OVERVIEW OF THE INPATIENT MANAGEMENT OF ASTHMA AT CHILDREN’S HOSPITAL

Asthma is a chronic inflammatory disease of the airways that affects millions of children in the United States. The etiology of asthma is multi-factorial, including genetic predisposition to atopy (allergy), bronchial hyperresponsiveness (twitchy, sensitive airways), and early programming of the immune system in response to environmental and infectious stimuli. The hallmarks of medical therapy are bronchodilation and decreasing airways inflammation. However, asthma education and ensuring appropriate outpatient follow-up are also key parts of the inpatient management.

In an effort to promote an evidence-based approach to asthma, the National Heart Lung and Blood Institute (NHLBI) convened an expert panel in 1991, and again in 1997 and 2001, to establish best practice guidelines for the diagnosis and management of asthma. These NHLBI Guidelines are the foundation upon which the Children’s Hospital clinical pathways are based.

**Diagnosing Asthma**

The 3 components of asthma diagnosis are: 1) the history or presence of episodic signs/symptoms of airflow obstruction, e.g. wheeze, dyspnea, shortness of breath; 2) airflow obstruction that is at least partially reversible; and 3) the exclusion of other diagnoses, e.g. foreign body aspiration, vascular rings, and vocal cord dysfunction. Children less than 3-years-old wheeze most commonly in conjunction with acute viral respiratory infections. Many of these children will have remission of their symptoms when they reach school age (transient wheezers) while some will continue to wheeze as they get older (persistent wheezers). Clinicians often label patients in the group of transient wheezers as having “reactive airways disease” rather than “asthma.” Both diagnoses are used commonly at Children’s. No matter what the label, children with repeated episodes of airways obstruction associated with respiratory tract infections are treated the same as those with non-infectious triggers, with emphasis on bronchodilation and anti-inflammatory therapy.

**Highlights of Inpatient Asthma Management**

1. The medical management of acute asthma is based on providing bronchodilation with short-acting beta agonists (albuterol) and at times with the anticholinergic agent, ipratropium (Atrovent), and decreasing airways inflammation with systemic corticosteroids (prednisone, methylprednisolone, dexamethasone).

2. Frequent reassessment of the patient’s clinical status and response to therapy followed by adjustments in medications is key!

3. Objective measures of airways obstruction (peak flow rates, spirometry, PCO2) can help you determine how well or poorly your patient is doing.

4. Look for and treat co-morbidities, and determine the patient’s asthma triggers. Common co-morbidities include gastro-esophageal reflux, sinusitis, and allergic rhinitis. Other exacerbating factors are tobacco smoke, aeroallergens (trees/grasses/molds, cat/dog dander, dust mites), exercise, cold air, and weather changes.

5. Remember that asthma is a chronic disease, and we should use the hospitalization as an opportunity to adjust the patient’s outpatient treatment plan and to educate patient and family members about asthma.
THE ASTHMA Guideline of Care:

The asthma guideline of care is placed on the front of the chart and includes, an Asthma Severity Assessment form, a Follow-up and Maintenance Plan, and an Asthma Management Plan. These are to be used in conjunction with the online orders and the RCU protocol. The Asthma Severity Assessment form guideline of care must be filled out by an RN, RT, or MD as part of the Discharge Plan. The Discharge Plan should be developed in collaboration with the patient’s primary care physician (PCP) when possible. The Asthma Management Plan must be completed and signed by a physician before the patient is discharged.

This asthma guideline of care is a TEMPLATE for the management of children hospitalized with asthma exacerbations. The Asthma Management Plan must be completed by the time of hospital discharge. The goals of the guideline are to facilitate consistent care based on current medical evidence and expert consensus and to standardize care provided by nurses, respiratory therapists, and physicians. When implemented, the guideline should help you provide high-quality care and also save time writing orders. However, not everyone with asthma should be put on the pathway. Pathways generally apply to previously healthy children whose illness is following a "typical" course. For example, the pathway is not designed for an ex-preemie with BPD or an infant with heart disease. We expect you to think critically about your patient’s individual situation. Use the guidelines as the basis of your care of the child with asthma, but you should modify them if they do not apply to your patient. Be aware that the GUIDELINES for the Management of Acute, Severe Asthma are a dynamic document, and modifications will be made based on new data.

RESPIRATORY CARE UNIT (RCU):
Beginning in the winter of 2002 we established a comprehensive treatment and family education unit/pathway (the RCU pathway/protocol) in order to facilitate the management of patients admitted for treatment of asthma. To be eligible for the RCU pathway, children need to meet the following criteria: 1) have a primary admitting diagnosis of acute asthma, 2) be ≥ 24 months old, and 3) not have other significant underlying diseases, e.g. BPD, cystic fibrosis. The RCU patients receive bronchodilator therapy determined by their clinical asthma severity score, and their treatment is protocol-based, requiring frequent RN/RT assessments using the respiratory scoring tool. Based on the clinical asthma score, the patient’s dose and/or frequency of short-acting beta agonist medication is either weaned, kept the same, or escalated. The parents/guardians are encouraged to stay with their child in order for the RN/RT/MD team to devote more time to education. The patient’s clinical score and medication doses are recorded as he/she progresses along the pathway. Families also receive an asthma educational video in addition to other asthma educational material. Patients can receive continuous beta-agonist therapy on the wards, but depending upon the severity of their exacerbations some of these children will require treatment in the ICU.

THINGS TO THINK ABOUT WHILE FILLING OUT THE ADMIT ORDERS:

DIET/IV: IV fluids/medications are not always needed. Consider hydration status, work of breathing, ability to tolerate oral corticosteroids.

ISOLATION: Upper respiratory tract infections (URIs) are the most common trigger for asthma exacerbations leading to hospitalization. The decision to isolate a patient is made by the charge nurse based on pre-established criteria. If you think an error has been made, then feel free to discuss it with them.
OXIMETRY: Oximetry is most useful as an early warning sign of deterioration in the acute phases of an asthma exacerbation when the trajectory of the disease process is unknown or still worsening. Once a child has stabilized, then re-evaluate daily whether your patient still needs to be monitored with a pulse oximeter. A room air SaO2 of ≥ 94% is reassuring, though > 90% is acceptable. Remember that oxygen saturation is not a good measure of the degree of airways obstruction. The Oximetry Guidelines have been established to help streamline oximetry. (See Copy in this section).

MEDICATIONS: (See Pathway and STD orders)
Recently we have made some changes to our recommendations for the use of albuterol. Specifically we have gone away from weight-based dosing and have introduced MDIs as an alternative to nebulized therapy. Please note that the emergency department (ED) still doses albuterol by weight, but we are no longer doing this on the wards.

1. Albuterol: This short-acting beta2-adrenergic agonist remains the bronchodilator of choice. Doses range from continuous albuterol at 30mg/hr (in the unit the continuous dose varies, but on the wards it's always 30mg/hr) to 4 puffs (=2.5 mg of albuterol by nebulizer) every 4-6 hrs. If the patient is on the RCU pathway, then the dose and frequency of albuterol are determined by the patient's asthma severity clinical score. Albuterol administered by MDI is as effective as nebulized albuterol. The conversion is 4 puffs of albuterol by MDI = 2.5 mg albuterol delivered by nebulizer. In the revised RCU pathway, the dosing interval of albuterol administration is extended before the dose per treatment is decreased. For example, a patient who is receiving albuterol 8 puffs (5 mg by neb) every 2 hours is then decreased to 8 puffs every 4 hrs and then to 4 puffs every 4 hrs. The decision to use an MDI vs. nebulizer is subjective and is based primarily on patient and physician preference. Nurses/RTs will wean the albuterol frequency per the RCU protocol, though the physician team can always alter this weaning strategy. Please note that there is a standard order to “Call HO for all changes in doses or frequency or if the patient needs a treatment before the next scheduled dose.” This is meant to be a safety net that ensures that you are aware of the changes and provides you with the opportunity to assess whether your patient is being weaned too quickly.

2. If your child is very sick you should examine the patient frequently and especially at times when the RN/RT notifies you that the child is ready to wean the albuterol dose/frequency. Remember when filling out your initial orders and admit note to make a note of the frequency and strength of albuterol dosing given in the ED. The main toxicities of albuterol with higher doses are tachycardia and tremor (common) and hypokalemia (rare).

3. Levo-albuterol (Xoponex), the R-isomer of albuterol, is an effective bronchodilator. It is more expensive than albuterol but may have fewer adverse effects. Currently it is only available in nebulized form. Levo-albuterol is not routinely used at Children’s, but it may be considered in special cases.

4. Corticosteroids: Systemic corticosteroids are the foundation of anti-inflammatory treatment for asthma exacerbations. Commonly used corticosteroids are prednisone, methylprednisolone (solumedrol), and dexamethasone. Inhaled corticosteroids are not as effective as oral or IV steroids for treating acute asthma, and we do not treat inpatient exacerbations at Children’s Hospital with inhaled corticosteroids. Oral corticosteroids are generally as effective as IV forms, so the decision to use IV preparations is based primarily
on whether the patient can tolerate PO meds. The ED physicians will frequently treat patients with 0.4-0.6 mg/kg of dexamethasone. Patients treated for asthma and then discharged from the ED will often go home to complete a 2-3 days course of dexamethasone. Patients that are admitted to the hospital will probably need longer courses. The average prednisone dose is 2-3 mg/kg/day, given as a single or divided dose, for 5-7 days. Dexamethasone is approximately 5 times more potent than prednisone, so the dose is 0.4-0.6 mg/kg/day. Dexamethasone is longer acting than prednisone, so it can be given once daily, while prednisone is usually administered bid. The average duration of a dexamethasone course for a child ill enough to be admitted to the hospital for treatment of asthma is 3-5 days. If a child is extremely ill or unable to tolerate oral corticosteroids, then you can use IV methylprednisolone 1 mg/kg either every 12 hrs or even every 6 hrs. Children with severe exacerbations or refractory symptoms may need to take oral corticosteroids for longer than 5 days. Please note that it is rarely necessary to taper a patient off of corticosteroids.

5. Ipratropium bromide (Atrovent) nebs/MDI: This is an anticholinergic agent with an excellent safety profile. It is a bronchodilator that can be added to albuterol. Data from studies performed in EDs indicate that ipratropium when added to albuterol in children presenting with severe airways obstruction can improve pulmonary function and decrease admission rates, compared to albuterol alone. However, ipratropium does not change the course of children already admitted to the hospital (J. Pediatrics 2001; 138:51-8). Thus, it is used primarily in the ED and ICU. Ipratropium bromide (Atrovent) should not be used as part of standard inpatient treatment for asthma outside of the ED or ICU.

6. Inhaled corticosteroids: Inhaled corticosteroids are the mainstay of “controller” therapy for persistent asthma, but their role in treating asthma exacerbations is limited. Increasing a patient’s inhaled corticosteroids dose may attenuate mild, out-pt, exacerbations, but it is not as effective as a short course of systemic corticosteroids. For exacerbations severe enough to warrant hospital admission, there is no role for using inhaled corticosteroids to treat the exacerbations. Rather, oral or IV corticosteroids should be used.

WHAT TO DO WHEN A CHILD WITH “RAD” IS NOT IMPROVING OR GETTING SICKER:
1. Assess the patient! A-B-C’s always come first. Check work of breathing, respiratory rate, degree of air movement (a quiet patient can be the scariest!), fatigue, ability to speak in sentences, vomiting, etc. Consider a blood gas to check PCO2 and/or CXR.

2. Reconsider your diagnosis: Consider foreign body, bronchiolitis, GERD, aspiration, pneumonia, congenital malformations, etc.

3. Consider medication changes to include adding ipratropium aerosol treatments (MDI or nebulizer), increasing albuterol dosages or frequency, and increasing the corticosteroids dose.

4. Consider the complicating factor of mucus plugging. Encourage more activity, if the patient is not too sick, encourage coughing, and also consider chest physiotherapy with the flutter device.

5. Call for help sooner rather than later. Call your senior resident and let the attending know that the child is struggling. Acutely, the PICU fellow can always help evaluate a patient who is worrisome. Consider a pulmonary consultation.
LABS:
1. Most children admitted for treatment of asthma exacerbations do not require labs.
2. If the patient is receiving continuous albuterol then electrolytes should be checked to look for hypokalemia and acidosis.
3. If the patient is in severe respiratory distress and is not clinically improving with treatment then consider obtaining a PCO2 (CBG). Note: a PCO2 > 40 mm HG in a patient who is in respiratory distress is a Red Flag. Remember that hypercapnea (in the case of acute asthma that means > 40 mm Hg) may herald respiratory failure. It is a warning that your patient may need to be transferred to the ICU.

X-RAYS:
1. Most children admitted with asthma exacerbations do not need a CXR. If you suspect pneumonia or the asthma exacerbation is atypical making you worried about other diagnoses, then obtain a CXR. If your patient’s condition deteriorates, then a CXR may be indicated; rarely patients with acute asthma develop life-threatening pneumothoraces. The primary reason to obtain a CXR is to exclude other diagnoses rather than to confirm asthma.
2. If the patient has never had a CXR before, then it is reasonable to obtain one before hospital discharge, as a baseline.

PEAK FLOWS:
1. This is an objective measure of airways obstruction and can be a useful monitoring tool in children > 5 yrs-old. It is very effort dependent, so you must make sure that the patient has performed the test accurately before you interpret the values.
2. Children > ages ~ 5 yrs can usually be taught to use a peak flow meter, but it is most useful in children > 7 yrs-old. It is best to compare peak flow values with the patient’s “personal best”, but if this is not available then there are predicted values. (See the peak flow norms in the handout that accompanies this document).
3. Remember that peak flow measurements are very effort dependent, so evaluate your patient’s technique before you believe the numbers.

DISCHARGE CRITERIA:
1. As a rule, children should be tolerating every 4-6 hr albuterol treatments and have a RA SaO2 > 93% for at least the 6 hrs prior to discharge.
2. Determine soon after admission whether the child will need a nebulizer machine and/or training with an MDI/spacer. Please note that with the increased use of MDIs we are prescribing fewer home nebulizers.
3. Try to get the patient (and parent) to the hospital’s Asthma Class. Include this in the admission orders! This class is not for parents of patients under age 2 yrs-old that are first time wheezers unless there is a strong family history or obvious atopy.
4. You should write your discharge orders by the time the patient is on every 3-4 hour albuterol treatments. This will allow the family to get their medications and sufficient time for the floor RN or RT go over the use of the medicines and nebulizer.

GETTING A CHILD READY FOR DISCHARGE:
1. Many patients are hospitalized for only 1 or 2 days. When discharge is considered, it is important for you to stop and make SURE the child is actually safe and the family ready to go home. Make sure that the patient is: 1) tolerating oral corticosteroids and taking fluids well; 2) is tolerating every 4-6 hr albuterol treatments; and 3) has been off of supplemental oxygen x 6 hrs.

2. Make sure parents have a basic understanding of respiratory distress and the signs/symptoms of worsening asthma. They should know how to identify these and understand the plan for what to do if the patient’s asthma worsens.

3. Social issues play a major factor in determining whether a child is ready for discharge. Put patient safety first! If a child is ready for discharge but the parents haven’t attended asthma class, they sometimes can come back for the class later.

4. Make sure that the patient understands the home medication plan. The usual home albuterol dose is 2-4 puffs by MDI or 2.5 mg by nebulizer up to every 4 hrs. Patients often require controller medications (inhaled corticosteroids, montelukast), and they should complete a course of oral corticosteroids (prednisone, dexamethasone).

5. The discharging physician is responsible for signing the Asthma Management Plan – the form with the colored squares. The plan can be filled out with the help of the RN/RT taking care of the patient. The last page of the pathway has tables summarizing current national recommendations.

6. Remember almost all patients should use a spacer with the MDI, especially for inhaled corticosteroids. ALWAYS discuss the plan with the PCP and set up a follow-up appointment.
## CHILDREN’S RESPIRATORY SCORE

<table>
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<th>0 point</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
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<td>COUNT RESPIRATORY RATE FOR ONE FULL MINUTE while patient is awake</td>
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<td>61-69</td>
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<td></td>
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<tr>
<td>2-12 mos</td>
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<td>51-59</td>
<td>≥ 60</td>
<td></td>
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<td>&lt; 23</td>
<td>24-27</td>
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<th>3 of the following: subcostal, intercostal, substernal, suprasternal, supraclavicular OR nasal flaring or head bobbing (infants)</th>
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<th>Dyspnea</th>
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<td><strong>0-2 years</strong></td>
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<td><strong>2-4 years</strong></td>
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<td><strong>≥ 5 years</strong></td>
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| Auscultation (as it relates to wheezing) | Normal breathing; no wheezing present | End-expiratory wheeze only | Expiratory wheeze only (greater than end-expiratory wheeze) | Inspiratory and expiratory wheeze OR diminished breath sounds OR both |


Inpatient Management of Asthma at CHRMC – revision by Dr. Edward Carter, March 2005
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Overview of CF

Cystic fibrosis (CF) is an autosomal recessive disorder principally affecting the upper and lower respiratory tracts and the digestive system; the sweat glands and male reproductive tract are also involved. The underlying defect in CF is mutation of the CFTR gene, which encodes a protein that functions both as a chloride channel and as a regulator of other channels and membrane proteins; CFTR deficiency or dysfunction results in abnormal electrolyte transport across epithelia. Neonatal screening for CF, based on elevated serum levels of immunoreactive trypsinogen in CF newborns, followed up by genotyping, has been introduced in some states. Such screening facilitates immediate nutritional intervention for infants who would not be diagnosed until they were already failing to thrive. Otherwise, diagnosis is based on a combination of laboratory tests and clinical history. Measurement of increased chloride in sweat (pilocarpine iontophoresis, or “sweat test”) is a sensitive and specific diagnostic test for CF, provided an adequate quantity of sweat is obtained and that the patient is not salt-depleted at the time of testing. The physiological abnormality on which this test is based does not often have clinical consequences; however, individuals with CF may experience salt-wasting syndromes (i.e., hypochloremic metabolic alkalosis) during heat waves or when visiting hot climates.

The gastrointestinal tract is markedly affected by cystic fibrosis. Pancreatic ducts in CF are obstructed by abnormally viscous digestive secretions, resulting in pancreatic insufficiency and malabsorption of lipids, proteins, fat-soluble vitamins (principally A, D, E, and K), and minerals such as zinc and calcium. In locales such as Washington State where newborn screening is not routinely performed, the presenting symptoms of CF often involve the digestive tract, namely, failure to thrive and steatorrhea. Some newborns with CF (about 10-15%) present with meconium ileus, resulting from plugging at the ileocecal valve; more distal plugging may present as rectal prolapse. Older individuals with CF may experience distal intestinal obstructive syndrome (DIOS), so-called “meconium ileus equivalent.” Less commonly, individuals with CF may present primarily with biliary obstruction and concomitant hepatic disease, which may progress to biliary cirrhosis and portal hypertension. Some patients with CF also have increasing glucose intolerance during adolescence (culminating in CF-related diabetes mellitus, or CFRDM) due to several factors including progressive pancreatic injury affecting beta cell insulin secretion, chronic administration of glucocorticoids, and insulin resistance of unclear etiology.

Patients with cystic fibrosis usually have chronic endobronchial infection, often with multiple organisms, with consequent airway inflammation and obstruction by copious thick secretions. Because the genetic defect affects all respiratory epithelia, many of these patients also have chronic inflammatory sinus disease. This airway process may flare in response to various viral, environmental or endogenous insults, leading to the “pulmonary exacerbation”. The respiratory manifestations of a pulmonary exacerbation may include dyspnea with exertion or even with speech, increased cough frequency or paroxysms, occurrence of nocturnal cough interfering with sleep, abdominal and/or chest wall pain, pleuritic chest pain, spotting or frank hemoptysis, and increased sputum volume, viscosity and coloration. However, sometimes the quantity of expectorated sputum actually decreases due to inspissation. Increased airway obstruction may be measured in the PFT lab as decreased FEV₁ and FEF_{25-75}. Extrapulmonary manifestations may include impaired exercise tolerance, decreased activity level, frank malaise, headache, mild fever, and anorexia. Nutritional status often declines during pulmonary exacerbation, sometimes with weight loss.

Management of CF

Based on this constellation of problems, interventions for acutely ill individuals with CF may include:

1. Treatment of endobronchial infection with intravenous, oral, and/or aerosolized antibiotics, based on susceptibility of isolates cultured from upper or lower airway secretions, or based on prior response. (NOTE: A change to once-daily dosing of intravenous aminoglycosides has recently been approved at CHRMC.) Inhaled therapies are given to improve clearance of secretions and to reduce bronchospasm. Topical and/or systemic glucocorticoids may be administered to reduce airway inflammation.

2. Management of chronic sinusitis as needed, often with input from Otolaryngology.
(3) Improvement in nutritional status with high-calorie, high-fat nutritional supplements, in addition to the patient’s usual enzyme and vitamin supplements, with the help of the CF nutritionist. Teenagers and adults with CF, particularly females, are prone to osteopenia due to a variety of factors, and may need calcium supplementation and even treatment with bisphosphonates.

(4) Management of CFRDM as needed with the help of Endocrinology. Irregular eating habits during adolescence or use of glucocorticoids may exacerbate hyperglycemia due to CFRDM. Dehydration due to hyperglycosuriic diuresis may predispose to drying and inspissation of respiratory secretions. Hyperglycemia may also impair immune function. Thus, proper management of CFRDM, including the appropriate use of insulin therapy, is important to maintain maximal lung function.

(5) Relief of intestinal obstruction (e.g. Golytely or Miralax cleanout, followed by a course of lactulose), with input from Gastroenterology or General Surgery as needed.

(6) Management of liver disease and any associated portal hypertension with the help of the GI Service.

Children’s Hospital has approximately 200 CF admissions annually. Most of these are for acute pulmonary exacerbations. Children’s housestaff and Pulmonary Medicine attending staff work together to manage the hospital care of CF patients, with crucial support from an interdisciplinary CF Team that includes CF nurses, a CF nutritionist, and a CF social worker. In addition, CF patients are often assigned to those nurses who have more extensive experience in hospital-based CF management. Seeking input from the Pulmonary team and the inpatient nursing staff while CF admission orders are being entered improves patient care, saves time, and minimizes late night pages. The CF clinic nurses can usually provide a rapid overview of the patient’s history and care plan, and are available through the paging operator (9A-5P, M-F). The pulmonologist on-call is always available to answer questions regarding admission orders or other issues as they arise.

Hosestaff and students are also referred to several excellent review of CF clinical care available in the Teaching Files located in the CHRMC Library; particularly recommended is a review article by Drs. Ron Gibson, Jane Burns, and Bonnie Ramsey entitled “State of the Art: Pathophysiology and Management of Pulmonary Infections in Cystic Fibrosis,” American Journal of Respiratory and Critical Care Medicine (2003), Vol. 168, pp.918-951.

Order Set for CF Admissions

The CF admission order set in CPOE was designed to streamline the admission and management of patients with CF pulmonary exacerbations. It is not intended to create a regimented system for CF care, however. Here are some specifics to keep in mind when admitting CF patients:

1. **Adolescent issues:** Some adolescent patients with CF experience difficulties related to limits and limit-setting in the hospital. Parents, nurses, and CF social worker are the main sources of information about the boundaries that have been established for a particular patient. Guidelines and rules for teens should be provided to patients and their parents or guardians on admission, as should reminders about any specific limitations that have been agreed to by the individual patient.

2. **IV therapy:** Some patients have a port-a-cath. If so, most IV therapy and lab draws can be accomplished by this route. The exceptions mostly involve the need to avoid drawing antibiotic levels from the site where they are administered. When patients need a line placed, a percutaneously inserted catheter (a “PIC” line, or, if the tip terminates in a central vein, “PICC” line) is preferred because of the duration of IV therapy.

3. **Past culture results and the choice of antibiotics:** The choice of antibiotics is usually based on susceptibility data from the most recent upper or lower airway culture, although sometimes (e.g., for a sick patient with new diagnosis CF and no previous cultures) one must choose empirically, perhaps based on the patient’s prior response to initial empirical therapy. (This topic is covered in detail in the review cited above.) We recommend that you review your patient’s recent airway culture results to understand the rationale for the antibiotics that have been chosen. Does the patient have more than one morphotype of *Pseudomonas aeruginosa*, or additional organisms (e.g., *Stenotrophomonas maltophilia*), and if so, how

(Guidelines for Cystic Fibrosis Admissions – Drs. Moskowitz & Gibson – Rev. 5/05)
do the bacterial densities and antibiotic susceptibilities vary among these? Do some isolates exhibit multiple resistances or pan-resistance?

Most patients with Pseudomonas endobronchial infection are treated with a combination of a β-lactam antibiotic and an aminoglycoside. Intravenous ceftazidime and tobramycin represent the most common combination. The CHRMC Pharmacy and Therapeutics Committee has recently approved once-daily dosing of intravenous aminoglycosides for CF patients >1 year of age. (Eight-hour dosing intervals should be used for infants with CF, as well as for all non-CF patients.) Serum levels of aminoglycosides are monitored based on pharmacokinetic calculations, to assure safe and effective levels. With once-daily dosing, calculation of the area under the curve (AUC) is based on serum levels drawn 2 hours and 6 hours post-dose. Patients with levels determined during a recent once-daily aminoglycoside intravenous course (i.e., within the past six months) should have only a single aminoglycoside level drawn approximately 6 hours post-dose, since their true peak and trough can be calculated from this single measurement using their previously measured pharmacokinetics. In either case, it is not necessary to draw aminoglycoside levels at an exact time-point; however, it is critical that the lab phlebotomist AND the patient's nurse document the exact time that each level is drawn, as the timing of the levels is needed for accurate calculation of the AUC. The current recommendation is to measure serum aminoglycoside levels only at the beginning of a treatment course. Serum creatinine levels are measured annually, rather than in relation to aminoglycoside treatment, because the onset of renal toxicity in CF patients is typically delayed and gradual, and rarely coincides with treatment.

If the patient has one or more strains resistant to ceftazidime or tobramycin, alternative anti-pseudomonal β-lactams (such as piperacillin-tazobactam, which also covers Staphylococcus aureus), monolactams (such as meropenem or aztreonam) or aminoglycosides (typically amikacin) are considered. Second-line, broad spectrum agents such as fluoroquinolones, tetracyclines, trimethoprim-sulfa, or chloramphenicol may be added to the above if the patient's bacterial isolates are resistant to multiple classes of antibiotics, or in case of drug allergy or history of ototoxicity or nephrotoxicity with aminoglycosides. The use of these agents in CF patients does not require prior approval from the infectious disease service; however, their use must first be discussed with the Pulmonary staff. A patient who has developed an allergy to ceftazidime or to another antibiotic which susceptibility data has shown to be the optimal agent for their CF pathogens may undergo allergic desensitization in the Pediatric Intensive Care Unit, prior to admission to the ward for IV therapy with that antibiotic. The duration of IV therapy is determined by clinical status and sometimes by plateau in PFT improvement, with a usual range of 10-14 days. However, the duration of therapy for any given patient is difficult to predict at the start of therapy.

Many patients with P. aeruginosa are on oral azithromycin three times a week (usually M/W/F) as an ongoing therapy, based on recent data indicating that some patients have improved lung function on this macrolide. It is unclear whether the beneficial effect of this drug is primarily anti-inflammatory, anti-bacterial, or due to other properties. Because airway infection with atypical mycobacteria is a contraindication to macrolide monotherapy, due to the risk of selecting for macrolide-resistant mycobacteria, sputum culture and smear for AFB should be obtained prior to starting chronic azithromycin. This drug can be initiated while the AFB results are pending, and should be continued during courses of IV antibiotics.

4. Bronchodilators/Mucolytics: These treatments are usually continued per the patient's home regimen. Sometimes, dornase alfa (DNase, a mucolytic) nebulizer therapy will be initiated in an attempt to increase the productivity of the patient's cough. However, it is important to ask the patient about hemoptysis, which may be an indication for temporarily withholding DNase.

5. Respiratory care: Most patients with CF are expected to have chest physiotherapy (CPT) three or four times per day, in conjunction with inhaled medications given in a standard sequence (as relevant):

Before CPT: (1) bronchodilator(s)  
(2) dornase-alfa [DNase] (if ordered)

After CPT: (3) inhaled corticosteroid and/or long-acting beta-agonist (often Advair Diskus or fluticasone MDI) (if ordered)  
(4) inhaled antibiotics (if ordered)

The rationale for this sequence is to open the airway, decrease sputum viscosity, promote expectoration of secretions, and then to deliver anti-inflammatory treatments and/or antibiotics as widely and deeply as possible within the bronchial tree. The respiratory therapist determines the mode of CPT by conferring with the patient and/or the parents regarding experiences with and preferences for various CPT techniques. Because consistent, effective CPT using proper technique is one of the most important

(Guidelines for Cystic Fibrosis Admissions – Drs. Moskowitz & Gibson – Rev. 5/05)
interventions in the pulmonary regimen, we often ask our home respiratory therapy specialists (Carol Franzen RRT and Leslee Hill RRT) to review current or new CPT techniques with the patient during their stay. If a patient is experiencing active hemoptysis, CPT and DNase may be discontinued until the bleeding has stopped, then restarted sequentially as tolerated. However, modifications of the respiratory care regimen in the setting of hemoptysis must be individualized, as patients with severe airway obstruction may not tolerate discontinuation of these therapies.

Most patients with CF are not on chronic oxygen therapy, and are aware that need for oxygen is a hallmark of end-stage CF lung disease. Because recommending chronic oxygen therapy implies a serious prognostic judgment, this should be discussed with the Pulmonary attending before ordering.

6. **Glucocorticoids/Anti-inflammatories**: The use of pulse steroids for CF pulmonary exacerbation is not routine, thus the initiation, increase or tapering of these agents is individualized in consultation with the Pulmonary team. Consideration should be given to prescribing an acid reducer (usually an H2-blocker) for patients on chronic or pulse steroids, particularly during acute illness or if oral intake is diminished, and the patient should be monitored for hyperglycemia and/or glycosuria. It is the policy of the CF service to **discontinue high-dose ibuprofen as an anti-inflammatory therapy while the patient is on IV aminoglycosides, in order to reduce the risk of renal toxicity**. When considering the analgesic use of Cox2 inhibitors (e.g., celecoxib) or other NSAIDs, one must weigh the patient’s hydration status, current renal function, and concurrent use of other potentially nephrotoxic agents.

7. **Nutrition, GI, and Endocrine**: It is important to use the exact name of the patient’s enzyme preparation, as these vary in their content (e.g., Ultrase contains 4,500 units of lipase and 20,000 units of amylase and protease, whereas Ultrase MT20 contains 20,000 units of lipase and 65,000 units of amylase and protease). Most patients are on vitamins, many are on acid reducers, and some are on ursodiol (actigall) to treat biliary disease (as indicated by elevations in GGT or transaminases). Weights should be measured every other day and at discharge to document weight trend during treatment. Lactulose is prescribed to prevent recurrence of distal intestinal obstruction syndrome (DIOS, or the so-called "meconium ileus equivalent") in those with a history of this. Patients with CFRDM may be on insulin, and Endocrine may be consulted regarding adjustments to such regimens. Patients age 12 and older are screened for CFRDM by checking random serum glucose levels on days 1 and 3 of admission; a fasting level is obtained if the random levels are >200. The Endocrine Service is to be consulted regarding patients with fasting hyperglycemia.

8. **Laboratory**: CF patients usually need a new sputum or throat culture at admission and may also need annual labs (see flowsheet that follows this section). However, most do not need daily labs after that. An acutely ill CF patient in respiratory distress may need a capillary blood gas on admission. Clinical status or need to check PIC placement determines the need for a chest x-ray at admission or before initiating IV therapy, respectively. Computed tomography of chest or sinuses is used to evaluate advent or evolution of bronchiectasis or sinusitis, with the decision about obtaining these based upon clinical or CXR findings.

9. **Pulmonary function testing (PFTs)**: These serve to quantify the severity of disease and to document response to treatment (i.e., reversal of airway obstruction) in patients old enough to follow directions (generally 5 years or older). Most patients have PFTs on admission (often already done in clinic) and then each Monday and Thursday. However, some patients are too sick to do meaningful PFTs on admission. Others, particularly those with severe lung disease, may experience an improved sense of well-being on IV antibiotics without an objective improvement in lung function, and thus may have PFTs only at the end of therapy, to document stability.

10. **Discharge planning**: It is helpful to incorporate patient’s discharge needs within your admission orders, to the extent that these can be anticipated. This is especially important for a patient who may be discharged during a weekend to complete the remainder of their IV antibiotic course at home. When weekend discharge is anticipated, please note this in your admission orders; otherwise, plan to notify the CF nursing staff by Friday morning at the latest so that appropriate homecare referrals can be made. Please refer to the CF Clinical Pathway for additional discharge items.
CYSTIC FIBROSIS HISTORY AND PHYSICAL WORK-SHEET

This is an abridged version of the CF clinic worksheet. It may be useful as a prompt when doing your H&P on a CF patient who is being admitted. Not all issues apply to all patients, so use discretion.

HISTORY

I. **Nutritional Status:**
   Growth grid status, growth in last 6 months (wt loss, gain, etc.), Appetite, Diet, Supplements, G-tube use, Vitamins (multi/A/E), Susan Casey, R.D. evaluation

II. **Pulmonary Status:**
   Cough: dry, night, productive, associated with emesis; exercise tolerance; hospitalization hx; chest pain; asthma sx; hemoptysis; school absenteeism; culture results

III. **GI Issues:**
   Enzyme use. Stools (quality, # per day). Abdominal pain/epigastric pain. Obstipation/diarrhea Emesis

IV. **Nasal sx:**
   Acute or chronic nasal sx. Polyps. Sinusitis. Meds. ENTevaluation. ENT surgery

V. **Other PMHx:**
   EGA (pre-term/term/post term). Ventilator/Oxygen, other med problems, past hosp’ns, surgeries

VI. **Other ROS:**
   Eyes, ears, heme, CNS, ID, Immune, Hives, Eczema, Food intolerance, previous allergy w/up.

VII. **Allergies/med reactions**

VIII. **FHx**

IX. **SHx:** Consider environmental issues particularly: location and type of home, dust, mold, heat type, animals, smokers, daycare

PHYSICAL EXAM

Ht and Wt, plotted

LABS

Patients get the following at least annually (mainly in clinic), and some may need to be done at admission:
   CBC with diff. ALT and GGT. Vit A/E. Complete PFTs. CXR – AP/lat. Quant CF sputum.
   If FVC <60% and oximetry <92%; CBG, electrolytes, and echocardiogram or EKG.
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CHMRC Bronchiolitis Guideline

1. Supportive care: Clinical pathways that emphasize minimal intervention have a positive effect on the treatment of patients hospitalized with bronchiolitis (Perlstein et al, 1999; Adcock et al, 1998).
   • Maintain the patient’s hydration. If the patient cannot take adequate PO fluids then IV fluids should be considered. If PO feeding is delayed for more than 2 days then one should consider placing an NG tube for enteral feeds.
   • Nasopharyngeal suctioning is an important part of the supportive care of infants with bronchiolitis.
   • Chest physiotherapy is usually not beneficial but can be considered in select patients who have mucous plugging and atelectasis.
   • No specific medication has been shown to be consistently efficacious in children with bronchiolitis.

2. Corticosteroids:
   • There is some evidence from a meta-analysis of 6 randomized controlled trials (Garrison et al, 2000) that parenteral or oral corticosteroids may improve clinical symptoms of bronchiolitis and shorten of the duration of symptoms and length of stay (by approximately 0.4 days).
   • Klassen et al (J Pediatr, 1997) and Boeck et al (J Pediatr, 1997), both found corticosteroids did not change the clinical course of infants admitted to the hospital with bronchiolitis.
   • Berger et al (Pediatr Pulmonol, 1998) found no benefit of 2 mg/kg/day x 3 days of prednisone in children 1-18 months old presenting to the ED with bronchiolitis. However, Schuh et al (J Pediatr 2002) did find that infants with bronchiolitis treated in the ED with a single dose (1 mg/kg) of dexamethasone had clinical benefit and a decreased rate of hospitalization.
   • Corticosteroids are beneficial in acute asthma, and in older infants and toddlers it is difficult to differentiate between bronchiolitis and respiratory infection-induced exacerbations of asthma.

Recommendations for the use of corticosteroids:
   • The routine use of corticosteroids for infants admitted to the hospital with presumed bronchiolitis is not recommended. However, systemic steroids are recommended for infants presenting with recurrent wheezing or who have a strong family history of atopy/asthma, e.g. those patients who might be suffering from an asthma exacerbation.
   • Children > 12 months-old who present with bronchiolitis are more likely to have a reactive airways component to their disease, so they are more likely than young infants to benefit from corticosteroids.
   • Treating infants with bronchiolitis while they are in the ED (pre-hospitalization) with corticosteroids is optional and should be considered on a case-to-case basis.

3. Bronchodilators: A review of the literature on bronchodilators therapy for infants with bronchiolitis reveals:
• There is no conclusive evidence that $\beta_2$-agonists are efficacious in infants admitted to the hospital with bronchiolitis (Flores and Horwitz, 1997; Hartling et al, 2003).
• Bronchodilators, either epinephrine or $\beta_2$-agonists, do not decrease length of hospital stay or influence clinical course in hospitalized patients with bronchiolitis. Specific studies are noted below.
• The meta-analysis by Hartling et al (Arch Pediatr Adolesc Med, 2003) and a systematic review (Kellner et al, 1999) found no change in length of stay with albuterol or epinephrine.
• A multicenter trial of nebulized epinephrine vs placebo in 194 infants admitted to the hospital with bronchiolitis found no difference in length of stay or clinical improvement with epinephrine (Wainwright et al, NEJM, 2003).

Patel et al (J Pediatr, 2002) evaluated the use of epinephrine vs albuterol or placebo in 149 infants admitted to the hospital with bronchiolitis. They found no benefit from either albuterol or epinephrine in shortening length of hospital stay, decreasing the time to normal oxygenation and adequate PO intake, or in decreasing clinical score.
• There is evidence that racemic epinephrine is more effective than albuterol when treating children with bronchiolitis in the emergency department. (Kristjansson et al, 1993; Menon et al, 1995; Reijonen et al, 1995). The meta-analysis by Hartling et al also showed some benefit of bronchodilators in the outpatient setting, but this was not conclusive.

Recommendations for the use of bronchodilators:
• Bronchodilator use should be discouraged in infants with bronchiolitis.
• However, bronchodilators may be considered in infants presenting with recurrent wheezing or who have a strong family history of atopy/asthma, e.g. those who might be suffering from asthma.
• Children > 12 months-old who present with bronchiolitis are more likely to have a reactive airways component to their disease, so they are more likely than young infants to respond to bronchodilators.
• If bronchodilators, either nebulized epinephrine or nebulized/MDI albuterol, are tried then it is important to assess for clinical improvement. This should be done using the CHRMC respiratory score. Bronchodilators can be continued if there is evidence of clinical benefit, e.g. improvement in clinical score. However, bronchodilators should be discontinued if no positive clinical effect is noted.
• Before assessing response to bronchodilators the patient should undergo nasal suctioning to ensure that suctioning alone is not the cause of the patient’s clinical improvement.
• Follow the CHRMC bronchodilator treatment protocol whenever possible and appropriate.
4. Supplemental Oxygen:
   • Healthy infants < 6 months-old breathing room air can have brief O2
desaturations to < 90% (Hunt et al, 1999). However, the normal oxygen saturation
for infants breathing air at sea level is > 94% (Levesque et al, 2000).

Recommendations for the use of supplemental oxygen:
   • Supplemental oxygen should be used if the patient’s SaO2 is consistently < 88%.
Supplemental oxygen can be provided in the form of a hood box or facemask, but
it is most commonly delivered via nasal cannula. The flow rate can range from 0.1
lpm to 2.0 lpm. Use the lowest flow rate possible that maintains SaO2 > 88%.
   • The patient’s oxygen saturations while breathing room air should
consistently be greater than 88% for at least 12 hours before hospital
discharge.

5. Respiratory status assessment:
   • Clinical scoring is useful in the assessment and monitoring of children with
bronchiolitis. The CHRMC respiratory clinical score should be used routinely for
longitudinal assessment of clinical change. (Liu et al, Pediatric Pulmonology
2004). It should also be used to objectively assess the clinical effect of
interventions such as nasopharyngeal suctioning and bronchodilator
administration.

6. Risk of bacterial infection:
   • The risk of serious bacterial infection in infants with bronchiolitis is low,
approximately 1% (Antonow et al, 1998; Greenes et al, 1999; Davies et al,
1996, Purcell and Fergie, 2002).

Bronchiolitis guidelines – revised December 2004 Page 3
Recommendations for the use of antibiotics:
   • Antibiotics should not be routinely used in patients with viral bronchiolitis.

7. Use of chest radiography:
   • A randomized controlled trial found no improvement in clinical outcome of
infants with acute lower respiratory infections who received chest x-rays
compared to those who did not (Swingler et al, 1998). In addition, the routine use
of chest radiography resulted in more antibiotic use.
   • The risk of bacterial pneumonia is low in bronchiolitis.
   • Indications for obtaining a CXR include a persistently asymmetric chest exam
and an illness that is not following the expected course, e.g. no improvement after
2-3 days, high supplemental oxygen requirement, or fever for more than 2 days.

Recommendations for the use of chest radiographs:
   • Chest radiographs should not be routinely ordered on patients with
bronchiolitis. However, there are times when a CXR may be indicated.

8. Respiratory viral studies:
   • Respiratory viral panels are not necessary in all patients presenting with
bronchiolitis during the bronchiolitis season (Nov/Dec-March/April).
Recommendations

• Potential indications for ordering a respiratory viral panel are to identify etiologic agents with confidence, for epidemiological tracking, and for aid in cohorting patients with the same infection.
• If the provider is uncertain that the diagnosis is viral bronchiolitis, a respiratory viral panel should be done before pursuing further diagnosis testing, e.g. chest radiographs, and before starting antibiotics.
• Also consider ordering a respiratory viral panel if the infant does not present with typical bronchiolitis, presents with clinical evidence of bronchiolitis outside of the typical bronchiolitis season, or if the patient is to going to be placed into a multi-bed room, e.g. cohorted.

9. Discharge Planning and Education: Most infants with bronchiolitis should not be prescribed bronchodilators for home use. All parents should be offered the bronchiolitis class and NOT the asthma class. The education plan should include:
  • Recognizing the signs/symptoms of respiratory distress
  • Use of nasal bulb syringe and proper feeding technique
  • Discussion on passive smoke exposure
  • Review of d/c medications and follow-up appointments

10. Tracking measures (metrics):
  • Readmission to the hospital
  • Length of stay
  • Percentage of patients prescribed bronchodilators (albuterol and/or epinephrine)
  • Percentage of patients who had a chest x-rays
  • Percentage of patients treated with antibiotics (parenteral and PO)
  • Percentage of patients prescribed corticosteroids

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References for the CHMRC Bronchiolitis Guideline


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The Parapneumonic Effusion/Empyema Algorithm

Overview:
The management of children with pneumonia and pleural effusion (parapneumonic effusion/empyema) is not straightforward. In order to provide some consistency of care, a group of Children’s Hospital clinicians interested in this area convened to establish an evidenced-based approach to the management of children with parapneumonic effusion. The following specialties were represented: Pediatric Surgery, Pulmonary, Radiology, Infectious Diseases, General Pediatrics, and Pediatric Residents. The medical literature was reviewed, and in a series of meetings held in 2004 the group decided on a general approach. An algorithm was developed and went through several drafts. Once the group completed the final draft, this draft was presented to each of the representatives’ Divisions for approval.

As with all algorithms/clinical guidelines, this one is intended as a template for care, and it is not absolute. There are many ways to treat children with parapneumonic effusions, and clinical judgment always is important. However, the group of Children’s Hospital clinicians who developed this algorithm decided that this represents a “best management strategy” for children admitted to this hospital.

Key Points on Parapneumonic Effusions:
1. Parapneumonic effusion is defined as a pleural effusion associated with pneumonia (primarily bacterial). An empyema is normally defined as purulent pleural fluid or pleural fluid containing bacteria (identified by gram stain or culture). The distinction between a non-empyema parapneumonic effusion and an empyema is becoming less important, and the terms are occasionally used interchangeably.
2. Most children with parapneumonic effusions get well and have no long-term sequellae, independent of how their illness is treated. However, appropriate treatment and early intervention with pleural drainage can shorten the course of illness. One key to treatment is deciding if and when a child should undergo pleural fluid drainage.
3. The clinical condition of the child is key to deciding how aggressively to intervene. The sicker the child, the more likely that child will benefit from some form of pleural fluid drainage.
4. The most common bacterial cause of parapneumonic effusion is strep pneumoniae, though MRSA is emerging as an important pathogen.

Key points on the Parapneumonic Effusion/Empyema algorithm:
1. Thoracentesis upon initial presentation has low yield for a positive bacterial culture, and pleural fluid analysis is not particularly helpful in determining how to manage these patients. Therefore, in this algorithm early thoracentesis is not recommended.
2. This algorithm is based on the Parapneumonic Effusion Working Group’s interpretation of the literature and experience with managing this disease. The data supporting one treatment over another, e.g. fibrinolytics vs. surgical drainage with video-assisted thoracoscopy (VATS) is not particularly strong. We opted to not include treatment with fibrinolytics instilled via a chest tube in this algorithm. Fibrinolytics can be effective but have not been shown to be more effective than VATS. Fibrinolytics require a chest tube, and their instillation can cause pain. As there is no proven benefit of fibrinolytics over early surgical drainage we opted avoid them in favor of VATS.
3. When managing children with parapneumonic effusions, there is often debate over when to treat with antibiotics alone vs. when to intervene with a chest tube or VATS. The pulmonary and surgical services are often involved with these decisions. To improve
communication and to facilitate presenting a united plan to the family, we recommend a joint pulmonary/surgical consultation early in the algorithm.

4. Parapneumonic effusions start free-flowing and then develop fibrin strands eventually leading to loculation. Loculated fluid cannot be drained via a simple chest tube. Therefore, if patients require pleural fluid drainage then they should first undergo imaging to assess for loculations. The ultrasound is sufficient for this purpose. Thus, the imaging treatment of choice is an ultrasound and not a CT scan. However, a CT scan can be done if clinically indicated.

5. There are few data on the appropriate length of antibiotic treatment. The course proposed on the algorithm is safe, standard, but necessarily arbitrary.

6. Repeat CXRs in the hospital lend little to the management decisions and should be ordered judiciously.

7. Patients will clinically improve long before their CXR returns to normal. Thus, we recommend repeat imaging 4-6 months after resolution of the infection unless clinically indicated earlier.

The Parapneumonic Effusion Working Group:
Chuck Cowen (representing general pediatrics); Sherilyn Smith (ID); Ted Carter & Luke Hoffman (Pulmonary); John Waldhausen (Surgery); Kevin Sullivan, Lessli Hornung, Andre Ramos, & Tracy Wright (representing the Pediatric Housestaff); Eric Effmann (Radiology).

(The Parapneumonic Effusion/Empyema Algorithm – The Parapneumonic Effusion Working Group – 5/05)


Parapneumonic Effusion
Pleural effusion w/suspected pneumonia

Minimal Effusion?
(on yrs decub <30 mm Hg < 2 yrs,
and < 5 mm Hg < 2 yrs old)

No

Joint pulm/surg consult within the first 24 hrs of hospital admission

Clinical severity high?
(>RR, retractions, splinting, sapp O2 reg)

No

Antibiotics & Observe

Yes

Is the patient's condition critical?
Large effusion with mediastinal shift that is associated with hypoxemia;
The patient requires ICU admission;
>30% FiO2 needed to keep SpO2 > 90%;
Toxic appearance: moderate to marked dyspnea, retractions, pain

No

Antibiotics & Observe

Yes

Appropriate IV abx > 4 days?

Chest Ultrasound

Loculated fluid?

VATS
(If no Chest CT done yet, then Consider CT before proceeding to VATS - Up to the surgery team)

Drainage of fluid by the surgery team:
therapeutic thoracentesis, chest tube (NO pigtail catheters) or VATS
(Note: chest tube should stay in 48-72 hrs;
if pt is not improving within 48-72 hrs after chest tube placement then consider VATS)

Go to page 2

VATS
If VATS was not done, and the pt does not improve within 3-5 days or if condition worsens, then consider VATS

Go to page 2

All Patients:
Initial Labs: CBC w/diff, BC, CRP,
CXR, PA, Lateral, & Decubitus

Initial abx:
• cefuroxime; add clindamycin if pt has a high clinical severity or if pt is not improving with cefuroxime
• if suspect aspiration, add clindamycin
• if suspect staph or resistant pneumococcus then add vancomycin
Parapneumonic Effusion Algorithm
Ongoing and Follow-up Management

The decision has been made to treat the patient with VATS, chest tube, or IV antibiotics alone

Continue to treat with IV antibiotics for 5-14 days

Has the pt been afebrile off of antipyretics for 48 hrs and received at least 5 days of appropriate IV abx OR after 10-14 days of IV abx, fever is decreasing, CRP is decreasing, and patient is clinically near baseline? (e.g., good activity and appetite, Tmax < 38, and CRP < 5? Note: no around the clock antipyretics after the first 72 hrs of appropriate abx therapy

Yes

- Change to PO antibiotics and observe in house for 24 hrs
  - If doing well with PO then D/C home to complete a 10-day course of PO abx (high-dose amox, Augmentin, cephalosporin, clindamycin)

Follow-up

- F/U with PCP within 1 week
- F/U with surgery or pulmonary on a case-by-case basis
- Send pt home with a copy of the last CXR/CT scan
- Repeat CXR in 4-6 months or sooner if the patient has respiratory symptoms
- Consider Chest CT scan if CXR has not returned to normal within 6 months (excluding pleural thickening)

No

- Consider further imaging, including a Chest CT scan, and interventions per surgical/pulmonary recommendations

Note on fever in patients with parapneumonic effusions:
Fever spikes to 39-40°C for 5-7 days are typical. After the first week of appropriate antibiotics, the frequency and height of the fever should begin to decrease. Most patients will have fever for 7-14 days. During the second week of appropriate antibiotic therapy, the fever usually decreases in both frequency and magnitude. While defervescence suggests a good response to therapy, the patient's overall clinical condition is a better indicator of improvement than is fever response. Avoid around-the-clock antipyretics after the first 72 hrs of appropriate abx, as this may mask true defervescence.