CARILION CLINIC
Antimicrobial Stewardship

Management of Upper Respiratory Tract Infections in Adults and Children

Included Disease States:

- Pharyngitis
- Bronchitis
- Laryngotracheobronchitis (Croup)
- Bacterial tracheitis
- Retropharyngeal abscesses and deep neck infections
- Epiglottitis

Pharyngitis

- **Presentation**[1-2]
  - History and physical exam can be used to diagnose when very clear viral symptoms are present
    - Cough, rhinorrhea, hoarseness, oral ulcers, and conjunctivitis
    - *Strep* pharyngitis often produces white patches in the throat and on the tonsils with red swollen tonsils
    - Fungal pharyngitis may present with angular cheilitis (painful, cracked sores on the corners of the mouth) and curd-like plaques or smooth red patches within the oropharynx

- **Microbiology**[2-4]

Pathogens	
Viral (Most common ~40%)	**Adenovirus**, influenza, parainfluenza, rhinovirus, respiratory syncytial virus (RSV), Epstein-Barr virus (EBV), cytomegalovirus
Bacterial	**Group A streptococcus (20-30% in children, 5-15% in adults)**, Group C streptococcus, *Chlamydia pneumoniae, Mycoplasma pneumoniae*
Fungal	*Candida albicans* oral candidiasis or thrush involving the pharynx

- **Initial Assessment**[2, 5-6]
  - Rapid antigen detection tests (RADT) are recommended for traditional culture and sensitivity using the algorithm below (Manufacturer: Acceava®, 97% sensitive, 95% specific)
  - The M-Centor score should be utilized to determine testing and treatment recommendations for patients 3 years of age and older
  - Symptomatic children with negative RADT should receive a throat culture to follow up

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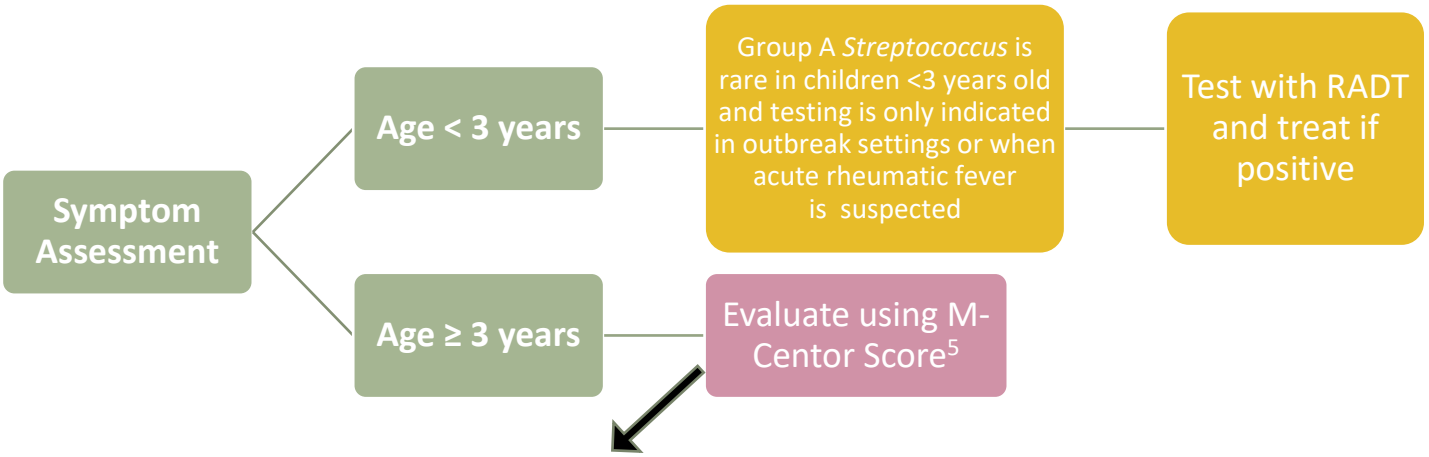

M-Centor Calculation	Symptom/Characterization	Point Value
	Absence of cough	1
	Swollen/tender anterior cervical lymph nodes	1
	Temp >100.4	1
	Age 3 – 14 years	1
	Age 15 – 44 years	0
	Age ≥45	-1

M-Centor Score Interpretation	Score	Recommendation
	0 – 1	Do not test, do not treat
	2	Test and treat if RADT positive
	3	Test or treat empirically
	4	Treat empirically

- **Group A streptococcus pharyngitis complications and treatment**[2,7]
  - Treatment of confirmed group A strep pharyngitis reduces the risk for development of acute rheumatic fever and spread to close contacts
    - The CDC recommends against routine antibiotic prophylaxis for household contacts; maintain a heightened index of suspicion for subsequent disease 30 days after a severe group A streptococcus infection
  - Group A streptococcus carriers with positive throat cultures/RADT positive without clinical symptoms usually do not require treatment
    - Carriers are less likely to transmit group A strep to others or develop complications
  - Other complications of group A streptococcus
    - Peritonsillar abscess, retropharyngeal abscess, cervical lymphadenitis, mastoiditis, post-streptococcal glomerulonephritis

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- **Pharyngitis Treatment for Adults and Children**[7-8]

Azithromycin is NOT an appropriate alternative for penicillin-allergic patients – Group A *Streptococcus* resistance is 53% per Carilion antibiogram

Adult Treatment Recommendations for Pharyngitis			
Infection Type	**Preferred**	**Alternative/Allergy**	**Duration**
Viral	Supportive treatment **No antibiotics indicated**		
Bacterial	Streptococcal: **Penicillin VK** 500 mg PO TID **Penicillin G Benzathine** 1.2 million units IM once **Amoxicillin** 500 mg PO BID	Streptococcal: **Cephalexin** 500 mg PO BID **Clindamycin** 300 mg PO TID	10 days
Fungal	Oropharyngeal: **Nystatin suspension** 400,000-600,000 units swish and swallow* four times daily *Swish in the mouth and retain for as long as possible (several minutes) before swallowing	Oropharyngeal: **Fluconazole** 100 -200 mg PO daily	7– 14 days
	Esophageal: **Fluconazole** 200-400 mg PO daily	Esophageal: **Anidulafungin** 200 mg IV daily	14 – 21 days

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Pediatric Treatment Recommendations for Pharyngitis			
Infection Type	**Preferred**	**Alternatives/Penicillin Allergy**	**Duration**
Viral	Supportive Treatment **No antibiotics indicated**		
Bacterial*	Streptococcal: **Penicillin VK** ≤ 27 kg: 250 mg PO BID/TID > 27 kg: 250 mg PO 4 times daily or 500 mg PO BID/TID **Penicillin G Benzathine** ≤27 kg: 600,000 units IM once ≥27 kg: 1.2 million units IM once **Amoxicillin** 50 mg/kg (max 1000 mg) PO daily *No atypical coverage required empirically (less common)	Streptococcal: **Cephalexin** 20 mg/kg/dose (max 500 mg) PO BID **Clindamycin** 7 mg/kg/dose (max 300 mg) PO TID	10 days
Fungal	**Oropharyngeal:** **Nystatin oral suspension** Infants: 200,000 units (100,000 units swabbed to each cheek) four times daily. Avoid feedings for 5-10 minutes following administration. Children & adolescents: 400,000 - 600,000 units swish and swallow* four times daily *Swish in the mouth and retain for as long as possible (several minutes) before swallowing	**Oropharyngeal:** **Fluconazole** 3 mg/kg (max 100 mg) PO daily	7 – 14 days
	Esophageal: **Fluconazole** 3 mg/kg (max 100 mg) PO daily	**Esophageal:** **Micafungin** 2 mg/kg (max 150 mg) IV q24h	14 – 21 days

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Bronchitis

- **Presentation**[9]
  - Acute or chronic inflammation of the bronchi
  - Dry or wet cough, runny nose, chest congestion/pain, low-grade fever and chills, wheezing, sore throat, vomiting/gagging; symptoms typically last 7-14 days, with cough extending 3-4 weeks after other symptoms have resolved

- **Microbiology**[10]

Pathogens	
Viral (most common)	Influenza, rhinovirus, adenovirus, human metapneumovirus, coronavirus, parainfluenza, respiratory syncytial virus (RSV), COVID-19
Bacterial	*Mycoplasma pneumoniae, Chlamydophila pneumoniae, Bordetella pertussis*

- **Initial Assessment**[9]
  - More than 90% of bronchitis cases are viral. The presence of purulent sputum does NOT indicate bacterial infection
  - Assess for presence of pneumonia if systemic signs of infection are present (chest X-rays, sputum cultures, etc.)

- **Treatment**[9-10]
  - **Supportive care** (rest, acetaminophen/ibuprofen for fever and pain, fluids, cool-mist humidifier)
  - Studies have shown minimal benefit regarding the treatment of acute bronchitis with antibiotics due to the viral origin of most cases. Several meta-analyses have found that antibiotics may have a modest beneficial effect for frail elderly patients with multiple morbidities who have scarcely been included in clinical trials. Benefits of antibiotics should be weighed with risks of adverse events, increased resistance of respiratory pathogens, and costs

NO antibiotics are indicated for treatment of acute bronchitis even in confirmed bacterial bronchitis

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Laryngotracheobronchitis (Croup)

- **Presentation**[11]
  - Most commonly affects children between 6 months and 3 years of age
  - Usually preceded by 24-72 hours of nonspecific cough, rhinorrhea, coryza and fever, with the abrupt onset of a barky cough, hoarseness, and inspiratory stridor; symptoms are often worse at night
  - Viral infection causes edema and inflammation of the upper airways and laryngeal mucosa resulting in narrowing in the subglottic region of the airway
  - ~60% of children will have resolution of symptoms within 48 hours and ~2% have symptoms persisting > 5 nights

Differential Diagnoses of Stridor[11]	
Common	Croup
Less Common	Bacterial tracheitis Epiglottitis
Rare	Upper airway abscess (peritonsillar or retropharyngeal) Foreign-body aspiration or ingestion (tracheal or esophageal) Allergic reaction with upper airway edema Angioedema Hemangioma Laryngeal diphtheria

- **Microbiology**[12]

Pathogens	
Most cases of laryngotracheobronchitis are **viral:**	Parainfluenza viruses (most common), RSV, adenoviruses, influenza viruses, enteroviruses, COVID

- **Assessment**[12-13]
  - The Modified Westley Croup Severity Score is used to assess severity of croup, guide treatment and medical management, and help predict clinical outcomes. The two most critical features are the presence of chest wall retractions and stridor at rest.
  - See next page for details

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Modified Westley Croup Severity Score	
Clinical Feature	**Assigned Score**
Level of consciousness	Normal, including sleep = 0 Disoriented = 5
Cyanosis	None = 0 With Agitation = 4 At rest = 5
Stridor	None = 0 With agitation = 1 At rest = 2
Air entry	Normal = 0 Decreased = 1 Markedly decreased = 2
Retractions	None = 0 Mild = 1 Moderate = 2 Severe = 3

Score	Severity	Description	Management
≤2	**Mild**	• Occasional barky cough • No stridor at rest • Mild or no retractions	• Home treatment (antipyretics, fluids, mist) • Outpatient: single dose PO dexamethasone
3 – 5	**Moderate**	• Frequent barky cough • Stridor at rest • Mild to moderate retractions • No or little distress/agitation	• Single dose PO dexamethasone • Nebulized epinephrine • Hospitalization generally not needed
6 – 11	**Severe**	• Frequent barky cough • Stridor at rest • Marked retractions • Significant distress/agitation	• Single dose PO/IM/IV dexamethasone • Repeated doses of nebulized epinephrine PRN • Inpatient admission usually required • Improved after corticosteroid and nebulized epinephrine
≥12	**Impending respiratory failure**	• Depressed level of consciousness • Stridor at rest • Severe retractions • Poor air entry • Cyanosis or pallor	• Single dose PO/IM/IV dexamethasone • Repeated doses of nebulized epinephrine PRN • ICU admission is usually required • May require intubation

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- **Additional Treatment Details**[14-22]

Observation and supportive care

Nebulized epinephrine may be trialed for short-term symptomatic management:

- Highly effective treatment for upper airway obstruction caused by croup via its alpha-1 effect of vasoconstriction; reduces length of stay, intubation rates and ICU admission
- Racemic epinephrine 2.25%: 0.5 mL nebulized x 1; may repeat every 20 minutes as needed
- If nebulized product not available, may use parenteral 1 mg/mL solution: 0.5 mL/kg (max dose: 5 mL) diluted in NS given via nebulizer x 1; may repeat every 20 minutes as needed
- Monitoring: If requiring ≥ 3 doses within a 2–3-hour period, initiate close cardiac monitoring

Albuterol does not have significant alpha-1 effect rendering it ineffective for treatment of croup, and its beta effect could potentially cause vasodilation, worsening upper airway edema

Glucocorticoids (dexamethasone, prednisone) reduce symptoms of croup at ~2 hours, shorten hospital stay, and reduce the rate of return visits

- For patients with mild-moderate croup, 0.15 mg/kg of dexamethasone may be as effective as 0.3 mg/kg or 0.6 mg/kg (max daily dose of 8-10 mg) in relieving symptoms. May be given PO/IV/IM.
- For patients with severe croup: dexamethasone PO/IV/IM 0.6 mg/kg (max: 10-16 mg/dose); may repeat x 1 for moderate-severe croup requiring hospital admission.

Observe patients with moderate persistent symptoms for at least 4 hours before initiating hospital admission to allow the steroids to take effect.

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Bacterial Tracheitis

- **Presentation**[23,24]
  - Mucopurulent exudation, ulceration, and sloughing of tracheal mucosa can cause acute upper airway obstruction
  - Clinical features are similar to croup and epiglottitis
    - Decreased response to treatment for croup (racemic epinephrine and steroids) and generally appear more toxic with higher body temperatures
    - Onset is acute with respiratory stridor, high fever, and, often, copious and purulent secretions
    - Respiratory obstruction may rapidly progress, often necessitating tracheal intubation
  - Presents secondary to acute respiratory viral infection
  - Primary affects children 6 months – 14 years (0.1 cases per 100,000 children per year)
  - Ventilator-associated tracheobronchitis (VAT) is a gray area without clear guidelines for treatment. Historically it has not been recommended to be treated.
  - Studies have shown that VAT may be an associated precursor for ventilator-associated pneumonia (VAP). VAP has a much higher mortality rate, so declining to treat VAT may lead to more frequent cases of VAP, and therefore increasing mortality. Individual clinical assessment should be considered for each patient.

- **Microbiology**[23]

Pathogens
M. catarrhalis, S. aureus, S. pneumoniae, Group A Streptococcus, *H. influenzae*
Viral coinfection is common
Anaerobe involvement is unclear

- **Initial Assessment**[25]
  - Tracheal aspirate cultures (aerobic and anaerobic)
    - Evaluation for both leukocytes and a positive bacterial culture
    - It can sometimes be difficult to interpret cultures as infection vs. colonization. Studies have shown a correlation between tracheal aspirate cultures and antibiotic initiation with longer durations of therapy. Careful assessment of the cultures should be taken.
  - Radiographic imaging +/- laryngobronchoscopy
    - Children with suspected bacterial tracheitis should receive imaging which frequently shows narrowing of the subglottic area
    - ~50% may have findings suggestive of pneumonia
    - Laryngobronchoscopy is the most definitive way to diagnose bacterial tracheitis and to exclude other differential diagnoses such as epiglottitis
      - Subglottic narrowing, diffuse erythema and mucopurulent exudates
      - +/- pulmonary toilet with culture obtainment
  - Differential from croup: poor response to racemic epinephrine and systemic corticosteroids

- **Treatment**[23-24,26]
  - Endotracheal intubation may be required
  - Adequate pain management to avoid cough suppression
  - Chest physiotherapy can be helpful to clear secretions

Pediatric Antibiotic Treatment Recommendations for Bacterial Tracheitis			
Treatment Stage	**Preferred**	**Alternative**	**Duration**
Empiric	**Ceftriaxone** 50-75 mg/kg (max 2000 mg) IV q24h **+ Vancomycin** 20 mg/kg (max 1000-2000 mg) IV q6h*	Beta lactam allergy: **Levofloxacin** **+** **Vancomycin** **or Clindamycin** **Levofloxacin:** 6 months – 5 years: 8 -10 mg/kg (max 375 mg) IV q12h ≥5 years: 10 mg/kg (max 750 mg) IV q24h	Continue IV antibiotics until clinical improvement **and** afebrile ≥ 48h
No response to initial therapy	Consider addition of anaerobic coverage **Clindamycin** 10 mg/kg (max 900 mg) IV q6-8h **or** **Metronidazole** 10 mg/kg (max 1000 mg) **IV** q8h	--	10 – 14 days (IV + PO)

*may require dosing adjustments based on renal function. See Pediatric Vancomycin Dosing Protocol for details

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Retropharyngeal Abscess & Deep Neck Infections

- **Presentation**[27]
  - Most common among young children (<5 years old)
  - Larger lymph nodes at this age are more prone to infection
  - Abscesses may form following an upper respiratory infection
  - Fever, limited mobility due to neck pain, dysphagia, pain with swallowing, very poor oral intake, drooling, change in voice, respiratory distress (tachypnea, stertor, stridor, tripod posture)
    - If the child has been pretreated with antibiotics, signs and symptoms may be more subtle

- **Microbiology**[28]

Bacterial Pathogens	
• ***Streptococcus pyogenes***	• *Peptostreptococcus Porphyromonas*
• ***Staphylococcus aureus*** **(including MRSA)**	• *Prevotella*
• *Bacteroides*	• *Veillonella*
• *Fusobacteria*	• *Haemophilus influenzae*

- **Initial Assessment**[27-28]
  - Lateral neck imaging (X-ray, CT scan, ultrasound)
  - Abscess (aerobic/anaerobic) cultures + CBC
  - Differential diagnoses
    - Epiglottitis/uvulitis, peritonsillar abscess, Ludwig's angina, angioedema anaphylaxis, tumor, bacterial tracheitis, viral croup, Lemierre's disease
  - Assessment of complications
    - Blocked airway/ARDS
    - Aspiration pneumonia
    - Jugular vein thrombosis
    - Infection spread: Pneumonia, bacteremia, septic shock

- **Treatment**[27-28]
  - All confirmed cases will require hospital admission, IV antibiotics, and ENT consult
  - If upper airway compromise is present, immediate surgical I&D of abscess
    - Careful airway monitoring (especially in the first 24 – 48 hours of treatment)
  - IV antibiotics until patient is clinically improved and afebrile for 24 hours
    - May then be transitioned to oral antibiotics
  - <u>Antibiotic selection considerations: clindamycin</u>
    - Not all patients are indicated for treatment with clindamycin
    - Preferred in patients with non-severe disease with MRSA risk factor (history of prior MRSA infection or carriage, known close/household contact with MRSA)
      - If patients do not improve after 48-72h; ENT consult, ID consult, and CT scan of neck are indicated
    - Patients with severe disease should be started on IV vancomycin + Unasyn (+ ENT consult, ID consult, CT scan of neck)

- Steroids[29-30]
  - Controversy exists about the use of corticosteroids due to their immunosuppressive effect
    - One study found that steroids for 48-72 hours showed great improvement in symptoms, specifically torticollis and odynophagia in less than 24 hours
    - Another study found that corticosteroids were associated with lower odds of surgical drainage in children and suggest there may be a synergistic effect with antibiotics for abscess treatment

Severity/Stage of Infection	Antibiotic Recommendations	Duration
Empiric: Non-severe	**No MRSA risk-factors** **Ampicillin-Sulbactam** 50 mg/kg (max 2000 mg of ampicillin) IV q6h **MRSA risk-factors or penicillin allergy** **Clindamycin** 10 mg/kg (max 600 mg) IV q6-8h	Continue IV antibiotics until clinical improvement and afebrile x 24 hours
Empiric: Severe	If patient appears septic, has risk factors for MRSA, or does not respond to initial therapy: **Ampicillin-Sulbactam** **+ Vancomycin** 20 mg/kg (max 1000-2000 mg) IV q6h* **or Linezolid** <12 years: 10 mg/kg (max 600 mg) IV q8h ≥12 years: 600 mg IV q12h **Penicillin Allergy** **Ceftriaxone** 50 mg/kg (max 2000 mg) IV q24h **+ Metronidazole** 10 mg/kg (max 1000 mg) IV q8h **+ Vancomycin** 20 mg/kg (max 1000-2000 mg) IV q6h*	
Oral Step-Down Therapy	**Amoxicillin-Clavulanate** 25 mg/kg amoxicillin (max 875 mg) PO q12h Utilize 7:1 amoxicillin/clavulanate formulations **Clindamycin** 10 mg/kg (max 600 mg) PO q8h	To complete 14 days

*may require dosing adjustments based on renal function. See Pediatric Vancomycin Dosing Protocol for details

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Epiglottitis

- **Treatment**[27-28]
  - Swelling and inflammation of the epiglottis
    - Leads to breathing issues that can worsen and cause airway obstruction
  - Often secondary to upper respiratory infection

- **Initial Assessment**[31]
  - Radiographic imaging, physical assessment
  - Blood and throat cultures
    - Dysphagia, dysphonia, drooling, distress

- **Microbiology**[31]
  - Can be viral but bacterial pathogens are most common

Bacterial Pathogens	
• *H. influenzae* (HIB vaccination significantly decreases risk) • *S. pneumoniae*	• Group A Streptococci • *S. aureus* (including MRSA)

- **Treatment**[31]
  - Requires hospitalization for management due to increased risk of need for intubation for airway protection
  - IV antibiotics +/- systemic steroids

Antibiotic Treatment Recommendations		
Preferred	**Alternative**	**Duration**
Ceftriaxone 50-75 mg/kg (max 2000 mg) IV q24h + **Vancomycin** 20 mg/kg (max 1000-2000 mg) IV q6h*	**Vancomycin + Levofloxacin** **Levofloxacin:** 6 months – 5 years: 8 -10 mg/kg (max 375 mg) IV q12h ≥ 5 years: 10 mg/kg (max 750 mg) IV q24h	10 days

*may require dosing adjustments based on renal function. See Pediatric Vancomycin Dosing Protocol for details

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