figure: Likelihood Ratio Nomogram

B. Rule of thumb:

An **LR value**

- greater than 10 is very helpful in increasing diagnostic certainty
  the presence of clinical sign is 10 times more likely to be present in a child with ABS than in a child without ABS
- of 1 is not helpful
  the presence of clinical sign is just as likely to be present in a child with ABS as in a child without ABS
- less than 0.2 is very helpful in ruling out the condition
  the presence of clinical sign is one-fifth as likely to be present in a child with ABS as in a child without ABS

C. How to calculate a Likelihood Ratio from sensitivity and specificity data:

LR for a positive result = (sensitivity) / (1-specificity) LR for a negative result = (1-sensitivity) / (specificity)

For more information on LRs see: http://www.cebm.utoronto.ca/glossary/lrs.htm#top

See likelihood ratios for common signs and symptoms for use in diagnosing acute bacterial sinusitis next page.

Appendix 1: Likelihood Ratios (LR), continued

D. Likelihood ratios (LRs) for clinical signs/symptoms of acute bacterial sinusitis in children

Sign/Symptom	Age range	LR (+)
Presence of symptoms for at least 10 days AND At least one of the following present: • blocked or stuffy nose • headaches or face pain • coughing during the day • coughing during the night • yellow or green mucus from the nose	6 months to 18 years	11.6

(Garbutt 1999 [C])

E. Likelihood ratios (LRs) for diagnostic study results of acute bacterial sinusitis in children

Imaging or Aspiration Test	"Gold standard" comparison	LR (+)	LR (-)
CT scan of ethmoid sinuses in infants: opacification* *(Ioannidis 2001 [M], Glasier 1989 [C])*	Clinically diagnosed URI	1.7	0.5
CT scan of maxillary sinuses in infants: opacification* *(Ioannidis 2001 [M], Glasier 1989 [C])*	Clinically diagnosed URI	1.5	0.3
Plain radiograph: any abnormality** *(Ioannidis 2001 [M], Jannert 1982 [C])*	Specified clinical criteria	2.8	0.3
Plain radiograph: any abnormality** *(Ioannidis 2001 [M], Van Buchem 1992 [C])*	Non-clear fluid in sinus aspirate	1.1	0.9
Plain radiograph: any abnormality** *(Ioannidis 2001 [M], Watt-Boolsen 1977 [C])*	Any fluid in sinus aspirate	2.7	0.2
Sinus aspirate: non-clear fluid *(Ioannidis 2001 [M], Van Buchem 1992 [C])*	Pathogens in sinus aspirate	0.9	1.0
Ultrasound: any abnormality *(Ioannidis 2001 [M], Van Buchem 1992 [C])*	Any abnormality** on plain radiograph	1.7	0.9
Ultrasound: any abnormality *(Ioannidis 2001 [M], Van Buchem 1992 [C])*	Non-clear fluid in sinus aspirate	0.5	1.2
Radiograph with sinus fluid or opacity *(Engels 2000 [M])*	Sinus puncture	3.65	0.34
Radiograph with sinus fluid or opacity or mucous membrane thickening *(Engels 2000 [M])*	Sinus puncture	2.31	0.16

*****excluding hypoplasia
**typically including mucous thickening, opacification, or air-fluid level

NOTE: The figures in these tables highlight the fact that the presence of clinical signs and symptoms of acute bacterial sinusitis (ABS) are generally more clinically useful in making the diagnosis of ABS than radiologic or laboratory studies. The clinical signs/symptoms positive likelihood ratio of 11.6 indicates a much greater probability of ABS when clinical findings are present, than the positive likelihood ratios of radiologic or laboratory studies, which range from 0.5 to 3.65. Also, a negative radiologic or laboratory test result is not helpful in ruling out ABS, as these negative likelihood ratios range from 0.16 to1.2.

Rule of thumb:

An **LR value**

- greater than 10 is very helpful in increasing diagnostic certainty
- of 1 is not helpful
- less than 0.2 is very helpful in ruling out the condition

Appendix 2: Antibiotic Therapy for Acute Bacterial Sinusitis

Antibiotic	Dose, Frequency & Max Daily Dose	Oral Dosage Forms	Relative Cost	Comments
First-line therapy				
amoxicillin	80 to 90 mg / kg / day Max daily dose 2 gm taken as: 40 to 45 mg / kg BID or 25 to 30 mg / kg TID	Suspension (per 5mL): 125, 200, 250 or 400 mg Capsules 250 or 500 mg Chewable tablet: 125, 200, 250, 400 mg Tablet: 500 or 875 mg	Low	• High-dose for resistant *S. pneumoniae* • 400 mg / 5ml formulation not covered by Ohio Medicaid (June, 2006)
amoxicillin-clavulanate (Augmentin®)	(amoxicillin) 80 to 90 mg / kg / day Max daily dose: 2 gm taken as: 40 to 45 mg / kg BID	amoxicillin component: Suspension (per 5mL) 125, 200, 250, 400, 600 mg Chewable tablet: 125, 200, 250, 400 mg Tablet: 500, 875 mg	High	Maximum dose of clavulanate not to exceed 6.4 mg / kg / day, to minimize diarrhea
Second-line therapy (first-line for non-type I [f] penicillin-allergic patient)				
cefuroxime (Ceftin®)	NOTE: Tablets and suspension are not bioequivalent and are not substitutable on a mg-for-mg basis. Suspension: 30 mg / kg / day Max daily dose: 1 gm taken as: 15 mg / kg BID Dosage form: (per 5 mL): 125 or 250 mg	Tablet: 500 mg / day taken as: 250 mg BID Dosage form: 250, 500 mg	High	Unpleasant taste *(Steele 1997 [O])*
cefpodoxime (Vantin®)	10 mg / kg / day Max daily dose: 800 mg taken as: 5 mg / kg BID	Suspension (per 5mL): 50, 100 mg Tablet: 100, 200 mg	High	Not covered by Ohio Medicaid (June, 2006)
cefdinir (Omnicef®)	14 mg / kg / day Max daily dose: 600 mg taken as: 7 mg / kg BID or 14 mg / kg once a day	Suspension (per 5 mL): 125, 250 mg Capsule: 300 mg	High	
Alternative Agents				
clindamycin (Cleocin®)	30 mg / kg / day Max daily dose: 1.8 g taken as: 10 mg / kg TID	Suspension (per 5 mL): 75 mg Capsule: 75, 150 or 300 mg	Med	• If *S. pneumoniae* is identified as a pathogen *(Anon 2004 [S,E], AAP 2001 [S])* • Use in combination with cefixime or other gram-negative coverage *(Anon 2004 [S,E])*
ceftriaxone (Rocephin®)	50 mg / kg Max daily dose: 1 gm taken as: once daily for 5 days *(Anon 2004 [S,E])*	Intramuscular	High	For treatment failure *(Anon 2004 [S,E], AAP 2001 [S])*
Type I [g] penicillin-allergic patient therapy				
clarithromycin (Biaxin®)	15 mg / kg / day Max daily dose: 1 gm taken as: 7.5 mg / kg BID	Suspension (per 5 mL): 125 or 250 mg 250 and 500 mg tablets	High	• Not covered by Ohio Medicaid (June, 2006) • Unpleasant taste *(Steele 1997 [O])*
azithromycin (Zithromax®)	day 1 = 10 mg / kg day 2 to 5 = 5 mg / kg Max daily dose: 500 mg taken: once a day or 20 mg / kg once daily for 3 days Max daily dose: 500 mg	Suspension (per 5 mL): 100 or 200 mg Tablet 250, 500 mg	High	• Not covered by Kentucky Medicaid (June, 2006) • Not used as standard therapeutic agents due to lack of efficacy and/or increasingly resistant *S. pneumoniae (Gay 2000 [D])*

[f] Non-type I penicillin allergy: more common; characterized by symptoms such as maculopapular, polymorphous rash, arthralgia, or emesis.

[g] Type I penicillin allergy: IgE-mediated; rare; anaphylactic reactions result in urticaria, pruritis, laryngeal edema, bronchospasm, cardiovascular collapse, and, potentially, death.

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Development Process

The process by which this guideline was developed is documented in the Guideline Development Process Manual; a Team Binder maintains minutes and other relevant development materials. The recommendations contained in this guideline were formulated by an interdisciplinary working group which performed systematic and critical literature reviews, using the grading scale that follows, and examined current local clinical practices.

To select evidence for critical appraisal by the group, the Medline, EmBase and the Cochrane databases were searched for dates of Jan 2000 through December, 2005 to generate an unrefined, "combined evidence" database using a search strategy focused on answering clinical questions relevant to ABS and employing a combination of Boolean searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and "natural language" searching on words in the title, abstract, and indexing terms. The citations were reduced by: eliminating duplicates, review articles, non-English articles, and adult articles. The resulting abstracts were reviewed by a methodologist to eliminate low quality and irrelevant citations. During the course of the guideline development, additional clinical questions were generated and subjected to the search process, and some relevant review articles were identified. April, 2001 was the last date for which literature was reviewed for the previous version of this guideline. The details of previous review strategies are not documented. However, all original citations were reviewed for appropriateness to this revision.

CCHMC Grading Scale			
M	Meta-analysis or Systematic Review	S	Review Article
A	Randomized controlled trial: large sample	E	Expert opinion or consensus
B	Randomized controlled trial: small sample	F	Basic Laboratory Research
C	Prospective trial or large case series	L	Legal requirement
D	Retrospective analysis	Q	Decision analysis
O	Other evidence	X	No evidence

A search using the above criteria was conducted for dates of December, 2005 through July, 2006. Six relevant articles were selected as potential future citations for the guideline. However, none of these references were determined to require changes to the 2006 version of the recommendations.

Appropriate companion documents have been developed to assist in the effective dissemination and implementation of the guideline. Experience with implementation of the original publication of this guideline has provided learnings which have been incorporated into this revision. The outcome measures monitored as of the revision publication date are:

- percent of guideline-eligible patients seen in the Emergency Department who are prescribed antibiotics who have had symptoms $\geq$ 10 days duration or who are severely ill;
- percent of guideline-eligible patients seen in the Emergency Department and with symptoms $\geq$ 10 days duration who are prescribed either high-dose amoxicillin or high-dose amoxicillin-clavulanate.

Once the guideline has been in place for three years, the development team reconvenes to explore the continued validity of the guideline. This phase can be initiated at any point that evidence indicates a critical change is needed.

Recommendations have been formulated by a consensus process directed by best evidence, patient and family preference and clinical expertise. During formulation of these guidelines, the team members have remained cognizant of controversies and disagreements over the management of these patients. They have tried to resolve controversial issues by consensus where possible and, when not possible, to offer optional approaches to care in the form of information that includes best supporting evidence of efficacy for alternative choices.

The guidelines have been reviewed and approved by clinical experts not involved in the development process, and other individuals as appropriate to their intended purposes.

The guideline was developed without external funding. All Team Members and Clinical Effectiveness support staff listed have declared whether they have any conflict of interest and none were identified.

Copies of this Evidence-Based Care Guideline (EBCG) and its companion documents are available online and may be distributed by any organization for the global purpose of improving child health outcomes. Website address: http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm . Examples of approved uses of the EBCG include the following:

- copies may be provided to anyone involved in the organization's process for developing and implementing evidence-based care guidelines;
- hyperlinks to the CCHMC website may be placed on the organization's website;
- the EBCG may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at HPCEInfo@cchmc.org for any EBCG, or its companion documents, adopted, adapted, implemented or hyperlinked by the organization is appreciated.

NOTE: These recommendations result from review of literature and practices current at the time of their formulations. This guideline does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the guidelines to meet the specific and unique requirements of individual patients. Adherence to this guideline is voluntary. The physician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.

For more information about these guidelines, their supporting evidences and the guideline development process, contact the Health Policy & Clinical Effectiveness office at: 513-636-2501 or HPCEInfo@cchmc.org

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