DATE: July 2020

OHSU HEALTH SYSTEM
OFFICE OF CLINICAL INTEGRATION AND EVIDENCE-BASED PRACTICE

GUIDELINE FOR PEDIATRIC COMMUNITY-ACQUIRED PNEUMONIA

Background

Pediatric pneumonia is an acute infection typically associated with respiratory symptoms and clinical and/or radiological evidence of parenchymal involvement. Evaluation and management of pediatric community-acquired pneumonia (CAP) is based largely on consensus and expert guidelines; diagnostic and therapeutic algorithms vary across health systems and medical associations, and rigorous studies are limited by issues such as lack of a universally accepted reference standard. Preventive, diagnostic, and treatment options have changed significantly since the 2011 publication of the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America's guidelines, as have considerations for antibiotic stewardship in the context of evolving causal pathogens. The Pediatric Community-acquired Pneumonia Guideline provides evidence-based recommendations on the diagnosis, management and follow-up for children with suspected CAP.

Prevalence

The introduction of vaccines against *Haemophilus influenzae* type b and *Streptococcus pneumonia* has significantly reduced the incidence of clinical and radiologic childhood pneumonia and subsequent morbidity and mortality. However, vaccination coverage is suboptimal in certain populations, and etiology is evolving. Viral pathogens (including respiratory syncytial virus and human influenza) and sequential or concurrent infections by multiple pathogens are increasingly responsible for pediatric pneumonia, and atypical bacteria (including *Mycoplasma pneumoniae* and *Chlamydophila pneumoniae*) and multidrug-resistant pathogens have been detected. Data on incidence of pediatric CAP in the U.S. are limited, but the most recent estimates for annual incidence is approximately 2 million outpatient visits[1] and 16-22 cases per 10,000 children hospitalized[2] (highest in children younger than 2 years).

Risks

CAP is a significant cause of respiratory morbidity and mortality in children. [3] Worldwide, CAP is the leading cause of death in children younger than five years old. [4] Factors that increase the incidence and severity of pneumonia in children include prematurity, malnutrition, low socioeconomic status, exposure to tobacco smoke, and child care attendance. [5]

Definitions

- Community-Acquired Pneumonia (CAP): Clinical signs and symptoms of an acute infection of the pulmonary parenchyma in a previously healthy child caused by an infection that has been acquired outside of the hospital.
- Hospital-Acquired Pneumonia (HAP): Pneumonia not incubating at the time of hospital admission and occurring 48 hours or more after admission.
- Complicated Pneumonia: Pneumonia plus presence of significant effusion, empyema, severe or impending respiratory failure, and/or signs and symptoms of sepsis or shock.
- Atypical pneumonia: Pneumonia caused by atypical bacteria (such as *Mycoplamsa* or *Chlamydophila*) rather than viruses or typical bacteria (such as *Streptococcus pneumoniae, Haemophilus influenzae,* or *Moraxella catarrhalis*).

Guideline Eligibility Criteria

Patients between the ages of 60 days and 18 years.

Guideline Exclusion Criteria

Children < 60 days old, and patients with:

- Hospital-acquired pneumonia
- COVID-19
- Cystic fibrosis and other chronic lung diseases
- Tracheostomy

- At risk for aspiration pneumonia
- Sickle cell disease
- Pre-existing and/or congenital neurologic, hematologic, renal, metabolic, and cardiac conditions
- Immunodeficiency or immunosuppressive therapy

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Clinical Practice Recommendations

Assessment of Patient for Presence and Severity of Pneumonia

History and physical examination should be conducted when CAP is suspected. Common signs and symptoms include fever, cough, increased respiratory rate, and difficulty breathing. Patient characteristics and examination results will assist in determining suspected origin (Table 1) and severity level (Table 2), which will inform if patient is provided care in outpatient, inpatient or intensive care unit (ICU) setting. [6,7,8] **(Adapted-consensus from external guidelines)**

Practice Implications

For patients with COVID-19 symptoms or exposure, refer to OHSU's COVID-19 (Novel Coronavirus) guidelines and algorithms for the most up-to-date testing criteria.

Factors to consider when differentiating viral, bacterial and atypical pneumonia[9]:

Table 1: Etiology of CAP

Bacterial	Viral	Atypical bacterial
• Focal auscultatory findings • Abrupt onset • Respiratory distress • Local chest pain • Appears ill or toxic • Fever	• Commonly children <5 years • Diffuse, bilateral auscultatory findings • Gradual onset • Wheezing • Upper respiratory infection symptoms • Mild fever	• Commonly children >5 years • Abrupt onset • Wheezing • Nonproductive cough • Nonspecific symptoms (malaise, headache, rash, etc.)

Factors to consider when differentiating severity[9]:

Table 2. Severity of Pediatric CAP

Mild	• Mild fever (<38.5°C) • Mild increase in respiratory rate • Normal feeding • Pulse oximetry >90% in room air • Capillary refill <2 seconds • Non-ill or non-toxic appearance

Moderate to Severe	• Fever (≥38.5°C)
	• Moderate to severe respiratory distress
	  • Persistent tachypnea above age-appropriate norms (see Table 3)
	  • Dyspnea
	  • Retractions (suprasternal, intercostal, or subcostal)
	  • Grunting
	  • Apnea
	  • Nasal flaring
	• Hypoxemia (persistent SpO2 <90% at room air)
	• Inadequate oral intake or signs of dehydration
	• Sustained tachycardia

	• Capillary refill ≥2 seconds • Failure of outpatient therapy (worsening symptoms or no response >48 hours after initial outpatient therapy)
Severe	• Severe respiratory distress • Remains hypoxic on >50% FiO2 • Concern for impending respiratory failure • Inadequate perfusion (altered mental status, hypotension, sustained tachycardia) • Need for mechanical ventilator support with artificial airway • New or increased CPAP or BiPap support

Tachypnea Criteria[10]:

Table 3. Tachypnea age-adjusted respiratory rates	
Age (year)	Respiratory Rate (breaths/minute)
2 months–1 year*	24–38
1–3 years	22–30
4–6 years	20–24
7–9 years	18–24
10–14 years	16–22
14–18 years	14–20

Clinical setting determined by severity

Mild - *Outpatient Management:*

Patients with mild CAP (as defined in table 2), adequate observation and follow-up care and ability to adhere to therapy, including adequate PO can be managed in the outpatient setting.[9] **(Strong Recommendation; Moderate Quality Evidence)**

Moderate – *Inpatient Management*

Patients who have moderate to severe CAP (as defined in table 2), including significant respiratory distress and hypoxemia, or inability to tolerate PO (vomiting), should be hospitalized.[9] **(Strong Recommendation; Moderate Quality Evidence)**

Threshold for admission should be lower for infants 2-6 months, as infants may need additional monitoring and supportive care to prevent clinical deterioration. **(Consensus)**

Additional Considerations Favoring Hospitalization:

- Suspected complicated CAP (pleural effusion/empyema, abscess)
- Children who cannot be adequately cared for at home
- Unable to comply with therapy, including inadequate PO
- Unable to follow up with appointments

Severe – *ICU Management*

Decision to treat severe patients (as defined in table 2) in an ICU unit should include signs of clinical deterioration such as sustained tachycardia, hypotension, altered mental status, or other signs of shock/impaired perfusion.[9] **(Adapted-consensus from external guidelines)**

Additional Consideration Favoring ICU Admission:

- Patient does not respond to initial resuscitation and is clinically deteriorating

Diagnostic Evaluation

To establish diagnosis of CAP, consider severity of disease factors (Table 2). History and physical assessment have demonstrated similar sensitivity and specificity to additional testing in predicting the etiologic agent of CAP and are generally sufficient to confirm diagnosis in cases of strongly suspected CAP. **(Consensus)**

For patients with suspected viral pneumonia, consider viruses such as respiratory syncytial virus (RSV), influenza, COVID-19 and/or seasonal appropriateness of additional studies. [9] **(Strong Recommendation; High Quality Evidence)**

Most laboratory tests (such as complete blood count or blood cultures) are not routinely recommended, as there is risk of potential contamination by other colonizing pathogens or multiple sources of infection, limited sensitivity and/or specificity for pathogens, difficulty in differentiating viral and bacterial pneumonia, and limited utility in informing clinical management. However, recommended testing will depend on severity and type of pneumonia, and requires clinical judgement based on patient assessment. Patients with signs and symptoms of moderate to severe disease and those with suspected bacterial CAP are more likely to develop complications and may therefore benefit from the use of chest radiograph or other imaging modalities. [9,11] **(Strong Recommendation; High Quality Evidence)**

Imaging

Mild

No diagnostic testing is indicated for mild cases, unless patient meets criteria for hospitalization. Many studies use chest radiography as the preferred diagnostic modality, but positive findings have not been shown to improve clinical outcomes or significantly change treatment. Chest imaging is most useful when the diagnosis is uncertain or when the findings from the history and physical examination are inconclusive. [9,12-14] **(Strong Recommendations; High Quality Evidence)**

Moderate and Severe

For patients with equivocal clinical findings, chest radiograph (CXR) may be helpful when considering possible causes of respiratory distress. Bacterial pneumonia may be suspected based on radiographic findings; however, these findings are not highly specific. Pleural effusion is the most significant predictor of bacterial pneumonia. Alveolar consolidation is more suggestive of bacterial than viral infection, especially if the consolidation is lobar. Interstitial infiltrates can occur in viral or bacterial infections. Positive radiographic findings may be absent in patients with early bacterial pneumonia. [9,12-17] **(Strong Recommendation; Moderate Quality Evidence)**

- Obtain both anterior-posterior (AP) or posterior-anterior (PA) and lateral views
    - AP in children <4 years
    - PA in children >4 years to minimize cardiac shadow
- Follow-up chest radiograph not indicated, unless progressive symptoms or clinical deterioration after 48 to 72 hours post-therapy initiation or as recommended by a radiologist.
- Point of care lung ultrasound is a potential alternative diagnostic modality to radiography, if obtained by proficient provider according to OHSU standards. If proficient provider is unavailable, consider formal ultrasound or chest radiography.

- For suspected complications associated with CAP:
    - Pleural effusion: consider point of care chest ultrasound if obtained by proficient provider. If proficient provider is unavailable, consider formal ultrasound.
    - Necrotizing pneumonia (prolonged fever, septic appearance): consider computed tomography (CT) with contrast or CXR

- Lung abscess: consider CT with contrast or chest radiographs

Microbiologic Testing

Moderate

Blood cultures are not routinely recommended in children requiring hospitalization for presumed uncomplicated bacterial CAP that is moderate in severity.[9, 25, 26] **(Strong Recommendation; Moderate Quality Evidence)**

Severe

Clinicians should obtain blood cultures in cases of complicated or severe pneumonia and for those who are under- or unimmunized, particularly those with complicated pneumonia. [9, 26] **(Strong Recommendations; Moderate Quality Evidence)**

A complete blood cell count (CBC) should be obtained only for patients with severe pneumonia, to be interpreted in the context of the clinical examination and other laboratory and imaging studies. [8,9] **(Conditional Recommendation; Low Quality Evidence)**

Initial Treatment Consideration

When initiating treatment, the clinician should consider setting, immunization status, β-lactam allergy, and suspected etiology. Immunization status should factor into threshold for initiating antibiotics, as under- or unimmunized patients are at high risk for bacterial CAP. See Table 5 for empiric selection of antibiotic therapy and Table 6 for Alternative therapy for beta-lactam allergy.[9,12] **(Consensus adapted from external guidelines)**

In children less than 5 years of age, etiology is more likely to be viral and routine use of antibiotics is not recommended.[9] **(Strong Recommendation; High Quality Evidence)**

For patients with suspected typical bacterial CAP,

- In both fully and partially immunized children, amoxicillin is considered acceptable first line therapy for outpatient management.[9,12] **(Strong Recommendation; Moderate Quality Evidence)**
    - In children who are penicillin-allergic, consider a 3rd generation cephalosporin or clindamycin.

For patients with suspected atypical bacterial CAP,

- If >/= 5 years old, consider monotherapy with a macrolide or can be added to beta-lactam therapy if uncertainty of diagnosis.[9,12] **(Conditional Recommendation; Moderate Quality Evidence)**
    - Azithromycin is an acceptable first line therapy,
    - Doxycycline and/or levofloxacin are acceptable second line therapies.

For patients with suspected viral CAP,

- Consider not initiating antibiotic therapy unless concerns for co-bacterial infection. If treatment is necessary for influenza, oseltamivir is considered acceptable first line therapy, and inhaled zanamivir is considered acceptable second line therapy if patient is older than 7 years old.[9]

Patients receiving intravenous therapy may be switched to oral treatment once they are afebrile and improving clinically, can tolerate oral intake, and have no complications (table 7).[18]

Table 4: Local *S. pneumoniae* susceptibilities (data from Theradoc, calendar years 2017 and 2018)

		All Specimen Sources Streptococcus pneumoniae	
	Isolates	156	
Penicillin	Amoxicillin-Clavulanate	95%*	(21/22)
	Ampicillin	100%*	(2/2)
	Penicillin	90%	(139/155)
Ceph 2nd Gen	Cefoxitin	100%*	(1/1)
Ceph 3rd Gen	Cefotaxime	100%*	(2/2)
	Ceftriaxone	99%	(152/153)
Ceph 4th Gen	Cefepime	100%*	(2/2)
Carbapenems	Ertapenem	100%	(35/35)
	Meropenem	94%	(76/81)
Glycopeptides	Vancomycin	100%	(42/42)
Aminoglycosides	Amikacin	0%*	(0/1)
	Tobramycin	0%*	(0/1)
Quinolones	Ciprofloxacin	100%*	(1/1)
	Levofloxacin	100%	(45/45)
	Moxifloxacin	100%	(36/36)
	Ofloxacin	97%	(35/36)
Miscellaneous Antibiotics	Chloramphenicol	99%	(75/76)
	Clindamycin	100%*	(3/3)
	Linezolid	100%	(35/35)
	Sulfamethoxazole-Trimethoprim	83%	(106/128)
Macrolides	Erythromycin	79%	(84/107)
Tetracyclines	Tetracycline	90%	(115/128)
CSF Antibiotics	Ceftriaxone Csf	97%	(149/154)
	Penicillin Csf	83%	(126/152)

Table 5: Empiric therapy selection for community acquired pneumonia

Presentation (site of care)	Age (years)	Immunization status	Empiric therapy		
			Bacterial pneumonia	Atypical pneumonia	Influenza pneumonia
Uncomplicated CAP; mild-moderate (outpatient or inpatient)	< 5	Full	Amoxicillin	**Atypical pneumonia is less likely in patients <5 years old*	1st line: oseltamivir 2nd line: if > 7 years old, inhaled zanamivir
	< 5	Under	Amoxicillin-clavulanate		
	>=5	Full	1st line: amoxicillin 2nd line: azithromycin, doxcycyline		

	>=5	Under	1st line: amoxicillin-clavulanate 2nd line: azithromycin, doxycycyline	1st line: azithromycin 2nd line: doxycycline, levofloxacin Can be added to beta-lactam therapy if uncertainty of diagnosis	Severe influenza infection should presume bacterial coinfection and administer antibiotics to cover severe CAP with particular attention to MRSA coverage [24] For mild-to-moderate pneumonia, consider not initiating antibiotic therapy unless concerns for co-bacterial infection
Uncomplicated CAP, moderate (inpatient)	Any	Full	Ampicillin		
	Any	Under	1st line: ceftriaxone 2nd line: ampicillin-sulbactam		
Uncomplicated CAP, severe (inpatient)	Any	Any	Ceftriaxone Consider addition of clindamycin or vancomycin if septic		
Complicated CAP, moderate (inpatient)	Any	Any	Ceftriaxone		
Complicated CAP, severe (inpatient)	Any	Any	Ceftriaxone + (clindamycin or vancomycin)		

Table 6: Alternative therapy for antibiotic allergy/contraindications

	Patient is Allergic to…	If Preferred Therapy is…	Then Alternative Therapy(ies) is/are…
Non-severe beta-lactam allergy (e.g. rash)	Penicillin	Amoxicillin ± clavulanate	Cefdinir Cefpodoxime
		Ampicillin ± sulbactam	Ceftriaxone
	Cephalosporins	Ceftriaxone	Ampicillin ± sulbactam
Severe beta-lactam allergy (e.g. anaphylaxis, delayed hypersensitivity reactions)	Any	Amoxicillin ± clavulanate	Azithromycin Doxycycline Levofloxacin
		Ampicillin ± sulbactam Ceftriaxone	Clindamycin Levofloxacin Linezolid Vancomycin
Severe macrolide allergy or contra-indication	Azithromycin	Azithromycin	Doxycycline Levofloxacin

[a] It is important to note that alternative therapies may not be as effective as the preferred therapy or may be associated with severe adverse drug events (e.g. fluoroquinolones); please evaluate patient's allergy to determine if true allergy or if patient can undergo allergy challenge.

Table 7: Intravenous to oral transition options for community-acquired pneumonia

If initial empiric intravenous antibiotic treatment was…	Then patient can be transitioned to:
Ampicillin	Amoxicillin
Ampicillin-sulbactam	Amoxicillin-clavulanate
Ceftriaxone	Preferred: amoxicillin ± clavulanate Alternative(s): cefpodoxime, levofloxacin
Ceftriaxone + clindamycin	Preferred: Clindamycin Alternative(s): linezolid

Table 8: Dosing for common antimicrobials used in pediatric community acquired pneumonia

Antibiotic	Dosing
Amoxicillin	80-90 mg/kg/day PO divided q8-12h (max: 1 g PO q8h)
Amoxicillin-clavulanate	80-90 mg/kg/day (amoxicillin component) PO divided q8-12h (max: 4 g/day)
Ampicillin	200-300 mg/kg/day IV divided q6h (max: 2 g/dose)
Ampicillin-sulbactam	200-300 mg/kg/day (ampicillin component) IV divided q6h (max: 8 g/day)
Azithromycin	10 mg/kg/dose IV/PO once (max: 500 mg) on Day 1; 5 mg/kg/dose IV/PO once daily (max: 250 mg) on Days 2-5
Cefdinir	7 mg/kg/dose PO q12h (max: 600 mg/dose)
Cefpodoxime	5 mg/kg/dose PO q12h (max: 200 mg/dose)
Ceftriaxone	50-75 mg/kg/dose IV q24h (max: 2 g/day)
Cefuroxime	Suspension: 15 mg/kg/dose PO q12h (max: 500 mg/dose) Tablet: 250 mg PO q12h
Clindamycin	30-40 mg/kg/dose IV divided q6-8h (max PO: 1800 mg/day)
Doxycycline	2-2.2 mg/kg/dose IV/PO q12h (max: 100 mg/dose)
Levofloxacin	< 5 years: 10 mg/kg/dose IV/PO q12h ≥ 5 years: 10 mg/kg/dose IV/PO q24h (max: 750 mg/day)
Linezolid	< 12 years: 10 mg/kg/dose IV/PO q8h (max: 600 mg/dose) ≥ 12 years: 10 mg/kg/dose IV/PO q12h (max: 600 mg/dose)
Vancomycin	15-20 mg/kg/dose IV q6h (adjust based on renal function and concentrations)
Oseltamivir	< 1 year: 3 mg/kg/dose PO BID ≥ 1 year: ≤15 kg: 30 mg PO twice daily >15 to 23 kg: 45 mg PO twice daily >23 to 40 kg: 60 mg PO twice daily >40 kg: 75 mg PO twice daily

Treatment courses of 7-10 days are recommended. Shorter courses may be as effective, particularly for more mild disease managed on an outpatient basis, but less research has been done on shorter courses **(Strong Recommendation; Moderate Quality Evidence)** [9,19-20]

Infections caused by certain pathogens, notably CAMRSA, may require longer treatment than those caused by S. pneumoniae **(Strong Recommendation; Moderate Quality Evidence)** [9]

Follow-up and Targeted Therapy

For children whose condition deteriorates after admission and initiation of antimicrobial therapy or who show no improvement within 48–72 hours, further investigation should be performed**. (Strong Recommendation; Moderate Quality Evidence)** [9]

Practice Implications

- Refer to infectious disease if patient is admitted to ICU and has cephalosporin allergy, and/or has suspected complicated bacterial CAP, and or has necrotizing pneumonia or empyema
- Refer to pulmonology if patient has empyema.
- Refer to surgery and interventional radiology (IR) if patient has chest tube placement

Identifying a Parapneumonic Effusion

History and physical examination may be suggestive of parapneumonic effusion in children suspected of having CAP, but presence of pleural fluid should be confirmed with chest radiography (CXR) or chest ultrasound. If CXR identifies effusion greater than 10 mm, then further imaging with chest ultrasound is recommended to determine whether fluid is loculated or free-flowing. Contrast-enhanced CT plays a limited role in evaluation of pleural fluid and should only be obtained for this purpose at the request of an attending physician. **(Strong recommendation; Moderate Quality Evidence)** [7-9, 11, 13]

The child's degree of respiratory compromise is an important factor that determines management of parapneumonic effusions. **(Strong Recommendation; Moderate Quality Evidence)** [21]

The size of the effusion and whether free-flowing or loculated are important factors that determines management. **(Strong Recommendation; Moderate Quality Evidence)** [7]

Laboratory Testing

Gram stain and bacterial culture of pleural fluid should be performed whenever a pleural fluid specimen is obtained. **(Strong Recommendation; Moderate Quality Evidence)** [9]

Nucleic acid amplification through PCR increases the detection of pathogens in pleural fluid and may be useful for management of *Streptococcus pneumoniae*. **(Strong Recommendation; Moderate Quality Evidence)** [9]

Analysis of pleural fluid parameters such as pH and levels of glucose, protein, and lactate dehydrogenase, rarely change patient management and are not recommended. **(Conditional Recommendation; Very Low Quality Evidence)** [9]

Analysis of the pleural fluid white blood cell (WBC) count, with cell differential analysis, is recommended primarily to help differentiate bacterial from mycobacterial etiologies and from malignancy. **(Conditional Recommendation; Moderate Quality Evidence)** [9]

Drainage

Small, uncomplicated parapneumonic effusions should not routinely be drained and can be treated with antibiotic therapy alone. **(Strong Recommendation; Moderate Quality Evidence)** [7,9,13, 21]

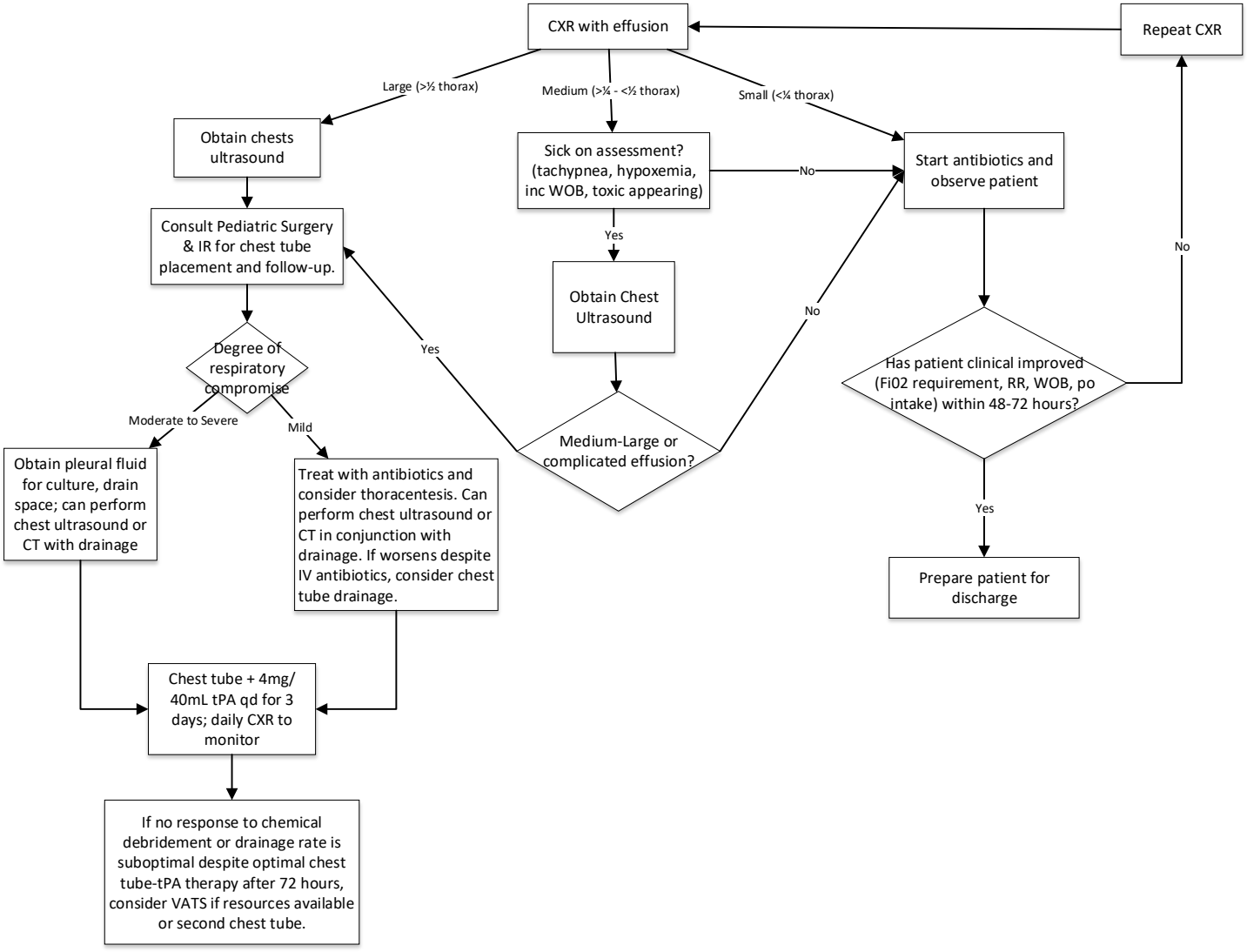
Moderate parapneumonic effusions associated with respiratory distress, large parapneumonic effusions, or documented purulent effusions should be drained. **(Strong Recommendation; Moderate Quality Evidence)** [7,9,13,21]

Both chest thoracostomy tube drainage with the addition of fibrinolytic agents (tPA) and VATS have been demonstrated to be effective methods of treatment. The choice of drainage procedure depends on local expertise. Both of these methods are associated with decreased morbidity compared with chest tube drainage alone. However, in patients with moderate-to-large effusions that are free flowing (no loculations), placement of a chest tube without fibrinolytic agents is a reasonable first option. **(Strong Recommendation; High Quality Evidence)** [9]

Video-assisted Thoracoscopic Surgery (VATS)

VATS should be considered when there is persistence of moderate to large effusions and ongoing respiratory compromise after failure of management with maximal chest tube and fibrinolytic therapy. **(Strong Recommendation; Low Quality Evidence)** [6-7,9,13]

Parapneumonic Effusions Algorithm



Chest Tube Removal

A chest tube can be removed in the absence of an intrathoracic air leak and when pleural fluid drainage is <1 ml/kg/24 h, usually calculated over the last 12 hours. **(Strong Recommendation; Very Low Quality Evidence)** [9]

Practice Implication:

After patient leaves PICU, the Pediatric General Surgery team will manage chest tube.

Antibiotic therapy and duration after treatment of parapneumonic effusion/empyema, excluding lung abscess and necrotizing pneumonia

When blood or pleural fluid bacterial culture identifies a pathogenic isolate, antibiotic susceptibility should be used to determine the antibiotic regimen. **(Strong Recommendation; High Quality Evidence)** [9]

Practice Implication:

Consult with Pediatric Infectious Disease.

- Empiric therapy selection as described in Table 5 for 'Complicated CAP – Severe (Inpatient)
  - Antibiotic therapy should be pathogen-directed, based on results of bacterial culture
  - If culture negative, or treatment started prior to obtaining fluid, therapy selection should be guided by regional epidemiology
- De-escalate and continue therapy for additional 7 days, once all criteria below are met
  - Chest tube removed
  - Afebrile
  - If patient had a positive blood culture, at least 1 negative blood culture

Appropriate management if patient is not responding to treatment

Children who are not responding to initial therapy after 48-72 hours should be managed by one or more of the following:

- Clinical and laboratory assessment of the current severity of illness and anticipated progression in order to determine whether higher levels of care or support are required. **(Strong Recommendation; Low Quality Evidence)** [9]

  Practice Implication:
  - Obtain sputum using flexible bronchoscopy with bronchoalveolar lavage to identify causative pathogens, if possible
  - For additional clarification post-bronchoscopy, may consider CT with contrast

- Further investigation to identify whether the original pathogen persists, the original pathogen was developed resistance to the agent used, or there is a new secondary infecting agent. **(Conditional Recommendation; Low Quality Evidence)** [9]

  Practice Implication:
  - Treatment
    - Expand coverage for MRSA and common local pathogens (e.g., ceftaroline, vancomycin, linezolid)

Discharge

Consider discharge if patient demonstrates overall clinical improvement including: **(Adapted-consensus based on external guidelines)** [7-9, 13-14, 22-23]

- Improved work of breathing
- Increased activity
- Decreased respiratory rate
- Decreasing fever curve
- Pulse oximetry >90% on room air for at least 12 – 24 hours
- Able to take medications orally
- Follow-up care coordinated:
  - Scheduled an appointment with primary care provider within 72 hours

  For patients with complicated pneumonia, consider additional appointments with
  - Scheduling appointment with infectious disease provider
  - Scheduling appointment with pulmonary provider in 6 to 8 weeks.

Prevention

Screen all patients for influenza, pneumococcal, Hib, and/or pertussis immunizations at admission. (**Adapted-consensus based on external guideline**) [22]

Provide influenza antiviral therapy for all children hospitalized with flu. (**Adapted-consensus based on external guideline**) [22]

Children should be immunized with vaccines for bacterial pathogens, including S. pneumoniae, Haemophilus influenzae type b, and pertussis to prevent CAP. (**Strong Recommendation; High Quality Evidence**) [9]

All infants >6 months of age and all children and adolescents should be immunized annually for influenza virus to prevent CAP. (**Strong Recommendation; High Quality Evidence**) [9]

Parents and caretakers of infants <6 months of age, including pregnant adolescents, should be immunized with vaccines for influenza virus and pertussis to protect the infants from exposure. (**Strong Recommendation; Low Quality Evidence**) [9]

Pneumococcal CAP after influenza virus infection is decreased by immunization against influenza virus. (**Strong Recommendation; Low Quality Evidence**) [9]

Improved hand hygiene is an important prevention strategy. (**Adapted-consensus based on external guideline**) [23]

> Practice Implication:
> For patients requiring isolation, please refer to OHSU Isolation Orders

Quality Measures:

Process:

- Percentage of patients receiving appropriate antibiotics
- Total duration of antibiotics by type (complicated vs. uncomplicated)
- Number of tissue plasminogen activator (tPA) treatments
- Duration of chest tube therapy (earlier tPA, efficacy of chest tube management)
- Diagnostic approach (# of CTs, blood culture, point of care ultrasound, full ultrasound)

Outcomes:

- Length of stay
- Readmissions
- % of patients receiving immunizations

Implementation Needs:

- Point of Care Ultrasound (POCUS) Education
- Delegation Protocol (Giving immunizations; involving nutrition & respiration therapy)
- Order Set (Create different order sets for complicated and uncomplicated)
    - Create best practice alert
- Education
    - Dissemination meeting for residents
    - Patient education on immunizations and hand washing
    - Launch Get Well Campaign
- Dashboard to monitor data
- Dissemination (Sub-specialties & partner sites)

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Guideline Preparation

This guideline was prepared by the Office of Clinical Integration (CI) and Evidence-Based Practice (EBP) in collaboration with content experts at Oregon Health and Science University and Hillsboro Medical Center.

Content Expert Team

Alex Foster, Pediatric Hospitalist, OHSU
Andrew Johnson, Interventional Radiology, OHSU
Beech Burns, Emergency Medicine, OHSU
Ben Hoffman, Pediatrics, OHSU
Bronwyn Baz, Pediatrics, Kaiser Permanente
Cat Livingston, Family Medicine, OHSU
Cheri Warren, Informatics, OHSU
Christina Ramo, Pediatrics, OHSU
Cydni Williams, Critical Care, OHSU
Dawn Nolt, Infectious Disease, OHSU
Diana Yu, Pharmacy, OHSU
Deidra Weinert, Acute Care Nursing, OHSU
Elizabeth Fialkowski, General Surgery, OHSU
George Schwoegler, Respiratory Therapy, OHSU
Hayes Bakken, Pediatrics, OHSU
Jared Austin, Hospital Medicine, OHSU
Katharine Hopkins, Diagnostic Radiology, OHSU
Kim Wirth, Family Representative
Louise Vaz, Infectious Disease, OHSU
Mike Powers, Pulmonology, OHSU
Mina Tahai, Pediatrics, OHSU
Natalie Wilcox, Pediatrics, OHSU
Rachel Castelli, Emergency Medicine, Tuality
Richard (Mick) Scanlan, Pathology, OHSU

Clinical Integration and EBP Team

Marcy Hager, MA, EBP Program Manager
Andrew Hamilton, MS/MLS, Liaison Librarian
Stephanie Halvorson, MD, Medical Director, Clinical Integration
Rebecca Jungbauer, DrPH, MPH, MA, Research Associate/Project Manager, Evidence-based Practice Center
Marian McDonagh, PharmD, Associate Director of the Evidence-based Practice Center (EPC)

Development Process

This guideline was developed using the process outlined in the CI and EBP Manual (2016). The review summary documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts
2. Review of Existing Internal and External Guidelines
   - Literature Review of Relevant Evidence
3. Critically Analyze the Evidence
4. Summarize the Evidence by preparing the guideline, and order sets
   - Materials used in the development of the guidelines, review summaries are maintained in ...

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **University of Pennsylvania's Trustworthy Guideline Rating Scale**. The summary of these guidelines are included in the evidence summary. The rating scale is based on the Institute of Medicine's "Standards for Developing Trustworthy Clinical Practice Guidelines" (IOM), as well as a review of the AGREE Enterprise and Guidelines International Network domains. This scale evaluates a guideline's transparency, conflict of interest, development group, systematic review, supporting evidence, recommendations, external review and currency and updates. The purpose of this scale is to focus on the weaknesses of a guideline that may reduce the trust a clinical user can have in the guideline, and distinguish weaknesses in documentation (e.g. guideline does not have a documented updating process) from weaknesses in the guidance itself (e.g. recommendations are outdated).

The **GRADE (Grading of Recommendations, Assessment, Development and Evaluation)** criteria were utilized to evaluate the body of evidence used to make clinical recommendations. The table below defines how the quality of the evidence is rated and how a strong versus conditional recommendation is established. The evidence summary reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
CONDITIONAL	Desirable effects closely balanced with undesirable effects
Quality	**Type of Evidence**
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies

Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, from RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Recommendations for the guidelines were directed by the existing evidence, content experts, and consensus. Patient and family preference were included when possible. When evidence is lacking, options in care are provided in the guideline and the order sets that accompany the guideline.

Approval Process

Guidelines are reviewed and approved by the Content Expert Team, Office of CI and EBP, Knowledge Management and Therapeutics Committee, Professional Board, and other appropriate hospital committees as deemed appropriate for the guideline's intended use. Guidelines are reviewed and updated as necessary every 2 to 3 years within the Office of CI and EBP at OHSU. Content Expert Teams will be involved with every review and update.

Disclaimer

Guideline recommendations are made from the best evidence, clinical expertise and consensus, in addition to thoughtful consideration for the patients and families cared for within the Integrated Delivery System. When evidence was lacking or inconclusive, content experts made recommendations based on consensus. Expert consensus is implied when a reference is not otherwise indicated.

The guideline is not intended to impose standards of care preventing selective variation in practice that is necessary to meet the unique needs of individual patients. The physician must consider each patient and family's circumstance to make the ultimate judgment regarding best care.