
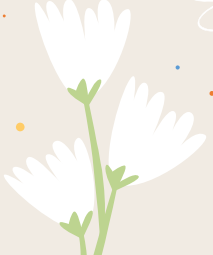


Airway Anatomy



- Large head
- Small mandible
- Small neck
- Large posteriorly placed tongue
- High glottis opening
- Small airways
- Presence of tonsils, adenoids
- Poor accessory muscle development
- Less rigid thoracic cage
- Horizontal ribs
- Primarily diaphragm breathers
- Increased metabolic rate, increased O2 consumption

Additional Considerations



Kids are often affected by congenital or infectious process versus adults affected by respiratory disease (COPD) or infectious process


Decrease respiratory reserve + increased O2 demand = increased risk of respiratory failure

Oxygenation failure: most common type of respiratory failure, main pathophysiology derangements (VQ mismatch, shunt, hypoventilation)

Classify O2 Emergencies



Types of Respiratory Conditions



- UPPER AIRWAY OBSTRUCTION**
 - Croup
 - Epiglottitis
 - FB aspiration
 - Anaphylaxis
 - Peritonsillar or retropharyngeal abscess
- LOWER AIRWAY OBSTRUCTION**
 - Asthma
 - Bronchitis
- LUNG TISSUE DISEASE**
 - Pneumonia
 - Pulmonary edema (congestive heart failure, sepsis, pulmonary contusion)

03 Signs of Respiratory Distress



Signs of Respiratory Distress


- General appearance
 - Speech
 - Anxious vs comfortable
 - Body position
- Retractions
 - Subcostal
 - Intercostal
 - Supraclavicular
 - Suprasternal
- Nasal flaring
- Grunting
- Oxygen requirement?

Signs of Impending Respiratory Failure

- Change in mental status
- Severe WOB
- Hypoxemia

Auscultation

WHEEZES High pitch often heard on expiration due to narrowing of lower airways	RALES Discontinuous sound like bubbling, popping, often on inspiration	RHONCHI Low pitch rattling or snoring heard on both inspiration and expiration
STRIDOR Continuous high pitch, lack of airflow to upper airway on inspiration	STERTOR Radiating upper airway congestion from nose or mouth	



Management 04



Bronchiolitis

Inflammation of small airways (bronchioles) causing obstruction via edema, mucus, cellular debris

Age: 2yo or less


- Bronchiolar edema is less clinically apparent as airway size increases with age

RSV, adenovirus, rhinovirus, bocavirus, influenza, coronavirus, etc

General assessment: **FATIGUE?** **PLAYFUL?** **OXYGEN REQUIREMENT?**
TACHYPNEA? **FUSSY?** **SIGNS OF DEHYDRATION?**

Auscultation: Wheezes, rales, or rhonchi or combination

Diagnosis: Clinical



Bronchiolitis

Antibiotics Inhaled Steroids

CXR Systemic Steroids

Albuterol?

Bronchiolitis

Management: Supportive care

- Suctioning
- Oxygen support
- Feeding support

Prevention:

- Palivizumab: monoclonal antibody that targets preF and postF protein
 - Qualifications:
 - Premature infants who are 6 months or younger
 - Children ages 24 months or younger who have been
 - Treated with bronchopulmonary dysplasia in the last 6 months
 - Those 24 months or younger with significant congenital heart disease
- Nirsevimab: monoclonal antibody that targets preF protein
 - Qualifications:
 - Infants under 8 months old who weigh less than 5 kg; For those born during RSV season, a dose is typically given during the first week of life.

Croup

Most common cause of upper airway obstruction in pediatrics

Viral infection of the upper airway: glottis and subglottic regions

- Diffuse inflammation, erythema, and edema develop in the tracheal walls
- Mobility of vocal cords becomes impaired
- Subglottic region is narrowest part of child's airway and surrounded by cartilage; swelling here will dramatically reduce airflow
- Alveolar gas exchange is usually normal because upper airways affected (unless condition is severe)

Ages 1-6 years old (peak incidence 2 years old)

Parainfluenza (65%), influenza, RSV, COVID-19, and more

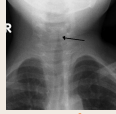
Croup

Hoarse voice; dry, barking cough; inspiratory stridor; respiratory distress

- Starts with rhinorrhea
- Often fever present
- Symptoms are worse at night
- Within 12-48 hours develops upper airway obstruction
- Most often just hoarseness and cough that will self-resolve in 3-7 days

Diagnosis:

- Clinical
- Neck x-ray may show "steeple sign" **but x-ray is not necessary**



**TO TREAT?
OR NOT TO TREAT?**

Croup

MILD CROUP

Never mild oridor at rest
Stridor only with agitation or activity
Never mild increased work of breathing

Dexamethasone 0.6mg/kg
Supportive care

MODERATE TO SEVERE CROUP

Stridor at rest
Moderate to severe work of breathing

- Moderate retractions
- Tachypnea
- Restless, SIV appearing
- Difficulty talking or feeding

Dexamethasone 0.6mg/kg
Racemic epinephrine every 2 hours as needed for respiratory distress
Supportive care

Observation for 2 hours after racemic epinephrine (racemic epinephrine lasts only 2 hours)
If condition worsens then repeat racemic epinephrine

Croup

Dexamethasone 0.6mg/kg/dose

- Choose least invasive route as able (PO if able)
- Can administer IV product by mouth (PO)
- Symptom improvement usually within 6-12 hours of administration

No evidence to support the use of:

- Viral PCR panel
- X-rays
- Cool mist

Pertussis

Highly contagious afebrile respiratory illness caused by **Bordetella pertussis**

- Attack rate 90-100% via aerosolized droplets

Can occur at any age; unvaccinated

INFANTS <3 MONTHS OLD DO NOT DISPLAY CLASSIC STAGES

Catarrhal phase only few days, often aerosolized followed by choking, gagging, gasping with the slightest stimuli; usually do not hear a whoop with cough; apnea, cyanosis

Number, severity, duration of coughing episodes diminish

congestion, rhinorrhea, fever

intense uninterrupted cough "whooping cough," posttussive emesis

Pertussis

Diagnosis: Clinical, PCR panel or respiratory culture

Management:

- Difficult to care for infants: do not startle (calm, dim lit room, quiet); feeding can be challenging
- TREATMENT: azithromycin
- PROPHYLAXIS: azithromycin to all household and close contacts, most effective within 21 days of cough onset

Epiglottitis

Inflammation of epiglottitis, which is a small flap of cartilage that closes over the airway during swallowing) caused by **Haemophilus influenzae type B (HIB)**

Most commonly ages 2-6 years old; unvaccinated

Epiglottitis

! Decrease anxiety. Find position of comfort. Do NOT use a tongue blade to examine pharynx!

Inflammation of epiglottitis, which is a small flap of cartilage that closes over the airway during swallowing) caused by **Haemophilus influenzae type B (HIB)**

Most commonly ages 2-6 years old; **unvaccinated**

Fever, sore throat, trouble swallowing, trouble moving neck downward

- **Typically no cough** (*different from croup!*)
- As infection progresses: **Sit upright, lean forward "tripoding,"** very still, tachypneic, **drooling** (cannot swallow saliva), **muffled voice**, respiratory distress
- Can rapidly develop into complete obstruction of the airway!

Diagnosis:

- Clinical.
- Lateral neck x-ray: "thumb sign"
- Definitive diagnosis: laryngoscopy in ICU or OR

Treatment: Often requires **intubation and/or surgical airway; IV ampicillin-sulbactam**; manage complications (pulmonary edema, bacteremia, pneumonia)

Asthma

AIRWAY INFLAMMATION <ul style="list-style-type: none"> • Edema • Cellular infiltration (eosinophils) • Increased secretions 	AIRWAY HYPER-RESPONSIVE <ul style="list-style-type: none"> • Abnormal smooth muscle contractility • Excess smooth muscle • External stimuli 	REVERSIBLE BRONCHO-CONSTRICTION <ul style="list-style-type: none"> • Reduced expiratory airflow improves with bronchodilator
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Asthma

Taking an asthma history:

- Duration
- Severity
- Current medications
 - Number of steroid courses in the last year
- Previous exacerbations
 - Number of ED visits for asthma in the last year?
 - Number of hospital admissions for asthma in the last year? Length of stay? ICU stay?
 - Intubations?
- Infectious symptoms
- Triggers
- Activity level

Red Flags:

- History of sudden, severe attacks
- Prior intubation and/or ICU admission
- ≥ 2 hospitalizations in the last year
- ≥ 3 ED visits in the last month
 - Recent use of steroids
 - Hospitalization in the last month
- < 5 yrs of age

Asthma

Physical exam

- General appearance
 - Signs of respiratory distress
 - Speaking? If so, how many words before out of breath?
 - Body position
 - Level of consciousness
- Vital signs (Tachypnea? Oxygen requirement? Tachycardia?)
- Lung exam
 - Adventitious sounds: wheezing
 - Phase: inspiratory, expiratory, end-expiratory
 - Diffuse versus localized
 - Quality of aeration
 - Symmetric?
 - Diminished breath sounds versus good aeration

Asthma

Diagnosis: Clinical; your ears and observation are more reliable (dynamic exam) over a static image

- Chest x-ray may show hyper-inflation and flattening of diaphragm (air trapping)
- Reversible bronchoconstriction, responsive to bronchodilator
- Age <5 years old?
- Outpatient can pursue pulmonary function tests
- Pediatric asthma score (PAS)

Asthma

ACUTE ASTHMA MANAGEMENT

Bronchodilator
Epinephrine: alpha and beta agonist
Terbutaline: beta agonist

Bronchodilator and smooth muscle relaxant (relieve bronchospasm)
Dose 50mg/kg (maximum 2g)
Administer with NS bolus

Bronchodilator
Beta-2 agonist
MDI 4-8 puffs vs continuous nebulization

Bronchodilator (less potent)
Anticholinergic
MDI vs nebulization
Given with albuterol x3 back-to-back (q20 minutes)

Reduces inflammation
Peaks in 6-12 hours
Oral is equivalent to IV (what route is safe?)
Systemic options:
• Dexamethasone
• Prednisolone, prednisone, methylprednisolone

Asthma

Admission criteria

- Oxygen requirement
 - NOTE: Transient hypoxemia is common after albuterol administration due to VQ mismatch
 - Persistent hypoxemia: O2 sats <90% after peak bronchodilator effect resolves
- Requiring albuterol administration more often than q4 hours

Discharge criteria

- No oxygen requirement
- Work of breathing improved
- Albuterol every 4 hours
- Prescribe steroid course (options):
 - Prednisone or prednisolone 2mg/kg/day x5 days
 - Dexamethasone administer during encounter and consider additional oral dose on day 2 or 3
- Close follow-up
- Anticipatory guidance, asthma action plan

Community Acquired Pneumonia

Worldwide, pneumonia kills more children than any other infectious disease.

Children in USA:

- 2 million outpatient visits/year
- 124,000 hospitalizations/year

Most common bacterial pathogens

- Streptococcus pneumoniae
- Haemophilus influenzae
- Streptococcus pyogenes
- Staphylococcus aureus (particularly after influenza)

Community Acquired Pneumonia

Presentation: Fever, tachypnea, respiratory distress, cough, rhinorrhea, congestion, sometimes abdominal pain

Physical exam: Consolidation: decreased aeration, rales, respiratory distress

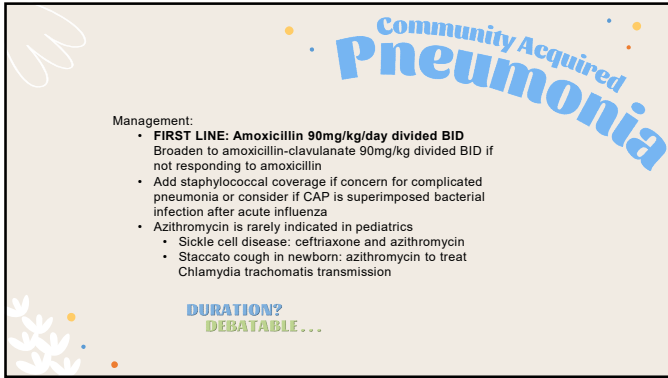
Diagnosis:

- Uncomplicated: Clinical**
 - Inflammatory markers ?utility
 - Imaging: CXR ?consolidation vs atelectasis; your ears are more reliable (dynamic exam) rather than relying on a static image
- Complicated:** Ultrasound (detect effusion, abscess)

CXR and inflammatory markers do not differentiate which patients should benefit from antibiotics.

What about viral pneumonia?

- No consolidation, exam is symmetrical
- Antibiotics are not necessary, symptomatic care only

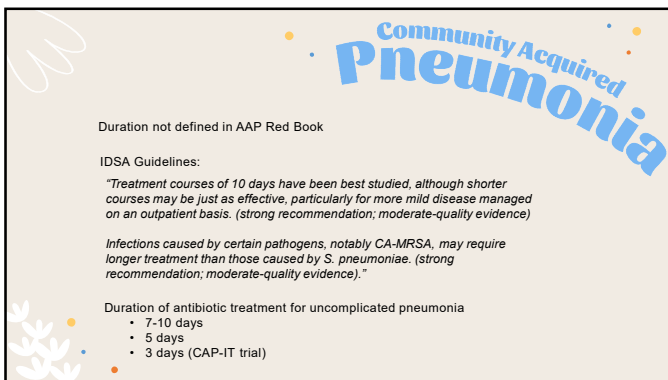


Community Acquired Pneumonia

Management:

- **FIRST LINE: Amoxicillin 90mg/kg/day divided BID**
Broaden to amoxicillin-clavulanate 90mg/kg divided BID if not responding to amoxicillin
- Add staphylococcal coverage if concern for complicated pneumonia or consider if CAP is superimposed bacterial infection after acute influenza
- Azithromycin is rarely indicated in pediatrics
 - Sickle cell disease: ceftriaxone and azithromycin
 - Staccato cough in newborn; azithromycin to treat Chlamydia trachomatis transmission

DURATION?
DEBATABLE...



Community Acquired Pneumonia

Duration not defined in AAP Red Book

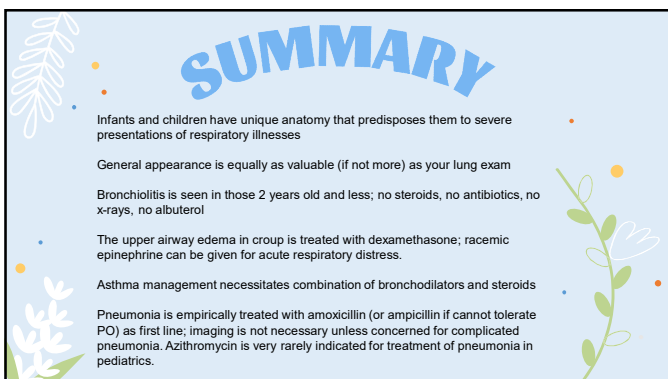
IDSA Guidelines:

"Treatment courses of 10 days have been best studied, although shorter courses may be just as effective, particularly for more mild disease managed on an outpatient basis. (strong recommendation; moderate-quality evidence)

Infections caused by certain pathogens, notably CA-MRSA, may require longer treatment than those caused by S. pneumoniae. (strong recommendation; moderate-quality evidence)."

Duration of antibiotic treatment for uncomplicated pneumonia

- 7-10 days
- 5 days
- 3 days (CAP-IT trial)



SUMMARY

Infants and children have unique anatomy that predisposes them to severe presentations of respiratory illnesses

General appearance is equally as valuable (if not more) as your lung exam

Bronchiolitis is seen in those 2 years old and less; no steroids, no antibiotics, no x-rays, no albuterol

The upper airway edema in croup is treated with dexamethasone; racemic epinephrine can be given for acute respiratory distress.

Asthma management necessitates combination of bronchodilators and steroids

Pneumonia is empirically treated with amoxicillin (or ampicillin if cannot tolerate PO) as first line; imaging is not necessary unless concerned for complicated pneumonia. Azithromycin is very rarely indicated for treatment of pneumonia in pediatrics.

REFERENCES

1. Shawn L. Rabito, et al. Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis. Pediatrics November 2014.
2. John S. Bradley et al. The Management of Community-Acquired Pneumonia in Infants and Children Older Than 3 Months of Age: Clinical Practice Guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clinical Infectious Diseases, Volume 53, Issue 7, 1 October 2011, Pages 605–616.
3. Cloutier MM, et al., Expert Panel Working Group of the National Heart, Lung, and Blood Institute (NHLBI) administered and coordinated National Asthma Education and Prevention Program Coordinating Committee (NAEPCCC) 2020 focused updates to the asthma management guidelines: a report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group. J Allergy Clin Immunol. 2020;146(6):1217-1276.
4. Katz SE, Williams DJ. Pediatric Community-Acquired Pneumonia in the United States: Changing Epidemiology, Diagnostic and Therapeutic Challenges, and Areas for Future Research. Infect Dis Clin North Am. 2018 Mar;32(1):47-63.
5. Briley JS, Brighton CL, et al. Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Executive summary, the management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis. 2011 Oct;53(7):1617-30.
6. Deborah Lehman. Revisiting Amoxicillin Dose and Duration in Children with Community-Acquired Pneumonia: Is Less Just as Good? NEJM. November 2021.
7. Penrice JM, Hamon S, Kam AJ, et al. Short-Course Antimicrobial Therapy for Pediatric Community-Acquired Pneumonia: The SAFER Randomized Clinical Trial. JAMA Pediatr. 2021;175(5):475-482.
8. Betsios JA, Shih W, Barak S, et al. Effect of Amoxicillin Dose and Treatment Duration on the Need for Antibiotic Re-treatment in Children With Community-Acquired Pneumonia: The CAP-IT Randomized Clinical Trial. JAMA. 2021 Nov 23;326(17):1713-1724.
9. Gao Y, Liu M, et al. Shorter Versus Longer-term Antibiotic Treatments for Community-Acquired Pneumonia in Children: A Meta-analysis. Pediatrics. 2023 Jun 1;151(6):e2022090997.
10. Wald-Dinkel N, Spießberg B. Short-course Antibiotic Therapy-Replacing Constanter Units With "Shorter Is Better". Clin Infect Dis. 2019 Oct 15;69(9):1476-1479.



Thank You

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