Provincial Clinical Knowledge Topic
Croup, Pediatric – Emergency and Inpatient
V 1.0

Revision History

Version	Date of Revision	Description of Revision	Revised By

Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

Guidelines

This Clinical Knowledge Topic is based on the following guidelines:

Guidelines Available on the AHS Internal Website

1. Alberta Children's Hospital Inpatient Croup Clinical Care Guideline

2. Alberta Health Services Alberta Children's Hospital Pediatric Intensive Care Unit Croup Guideline

3. Alberta Children's Hospital Emergency Department Dexamethasone for Barky Cough Protocol

Guidelines Available Outside of AHS Network

4. Canadian Pediatric Society. Practice Point: Acute management of croup in the emergency department.

5. Towards Optimized Practice 2008 Update: Guideline for the diagnosis and management of Croup

6. TREKK (Translating Emergency Knowledge for Kids) Bottom Line Recommendations: Croup

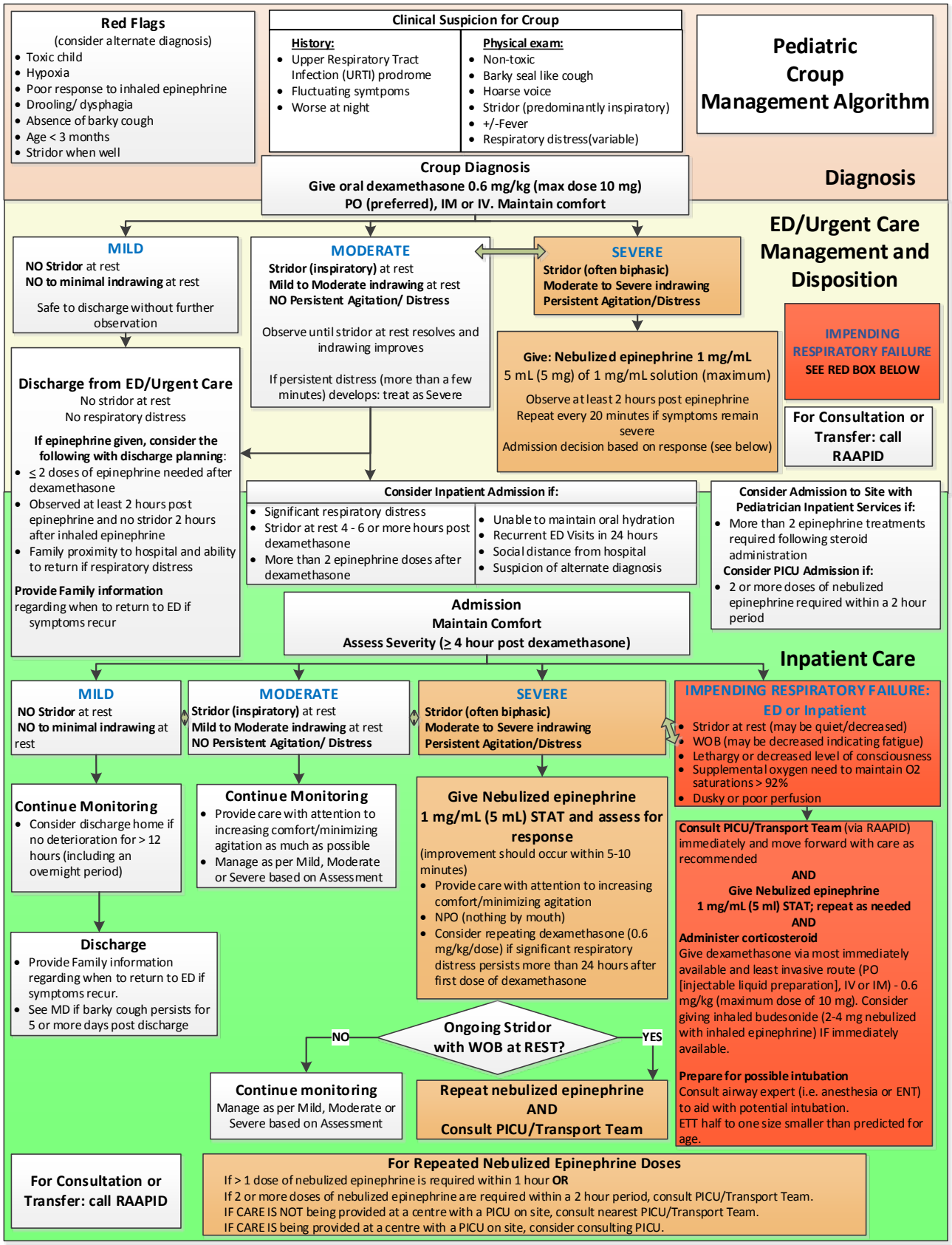
7. Cochrane summary: nebulized epinephrine in croup

8. Cochrane summary: glucocorticoids for croup

9. Seattle Children's Hospital: Croup v.2.0 ED Management (2015)

Keywords

- croup
- barking cough
- stridor
- corticosteroids
- epinephrine


Red Flags
(consider alternate diagnosis)
Toxic child
Hypoxia
Poor response to inhaled epinephrine
Drooling/ dysphagia
Absence of barky cough
Age < 3 months
Stridor when well
Clinical Suspicion for Croup
History:
Upper Respiratory Tract Infection (URTI) prodrome
Fluctuating symtpoms
Worse at night
Physical exam:
Non-toxic
Barky seal like cough
Hoarse voice
Stridor (predominantly inspiratory)
+/-Fever
Respiratory distress(variable)
Pediatric Croup Management Algorithm
Diagnosis
Croup Diagnosis
Give oral dexamethasone 0.6 mg/kg (max dose 10 mg)
PO (preferred), IM or IV. Maintain comfort
ED/Urgent Care Management and Disposition
MILD
NO Stridor at rest
NO to minimal indrawing at rest
Safe to discharge without further observation
MODERATE
Stridor (inspiratory) at rest
Mild to Moderate indrawing at rest
NO Persistent Agitation/ Distress
Observe until stridor at rest resolves and indrawing improves
If persistent distress (more than a few minutes) develops: treat as Severe
SEVERE
Stridor (often biphasic)
Moderate to Severe indrawing
Persistent Agitation/Distress
Give: Nebulized epinephrine 1 mg/mL
5 mL (5 mg) of 1 mg/mL solution (maximum)
Observe at least 2 hours post epinephrine
Repeat every 20 minutes if symptoms remain severe
Admission decision based on response (see below)
IMPENDING RESPIRATORY FAILURE
SEE RED BOX BELOW
For Consultation or Transfer: call RAAPID
Discharge from ED/Urgent Care
No stridor at rest
No respiratory distress
If epinephrine given, consider the following with discharge planning:
≤ 2 doses of epinephrine needed after dexamethasone
Observed at least 2 hours post epinephrine and no stridor 2 hours after inhaled epinephrine
Family proximity to hospital and ability to return if respiratory distress
Provide Family information
regarding when to return to ED if symptoms recur
Consider Inpatient Admission if:
Significant respiratory distress
Stridor at rest 4 - 6 or more hours post dexamethasone
More than 2 epinephrine doses after dexamethasone
Unable to maintain oral hydration
Recurrent ED Visits in 24 hours
Social distance from hospital
Suspicion of alternate diagnosis
Consider Admission to Site with Pediatrician Inpatient Services if:
More than 2 epinephrine treatments required following steroid administration
Consider PICU Admission if:
2 or more doses of nebulized epinephrine required within a 2 hour period
Admission
Maintain Comfort
Assess Severity (≥ 4 hour post dexamethasone)
Inpatient Care
MILD
NO Stridor at rest
NO to minimal indrawing at rest
MODERATE
Stridor (inspiratory) at rest
Mild to Moderate indrawing at rest
NO Persistent Agitation/ Distress
SEVERE
Stridor (often biphasic)
Moderate to Severe indrawing
Persistent Agitation/Distress
IMPENDING RESPIRATORY FAILURE: ED or Inpatient
Stridor at rest (may be quiet/decreased)
WOB (may be decreased indicating fatigue)
Lethargy or decreased level of consciousness
Supplemental oxygen need to maintain O2 saturations > 92%
Dusky or poor perfusion
Continue Monitoring
Consider discharge home if no deterioration for > 12 hours (including an overnight period)
Continue Monitoring
Provide care with attention to increasing comfort/minimizing agitation as much as possible
Manage as per Mild, Moderate or Severe based on Assessment
Give Nebulized epinephrine
1 mg/mL (5 mL) STAT and assess for response
(improvement should occur within 5-10 minutes)
Provide care with attention to increasing comfort/minimizing agitation
NPO (nothing by mouth)
Consider repeating dexamethasone (0.6 mg/kg/dose) if significant respiratory distress persists more than 24 hours after first dose of dexamethasone
Consult PICU/Transport Team (via RAAPID) immediately and move forward with care as recommended
AND
Give Nebulized epinephrine
1 mg/mL (5 ml) STAT; repeat as needed
AND
Administer corticosteroid
Give dexamethasone via most immediately available and least invasive route (PO [injectable liquid preparation], IV or IM) - 0.6 mg/kg (maximum dose of 10 mg). Consider giving inhaled budesonide (2-4 mg nebulized with inhaled epinephrine) IF immediately available.
Prepare for possible intubation
Consult airway expert (i.e. anesthesia or ENT) to aid with potential intubation.
ETT half to one size smaller than predicted for age.
Discharge
Provide Family information regarding when to return to ED if symptoms recur.
See MD if barky cough persists for 5 or more days post discharge
Ongoing Stridor with WOB at REST?
NO
YES
Continue monitoring
Manage as per Mild, Moderate or Severe based on Assessment
Repeat nebulized epinephrine
AND
Consult PICU/Transport Team
For Consultation or Transfer: call RAAPID
For Repeated Nebulized Epinephrine Doses
If > 1 dose of nebulized epinephrine is required within 1 hour OR
If 2 or more doses of nebulized epinephrine are required within a 2 hour period, consult PICU/Transport Team.
IF CARE IS NOT being provided at a centre with a PICU on site, consult nearest PICU/Transport Team.
IF CARE IS being provided at a centre with a PICU on site, consider consulting PICU.

Rationale

Croup is a disease primarily of infants and toddlers, with a peak incidence between 6 months and 3 years of age. Although less common outside of this age range, it can occur in infants younger than 6 months of age, as well as older children and adolescents.[1,2] The peak incidence of croup occurs during late fall and early winter but it can occur at any time of year.[1,2]

The signs/symptoms of croup typically resolve within 48 hours, but can persist, in a small proportion of patients, for up to one week.[3] In Alberta, more than 60% of children diagnosed to have croup have mild symptoms, about 4 percent are hospitalized, and approximately one in 4,500 children are intubated (approximately one in 170 hospitalized children).[4]

Key Messaging
The majority of children with croup recover quickly with no consequences and are not hospitalized, but croup can quickly result in severe respiratory distress, airway obstruction, and death in rare cases.

- A clinician's level of concern for a child with croup who requires hospitalization and/or repeated doses of inhaled epinephrine (especially 4 to 6 hours post-dexamethasone) should be heightened.
- Always prioritize appropriate airway safety and support measures during care and investigations with an emphasis on minimizing discomfort and agitation when a child with croup is distressed.

Pathophysiology

Croup is a viral infection that causes inflammation, hyperemia, edema, epithelial necrosis and shedding, within the larynx and subglottis, occasionally extending into the trachea and bronchi.[5]

The sub glottis is the narrowest part of the upper airway in children. Mucosal edema and exudates can significantly reduce the diameter of the airway, causing obstruction and increasing the work of breathing. Inflammation with exudate formation causes a characteristic barking cough and airway narrowing increases turbulence, which may progress to stridor. The decreased mobility of edematous vocal cords may cause a hoarse voice. Exudates and pseudo membranes may develop, causing significant and sometimes precipitous airway obstruction.[6, 7]

Infectious agents

Croup is caused by a variety of viral pathogens and occasionally by *Mycoplasma pneumonia*. [1] Parainfluenza type I is the most common cause of croup in North America.[8] Many other viruses have been isolated in cases of croup such as other strains of parainfluenza, adenovirus, respiratory syncytial virus (RSV), echovirus, human meta-pneumovirus, influenza A and B. [1, 9-11] Less common pathogens include enterovirus, measles, mumps, rhinovirus, and *Corynebacterium diphtheriae*. Early isolation of children with suspected croup is important to prevent the spead of infection.

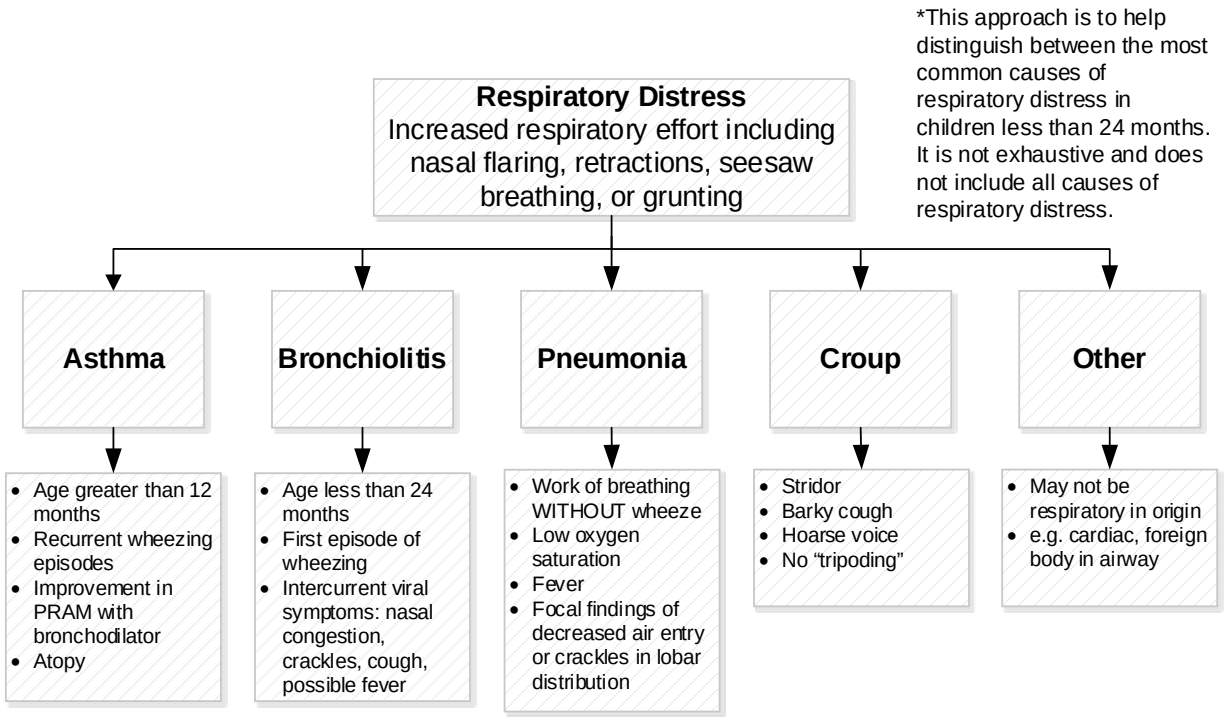
Common indications for hospitalization:

- Toxic appearance or atypical clinical picture suggesting severe illness or possible alternative diagnosis
- Persistent stridor at rest

- Significant respiratory distress
- Multiple doses of inhaled epinephrine required
- Incomplete response to inhaled epinephrine
- Inability to maintain oral hydration
- Recurrent visits to the ED within 24 hours
- Young age (e.g. less than 3 months)
- Social concerns (e.g. distance from the hospital)

Decision Making

Table 1. Differential Diagnosis for Respiratory Distress



Making the Diagnosis

Croup is a clinical diagnosis. **A thorough history and physical exam should be sufficient to make the diagnosis of croup or cause consideration of an alternative diagnosis in atypical or severe cases.**

When diagnosing croup (or considering alternative diagnoses), safe airway management and avoidance of exacerbation of respiratory distress (and possibly airway obstruction) should ALWAYS be a priority: **Avoid agitating a distressed child with stridor or croup.** If a child with stridor and respiratory distress requires care that may agitate them and potentially exacerbate airway obstruction, having healthcare providers present who are skilled in difficult airway management and the patient in an appropriate care environment should be a priority.

Common Features of History and Presentation of Croup:

Table 2. Clinical Features	
• Non-toxic appearance • Barky “seal-like” cough • Hoarse voice • Stridor (predominantly inspiratory)	• Fever (none to moderately high) • Signs of respiratory distress of varying severity • Possible signs of dehydration

Table 3. History	
• Possible prodrome of an upper respiratory tract infection (cough, coryza, nasal congestion, sore throat)	• Signs/symptoms may fluctuate (i.e. depending on whether the child is calm or agitated) and are often worse at night • Oral intake and urine output may be decreased

Recognizing Red Flags (<u>possibly</u> indicating an alternative or underlying diagnosis or an atypical case of croup)

- Toxic appearing child (e.g. lethargy, high fever, severe respiratory distress, or poor respiratory effort).
- Hypoxia/need for supplemental oxygen.
  - **Supplemental oxygen requirement in a child with croup requires urgent physician notification to allow prompt assessment of the patient.**
  - Croup typically affects the upper airway only (although, involvement of the lower airways can occur). When croup is isolated to the upper airway (and no concurrent lower airway disease exists), alveolar gas exchange is normal and supplemental oxygen is not required. Hypoxia (oxygen saturations less than 92% on room air) occurring in children diagnosed with croup may indicate airway obstruction or impending respiratory failure.
- Poor response to or frequent need for inhaled epinephrine.
- Drooling/Dysphagia - Croup should not cause significant drooling/dysphagia. Occasionally children may have mild drooling associated viral pharyngitis and hesitancy to swallow oral secretions but this **should improve with analgesia**. If a child has significant drooling/dysphagia or mild drooling that does not improve with analgesia, consider an alternate diagnosis.
- Absence of barking cough.
- Patient preference to sit forward in “tripod” or “sniffing position.”
- Recurrent episodes of croup that respond poorly to therapy.
- Less than 3 months of age (have an increased index of suspicion of an alternative diagnosis or an underlying congenital anomaly).
- History of previous intubation (i.e. NICU or PICU admission) which may indicate a predisposition to an anomalous airway (i.e. subglottic stenosis).
- There is a history of stridor and/or dysphonia when the patient is well.
- Illness course is prolonged (i.e. greater than 5-6 days).

Considerations when "Red Flags" are present - Differential Diagnoses for Stridor or Croup

Croup is the most common cause for acute onset stridor in children, however when the course is prolonged, refractory to treatment or other red flags exist, consider alternative diagnoses. Below is an extensive differential diagnosis list for croup and/or stridor. The majority of children with acute onset stridor have croup, but the most common alternative diagnosis is bacterial tracheitis. Post vaccination epiglottitis has become a rare disease; it should be considered in toxic appearing unimmunized patients. Other causes of ACUTE onset stridor are rare but are listed to aid clinicians in atypical cases.

Acute onset

- **Infections:** bacterial tracheitis, epiglottitis, retropharyngeal abscess, Epstein Barr Virus (Mononucleosis), peritonsillar abscess, deep space neck infection, measles, uvulitis, diphtheria
- **Anatomical:** foreign body
- **Allergy:** angioedema and anaphylaxis
- **Neoplasm**: neoplasm/mass (compressing trachea)
- **Inflammatory:** sarcoidosis, Wegener's Granulomatosis
- **Endocrine:** hypocalcemic tetany
- **Trauma:** laryngeal fracture, inhalation injury, corrosive ingestion

Suspect bacterial tracheitis in cases that are preceded by a mild to moderate croup illness for 2-7 days, followed by the abrupt onset of severe symptoms. Children with bacterial tracheitis are usually toxic in appearance, have high fevers, and respond poorly or briefly to nebulized epinephrine.[12] **If bacterial tracheitis is suspected, transfer of patient to a centre with a PICU and/or subspecialty services (e.g. respiratory medicine, ENT and anesthesia) is recommended.**

- o See Appendix A for more information about bacterial tracheitis.

Chronic onset (may present as an acute on chronic picture in the context of illness):

- **Infections:** laryngeal papillomatosis, laryngeal tuberculosis
- **Congenital/anatomical:** tracheomalacia, laryngomalacia, laryngeal web, subglottic stenosis, vascular ring, right/double aortic arch, pulmonary artery sling, aberrant subclavian artery, innominate artery compression, vocal cord paralysis/dysfunction
- **Vascular:** laryngeal hemangioma, subglottic hemangioma

Investigations

Croup is a **clinical diagnosis**. The diagnosis of croup (or the suspicion of an alternative diagnosis) should be made on the basis of a thorough history and physical exam in the majority of cases (e.g. no to minimal investigations are required in typical cases of croup).

Always prioritize appropriate airway safety and support measures during care and investigations.

Nasopharyngeal swab
In most cases this test will not change the management of croup and may agitate the child. If this test is done, it should be done when the child is having minimal to no stridor or respiratory distress. Children with suspected croup should be appropriately isolated regardless of whether a nasopharyngeal swab is done.

Diagnostic Imaging
Diagnostic imaging is unnecessary unless the diagnosis of croup is in question and imaging may help gain more information.

"Steeple Sign" on a plain film x-ray (narrowing of the laryngeal air column 5-10 mm below the level of the vocal cords) may be absent in patients with croup, present in patients without croup (normal variant), and may be present in patients with other diseases.

If diagnostic imaging is required, it should be done when the child is having minimal to no stridor or respiratory distress, otherwise appropriately skilled healthcare providers who are able to assist with difficult airway management should be immediately available.

Investigations when considering alternative diagnoses
Consider appropriate work up (e.g. blood work, imaging, laryngoscopy, etc.) according to the patient's presentation and rare alternative diagnoses under consideration.

Consider obtaining pediatric intensive care (PICU), respirology (respiratory medicine), ENT (otolaryngology), infectious disease or anesthesiology consultation(s) to guide investigations, treatment and support of the airway in atypical cases or when alternative diagnoses are being considered.

Emergency Department / Urgent Care Management and Disposition Planning

1. **Initial Assessment**
   At initial assessment all children with croup should receive oral dexamethasone.

2. **Severity Assessment**
   Severity assessment developed by the Alberta Clinical Practice Guideline Working Group.[13]

   The presence/absence of stridor and degree of work of breathing AT REST is a key indicator of the severity of illness. Stridor at rest should resolve following treatment with inhaled epinephrine in MOST children with croup. Stridor at rest continuing following treatment indicates severe croup in most cases but the possibility of an alternative diagnosis should be considered.

- **Mild** - Occasional barking cough, no audible rest stridor, and either mild or no suprasternal or intercostal in-drawing (retractions of the skin of the chest wall). Can be safely discharged home without any further observation.

- **Moderate** - Frequent barking cough, easily audible stridor at rest, and suprasternal and sternal wall retractions at rest, but little or no distress or agitation. Should be observed until both stridor at rest and in-drawing resolve (expected within a few hours). Children treated with inhaled epinephrine should be observed for a minimum of 2 hours before being discharged from medical care.

- **Severe** - Frequent barking cough, prominent inspiratory and occasionally expiratory stridor, marked sternal wall retractions, and significant distress and agitation. Other warning signs of severe respiratory disease include tachypnea and tachycardia that are out of proportion to the rest of the presentation.

- **Impending Respiratory Failure** – Barking cough (often not prominent), stridor at rest (occasionally hard to hear), sternal retractions (may not be marked), lethargy or decreased level of consciousness, hypoxia or a dusky appearance without supplemental oxygen. Any signs of decreased respiratory effort (especially with either lethargy or an altered level of consciousness) are concerning, such as decreased respiratory rate, decreased retractions, decreased breath sounds, and decreased stridor.

  Severe croup may require definitive airway management and intensive care if the patient does not respond to treatment. Consider contacting the nearest PICU (via RAAPID) as well as local personnel who are experienced in airway management (i.e. ENT and/or anesthesia) to support management.

3. **Considerations for Admission to Hospital**
   The decision to discharge home versus admit to hospital should occur within 6 hours of oral dexamethasone administration. Considerations include:
   - Significant respiratory distress
   - Persistent stridor at rest or only with mild activity persisting four or more hours after treatment with corticosteroids and repeated doses of nebulized epinephrine
   - Two or more doses of inhaled epinephrine required without improvement or incomplete response
     - Consultation with pediatric care providers experienced in the care of children with croup is strongly suggested
   - Inability to maintain oral hydration
   - Recurrent visits to ED within 24 hours
   - Young age (e.g. less than 3 months)
   - Social factors
     - Patient lives a long way from hospital or inadequate transportation to hospital
     - Potential difficulty caring for child at home
   - Patient with suspicion of alternative diagnosis or airway abnormality

4. **Considerations for Discharge from the Emergency Department:**
   - No stridor at rest nor significant indrawing at the time of discharge.

- The child has not received more than 2 doses of epinephrine since dexamethasone was administered and a minimum of 2 hours has passed since the last dose was given.
- The child's home is reasonably close to hospital and caretakers should be able to return to hospital if respiratory distress occurs at home

Supportive Care
The first rule of management is to **keep children with croup as comfortable as possible**.

Allow the patient to remain in a parent's arms or in their preferred position. Avoid unnecessary painful interventions that may cause agitation.

Infection control: Children admitted with suspected croup should be isolated (contact and droplet). Parents/caregivers/visitors should be advised regarding proper infection control policies and procedures.

Monitoring
- **Vital Signs:** Frequency of vital signs should be correlated with clinical severity. In most cases, regular vital signs every 4 hours is sufficient, at minimum follow local practice.
- **Oxygen Saturation Monitoring:** Spot oxygen saturation checks with routine vital signs is sufficient for children in minimal to no respiratory distress. Continuous oxygen saturation (or cardiorespiratory) monitoring should be initiated if moderate to severe respiratory distress is present.
- **Supplemental Oxygen:** Should not be given for oxygen saturation levels of greater than 92% on room air. Although concomitant lower airway disease can occur and cause hypoxia, croup is primarily a disease of the upper airway which does not cause hypoxia unless obstruction of the airway is present. Supplemental oxygen needs in a patient with croup should prompt urgent physician assessment of the child and concern for possible progressive upper airway obstruction.

Nursing Support- Red Flag Recognition and Actions during Monitoring:
- Notify physician immediately regarding **any signs of work of breathing** or **increased stridor.**
- Notify physician immediately of **supplemental oxygen use** to maintain oxygen saturations greater than 92%.

Hydration:
- Most children are able to maintain adequate hydration via PO fluids and do not require IV fluids.
- Consider a clear fluids diet in a child who has been recently moderately or severely distressed.
- NPO during periods of moderate to severe respiratory distress.
- Measure and monitor accurate "Ins and Outs".

- IV or NG tube placement should not be attempted in a distressed child (without proper airway assistance).

Antipyretics/Analgesia:
- Use recommended doses of acetaminophen or ibuprofen to treat fever and provide comfort.

Nursing Support- Supportive Care:
- During supportive care try to ensure the child is as comfortable as possible and avoid care that may cause agitation.
- When a child with croup has stridor at rest or signs of increased work of breathing, notify the physician immediately.

Medications

Systemic Steroids and Inhaled Epinephrine (*the "mainstays" of croup therapy):*

1. **Systemic Corticosteroids**[14-16]
   - Minimal to no adverse effects (when given in the doses and short duration recommended for the management of croup).
   - Decrease laryngeal mucosal edema via anti-inflammatory action.
   - Reduce the number and duration of intubations, rate and duration of hospitalizations, and need for nebulized epinephrine.

   Dexamethasone: 0.6 mg/kg (oral [PO], intramuscular [IM], intravenous [IV]) once (maximum daily dose of 10 mg) by the **least invasive route possible** (equally effective if given orally or parenterally[13, 17]). The oral route is preferred for children who are not vomiting as it is generally less traumatic.

   There are no published controlled studies that examine whether multiple doses of corticosteroids provide greater benefit than a single dose for croup. Given a short duration of symptoms in the majority of patients with croup, a single dose is sufficient in most cases.[13]

   Although there is no evidence regarding repeat dexamethasone dosing, the need for repeat dexamethasone doses (while in the hospital setting) should be assessed on an ongoing basis, based on each child's clinical course and respiratory distress. Repeat dexamethasone doses (0.6 mg/kg, max 10 mg, PO/IV/IM every 24 hours) may be considered/appropriate in some hospitalized children with ongoing significant respiratory distress.

   The prescription of dexamethasone for use in the community setting following emergency department visits/hospitalization for croup is not recommended. Once discharged, patients should seek medical attention as recommended for ongoing/recurrence of symptoms. However, if dexamethasone is prescribed for use in the community setting, alcohol free alternatives (i.e. the injectable solution compounded for oral use) rather than the

commercially available dexamethasone syrup (which contains alcohol), should be prescribed.

Lower dexamethasone doses (0.3 mg/kg and 0.15 mg/kg) have been studied and shown to be effective.[18] However, there is currently insufficient evidence to suggest routine administration dexamethasone doses lower than 0.6 mg/kg in the context of a hospitalized patient.

Prednisone (1 mg/kg) is effective in the treatment of croup. However, dexamethasone is more potent (6.67 times) and has a longer duration of action (36-56 hours) than prednisone (18-36 hours). Following dexamethasone administration, onset of action occurs within 1-2 hours and peaks in 6-10 hours.

Considerations and Possible Contraindications for Systemic Steroids:
Consider discussing the safety of systemic steroids with the infectious diseases (or other appropriate) service in patients who (may) have a concurrent infectious process that is at risk of dissemination (e.g. varicella or untreated tuberculosis) or in a child who is immunocompromised.[13]

2. **Nebulized epinephrine 1 mg/mL: 5 mL (5 mg) of 1 mg/mL solution (maximum).**
   - Causes constriction of the pre-capillary arterioles and decreased laryngeal mucosal edema via alpha-1 adrenergic stimulation, which is thought to provide the majority of clinical benefit.
   - Causes bronchial smooth muscle relaxation and bronchodilation via beta-2-adrenergic activity.

Clinical improvement (decreased stridor and respiratory distress) occurs within 10 minutes of administration. The effects of inhaled epinephrine begin to diminish within an hour and usually do not alter disease symptoms beyond 2 hours of administration.[19]

Dose modification of inhaled epinephrine on the basis of body weight has not been well studied and therefore is not routinely recommended. Randomized control trials regarding inhaled epinephrine dosing used fixed epinephrine dosing (as above).The smaller tidal volume of a child is thought to proportionately reduce the effective dose of drug delivered to the upper airway.[13] The inhaled epinephrine dose may be decreased to 2.5 mL or 0.5 mg/kg/dose (in children less than 5 kg) at the discretion of the clinician.

Epinephrine (1 mg/mL) does NOT require dilution for nebulization. However, if the epinephrine dose does not provide the minimum volume required by the nebulizer, normal saline can be added to the epinephrine to ensure the adequate volume required for nebulization.

Considerations and cautions with the use of nebulized epinephrine:
The management of airway obstruction and efforts to maintain airway patency are paramount. However, awareness of and monitoring for possible side effects is particularly important when inhaled epinephrine is required in children with narrow angle glaucoma or cardiac abnormalities (consider a cardiorespiratory monitor during administration).
Treatment with inhaled epinephrine should be reserved for children with stridor at rest with perceived discomfort or distress.

Key Epinephrine Considerations in patients with Croup:

- Nebulized epinephrine administration is suggested for patients with stridor at rest **AND** perceived discomfort or distress.
- **SCHEDULED or STANDING PRN nebulized epinephrine doses should NOT be ordered.** If a patient with suspected croup has a deterioration in their respiratory status or worsening of signs/symptoms, **a physician should be notified promptly to consider patient assessment and/or ordering a repeat nebulized epinephrine dose.**

Other Medications to Consider

1. **Inhaled corticosteroids**
   Inhaled budesonide: 2-4 mg nebulized (can be nebulized with epinephrine).

   The clinical efficacy of inhaled corticosteroids for treatment of croup has been studied and demonstrated (with budesonide). [20, 21] However, the high efficacy, relative ease of delivery, and low cost of systemic corticosteroid administration make systemic corticosteroids preferable to budesonide.
   - Oral dexamethasone is recommended as "first line" for steroid treatment in croup
   - Inhaled budesonide can be considered as an alternative in deteriorating or severely distressed patients who may not tolerate a PO/IM dexamethasone and do not have an IV in place

2. **Antibiotics**
   Croup is almost always due to a viral infection; therefore **empiric antibiotic therapy for croup is not recommended**. However, in rare cases, croup can be caused by *Mycoplasma pneumoniae* and if suspected (contacts, atypical, severe, or prolonged course), the use of a macrolide antibiotic should be considered.

3. **Antivirals: (oseltamivir)**
   Influenza A and B can cause croup. If an influenza virus is suspected in moderate or severe cases of croup, consider prescribing oseltamivir as per drug monograph recommendations.

4. **Helium Oxygen Mixtures**
   Outside of a PICU, helium oxygen (heliox) mixtures should be considered a temporizing therapy until more advanced/definitive airway management (e.g. intubation) can be established. It should only be administered in close consultation with a PICU team, in settings that support its safe use and monitoring.

   Helium administration to children with croup has been proposed because of the potential of this lower density gas (relative to nitrogen) to decrease turbulent airflow in a narrowed airway. Current evidence is insufficient to advocate for general use for managing croup.[22-26] A systematic review of data from three randomized clinical trials [27] concluded that heliox

may provide short-term benefit in children with moderate to severe croup who received corticosteroid treatment. Heliox must be administered by experienced personnel and has limitations, including that the 70:30 ratio of helium to oxygen blend limits fractional of inhaled oxygen that can be delivered to the patient.

Non-Evidence Based Interventions: Not recommended in the treatment of croup

1. Mist (croup tents, humidified oxygen/air) – good randomized controlled trials show no evidence for the use of mist [29, 30]
2. Antitussive and Decongestant medications
3. Beta-2-agonists (salbutamol)

Inpatient Ongoing Management

- Continue regular clinical assessment. See Supportive Care.
- Assess severity as per above categories.
- Maintain comfort.
- Nebulized epinephrine administration is suggested for patients with stridor at rest **AND** perceived discomfort or distress. Inpatients requiring nebulized epinephrine require frequent assessment and careful monitoring for deterioration.

Recognizing and Managing a Deteriorating Inpatient with Croup
The nearest Pediatric Intensive Care Unit (PICU) +/- transport team **should be** consulted promptly (with consideration of urgent ENT and anesthesia consults) when ANY of the following occur in an inpatient diagnosed with croup:

- Ongoing stridor at rest following a nebulized epinephrine dose
- More than 1 dose of nebulized epinephrine given within 1 hour
- Two or more doses of nebulized epinephrine given within 2 hours
- Supplemental oxygen is required to maintain oxygen saturations greater than 92% and/or any signs of impending respiratory failure exist (duskiness or poor perfusion, decreased level of consciousness or lethargy, signs of respiratory fatigue such as decreased work of breathing and/or stridor).

The above guidelines are based on the principle that children with croup **DO NOT** require nebulized epinephrine to treat stridor UNLESS stridor is occurring at rest **AND** is accompanied by perceived distress or discomfort (e.g. signs of distress or increased work of breathing).

> **In the event of acute respiratory failure and urgent need for intubation, anticipate that the endotracheal tube will likely be half to one size smaller than predicted for age.**

Recognize and Treat Complications
Overall, complications of croup are uncommon.

- Otitis Media
- Pneumonia
- Bacterial tracheitis
- Pneumothorax and pneumomediastinum (rare)
- Pulmonary edema (rare)

Inpatient Disposition Planning

1. **Discharge from hospital criteria** *(consider the timing of discharge with the following factors as well as the knowledge that croup symptoms may fluctuate and worsen during the night and once the effect of last dose of dexamethasone has diminished).*

   - No stridor at rest or work of breathing.
   - No requirement for inhaled epinephrine during a minimum 12 hour period (including no administration of epinephrine during an overnight period).
   - Maintaining adequate oral hydration.
   - Appropriate home social situation (i.e. reliable and informed caregivers) and ability to access medical attention promptly (i.e. proximity to a hospital or urgent care setting).
   - The family has been educated about appropriate actions to take should their child deteriorate/symptoms recur after being discharged from hospital.

2. **Follow up care:**
   - In uncomplicated or typical cases, no specific follow-up is required unless there are new or ongoing concerns.
   - In cases that are recurrent, prolonged, atypical or complicated, specific follow-up plans should be made in discussion with the involved consultants and include follow-up with the primary care provider within 1 week of discharge, or sooner if new concerns arise.

3. **Family Education/Discharge Instructions:**
   - Provide caregiver information on discharge:
     - Health Link (811)
     - Alberta Health Services- HEAL Croup handout
     - MyHealth.Alberta.ca- Croup
   - Educate primary caregivers about appropriate actions to take should their child deteriorate after being discharged from hospital
     - If symptoms are mild (not requiring urgent assessment, as suggested below) but if barky cough or stridor persists for 5– 6 more days after discharge, the child should be reassessed by a healthcare provider.
     - If child develops mild distress, exposure to cool night air may provide relief.
     - If child develops more significant respiratory distress but is not severely agitated or cyanotic return to the nearest ED right away.
     - Instruct parents to call 911 if:
       - If child develops severe agitation and/or cyanosis.
       - If child appears exhausted or becomes unconscious.
       - If child stops breathing.

Analytics

Baseline Analytic Outcome Measure #1

Name of Measure	Order Set Usage for Croup Pediatric Emergency Department Order Set
Definition	For all patients with Croup cared for in the Emergency Department, number of times Croup Pediatric Emergency Department Order Set is used. Overall, by region and by sites
Rationale	Intended to measure if the order set cited in the knowledge topic is being used and what % of time for the indicated disease or condition. May indicate areas with adoption issues or gaps in topic
Notes for Interpretation	Health record must have coding for disease/condition, site capacity, roll out of provincial CIS

Baseline Analytic Outcome Measure #2

Name of Measure	Order Set Usage for Croup Pediatric Inpatient Order Set
Definition	For all patients with Croup admitted to the hospital, number of times Croup Pediatric Inpatient Order Set is used. Overall, by region, by sites and by unit
Rationale	Intended to measure if the order set cited in the knowledge topic is being used and what % of time for the indicated disease or condition. May indicate areas with adoption issues or gaps in topic
Notes for Interpretation	Health record must have coding for disease/condition, site capacity, roll out of provincial CIS

Baseline Analytics – Outcome Measure #3

Name of Measure	Frequency of dexamethasone administration in the emergency department for children diagnosed with croup.
Definition	What % of time was dexamethasone ordered within the order set “Croup Pediatric Emergency Orders” for pediatric patients with croup.

Rationale	Intended to show compliance with clinical standards as it recommended initial dose of Dexamethasone is given as soon as the diagnosis of croup is suspected or made.

Baseline Analytics – Outcome Measure #4

Name of Measure	Frequency of laboratory and radiological assessments in a child diagnosed with croup.
Definition	What % of time are laboratory or radiological investigations ordered on pediatric patients diagnosed with croup.
Rationale	Intended to show compliance with clinical standards as laboratory and radiological assessments are not necessary to make the diagnosis of croup.

References

1. Denny F, Murphy T, Clyde W et al. Croup: an 11-year study in a pediatric practice. *Pediatrics*. 1983;71(6):871.
2. Bjornson C, Johnson D. Croup in children. *Canadian Medical Association Journal*. 2013;185(15):1317-1323. doi:10.1503/cmaj.121645.
3. Johnson D.W., Williamson J. Croup: Duration of symptoms and impact on family functioning. *Pediatr Research*, 2001; 49: 83A.
4. Johnson D. Croup. *Clin Evid* 2005; Dec(14):310-27.
5. Cherry JD. Croup (laryngitis, laryngotracheitis, spasmodic croup, and laryngotracheobronchitis). In Feigin R, Cherry J, eds. *Textbook Of Pediatric Infectious Diseases*. 3rd ed, Vol. 1. Philadelphia, PA: WB Saunders Company, Harcourt Brace Jovanovich, Inc.,1992: 209-220.
6. Davis GM. An examination of the physiological consequences of chest wall distortion in infants with croup. In: Medical Science. Calgary, Canada: University of Calgary, 1985:90.
7. Davis GM, Cooper DM, Mitchell I. The measurement of thoraco-abdominal asynchrony in infants with severe laryngotracheobronchitis. *Chest* 1993;103:1842-8.
8. Marx A, Török TJ, Holman RC, Clarke MJ, Anderson LJ. Pediatric hospitalizations for croup (laryngotracheobronchitis): biennial increases associated with human parainfluenza virus 1 epidemics. *J Infect Dis* 1997;176:1423-1427.
9. Chapman RS, Henderson FW, Clyde WA Jr, et al. The epidemiology of tracheobronchitis in pediatric practice. *Am J Epidemiol* 1981;114(6): 786-797.
10. Denny FW, Collier AM, Henderson FW, Clyde WA Jr. Infectious agents of importance in airways and parenchymal diseases in infants and children with particular emphasis on bronchiolitis. *Pediatr Res* 1977;11:234-236.
11. Glezen WP, Loda FA, Clyde WA Jr. et al. Epidemiologic patterns of acute lower respiratory disease of children in a pediatric group practice. *J Pediatr*, 1971;78(3):397-406.
12. Donnelly B, McMillan J, Weiner L. Bacterial tracheitis: report of eight new cases and review. *Rev Infect Dis* 1990;12:729-35.
13. Toward Optimized Practice (TOP) Working Group for Croup. 2008 January. Diagnosis and management of croup. Edmonton, AB: Toward Optimized Practice. Available from: http://www.topalbertadoctors.org
14. Tibbals J, Shann FA, Landau LI. Placebo-controlled trial of prednisolone in children intubated for croup. *Lancet* 1992;340:740-48.
15. Geelhoed GC. Sixteen years of croup in a western Australian teaching hospital: effects of routine steroid treatment. *Ann Emerg Med* 1996;28:621-6.
16. Kairys S, Olmstead EM, O'Connor GT. Steroid treatment of laryngotracheitis: a meta-analysis of the evidence from randomized trials. *Pediatrics* 1989;83(5):683-693.
17. Rittichier KK, Ledwith CA. Outpatient treatment of moderate croup with dexamethasone: intramuscular versus oral dosing. *Pediatrics* 2000;106(6):1344-8.
18. Geelhoed GC, Macdonald WBG. Oral dexamethasone in the treatment of croup: 0.15 mg/kg versus 0.3 mg/kg versus 0.6 mg/kg. *Pediatr Pulmonol* 1995;20:362-8.
19. Westley C, Ross CEK, Brooks JG. Nebulized racemic epinephrine by IPPB for the treatment of croup. *Am J Dis Child* 1978;132(May):484-487.

20. Klassen TP, Craig WR, Moher D, Osmond MH, et al. Nebulized budesonide and oral dexamethasone for treatment of croup: a randomized controlled trial. *JAMA* 1998;279:1629-32.
21. Geelhoed GC, Macdonald WBG. Oral and inhaled steroids in croup: a randomized, placebo-controlled trial. *Pediatr Pulmonol* 1995;20:355-361.
22. Terregino CA, Nairn SJ, Chansky ME. The effect of heliox on croup: a pilot study. *Acad Emerg Med* 1998;5:1130-3.
23. McGee DL, Wald DA, Hinchliffe S. Helium-oxygen therapy in the emergency department. *J Emerg Med* 1997;15:29-6.
24. Beckmann KR, Brueggemann WM. Heliox treatment of severe croup. *Am J Emerg Med* 2000;18:735-6.
25. Duncan PG. Efficacy of helium-oxygen mixtures in the management of severe viral and post-intubation croup. *Can Anaesth Soc J* 1979;26(3):206-12.
26. Kemper KJ, et al. Helium-oxygen mixture in the treatment of postextubation stridor in pediatric trauma patients. *Crit Care Med* 1991;19(3):356-9.
27. Moraa I, Sturman N, McGuire T, van Driel M. Heliox for croup in children. *Cochrane Database of Systematic Reviews*. 2013. doi:10.1002/14651858.cd006822.pub4.
28. Al-Mutairi B, Kirk V. Bacterial Tracheitis in Children: Approach to diagnosis and treatment. *Paediatr Child Health* 2004;9(1):25-30.
29. Moore M, Little P. Humidified air inhalation for treating croup: a systematic review and meta -analysis. Fam Pract.2007;24:295 – 301.
30. Scolnik D, Coates AL, Stephens D, Da Silva Z, Lavine E, Schuh S. Controlled delivery of high vs low humidity vs mist therapy for croup in emergency departments: a randomized controlled trial. JAMA. 2006 Mar 15;295(11):1274 - 80.

Appendix A: Differential Diagnosis: Bacterial Tracheitis[2,28]

The most common organisms causing bacterial tracheitis are *Staphylococcus aureus*, followed by *Group A Streptococcus*, *Moraxella catarrhalis*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, and anaerobes. Broad spectrum parenteral antibiotics must be started promptly if bacterial tracheitis is suspected.

First Line Therapy: A 3rd. generation cephalosporin (i.e. cefotaxime or ceftriaxone) **combined with** vancomycin*. **Note:** It is also increasingly difficult to rely on the presence or absence of historical risk factors for MRSA to guide whether to empirically treat for MRSA or not.

Given the severity of and the potential poor outcomes associated with inadequately treated bacterial tracheitis, as well as the rising incidence of MRSA (Methicillin-Resistant *Staphylococcus aureus*) and increasing difficulty in relying on the presence/absence of historical risk factors for MRSA, it is recommended to consider initiating vancomycin (INSTEAD of a beta-lactamase resistant penicillin such as cloxacillin) as part of first line therapy to cover for MRSA when bacterial tracheitis is suspected. When vancomycin has been started, please monitor drug levels as recommended.

If anaerobic organisms are suspected or a child is not responding to first line therapy, additional or alternative therapy with clindamycin or metronidazole may be considered.

Consider a respiratory, infectious disease, and/or ENT service consult if the diagnosis of bacterial tracheitis is suspected. Should sedation or general anesthetic be required for any reason, consult the anesthesia service as well.

Appendix B: Order Sets
Order Set Name: Croup Pediatric Emergency Orders

Order Set Components
Order Set Requirements: Weight
Order Set Key Words: croup, pediatric, emergency

Patient Care
Precautions and Safety:
☑ Isolation: Contact and Droplet

Activity
☑ Activity as Tolerated

Diet
For child who has been recently moderately or severely distressed:
☐ Clear Fluids

During periods of moderate to severe respiratory distress:
☐ NPO

For mild croup:
☐ Regular Diet

Respiratory Care
Supplemental oxygen need should prompt urgent physician assessment and concern for possible progressive upper airway obstruction.
☐ O2 Therapy- Titrate to maintain saturation above 92%. Notify physician of any NEW oxygen requirement.

Monitoring
Suggested vital sign frequency of every 1 to 4 hours based on severity of croup.
☐ Vital signs (Temperature, Pulse, Respiratory Rate, Blood Pressure, oxygen saturation) every _____hours.

Consider continuous oxygen saturation monitoring if moderate to severe respiratory distress is present.
☐ Oxygen saturation monitoring: Continuous

☑ Notify MD immediately if:
- oxygen required to maintain oxygen saturation greater than 92%
- increased stridor or increased work of breathing
- there is ongoing stridor at rest following a nebulized epiNEPHrine dose

☐ Intake and output: Monitor fluid volume intake and output every shift

Investigations
Laboratory and radiological assessments are not necessary to make the diagnosis of croup. The diagnosis can be reliably made based on the clinical presentation in combination with a careful history and physical examination.

IF considering alternate diagnoses:
Lateral soft tissue neck film may be helpful for making an alternative diagnosis of retropharyngeal abscess or bacterial tracheitis in the rare case of children with croup-like symptoms
NOTE: Patients should be monitored during Diagnostic Imaging by personnel experienced with managing a difficult airway.

☐ X-ray nasopharynx/soft tissue 1 view (GR Naso/Soft Tis Neck,1 projection)

Medications

Dexamethasone

Give an initial dose of Dexamethasone as soon as the diagnosis is suspected/made

☐ dexamethasone (*recommended dose 0.6 mg/kg/dose, Max 10 mg*) _____ mg _____(*specific route; PO recommended. IM or IV only if PO not possible*) ONCE.

Inhaled Medications

Children with croup should not require nebulized epinephrine to treat stridor unless stridor is occurring at rest AND accompanied by perceived distress or discomfort or increased work of breathing.

Nebulized epinephrine

May be repeated back to back in children with severe distress/ near respiratory failure but requires frequent re-evaluation.
Contraindications: *Caution should be exercised when used in children with narrow angle glaucoma or cardiac abnormalities (consider cardiorespiratory monitor during administration). Use repeated doses of nebulized epinephrine within short time frames with caution given reports of cardiac damage.*

☐ epiNEPHrine 1 mg/mL neb solution 5 mL (5 mg) via nebulizer ONCE

Budesonide: Consider in child with severe croup, or child with persistent vomiting

Nebulized budesonide is not routinely indicated for the treatment of croup. More commonly causes agitation than oral administration and more expensive than dexamethasone. Budesonide may be mixed with epinephrine and administered simultaneously.

☐ budesonide (*recommended dose 2 to 4 mg per dose*)_____ mg inhaled every 24 hours.

Antipyretics/Analgesics:

☐ acetaminophen liquid (*recommended dose 15 mg/kg//dose)* _____ mg PO/PR every 4 hours PRN for discomfort. (*Maximum 75 mg/kg/day, 1000 mg/dose AND 4 grams/day whichever is less*)

☐ ibuprofen liquid *(recommended dose10 mg/kg/dose)* _____ mg PO every 6 hours PRN for discomfort. *(Maximum 400 mg/dose, less than 6 months, acetaminophen is preferred)*

Order Set: Croup Pediatric Inpatient Orders

Order Set Components

Order Set Requirements: Weight
Order Set Key Words: croup, pediatric, inpatient

Patient Care

Goals of Care Designation:
☑ Goals of Care Designation: utilize appropriate Goal of Care
Precautions and Safety:
☑ Isolation: Contact and Droplet

Activity
☑ Activity as Tolerated

Diet

For child who has been recently moderately or severely distressed:
☐ Clear Fluids

During periods of moderate to severe respiratory distress:
☐ NPO

For mild croup:
☐ Regular Diet

Respiratory Care

Supplemental oxygen need should prompt urgent physician assessment and concern for possible progressive upper airway obstruction.
☐ O2 Therapy- Titrate to maintain saturation above 92%. Place the patient on supplemental oxygen to maintain oxygen saturation level greater than 92% AND notify physician of NEW oxygen requirement immediately.

Monitoring

For mild symptoms consider vital sign monitoring every 4 hours and more frequent for moderate or severe symptoms.
☐ Vital signs (Temperature, Pulse, Respiratory Rate, Blood Pressure, oxygen saturation) every _____ hours.

Consider continuous oxygen saturation monitoring if moderate to severe respiratory distress is present.
☐ Oxygen saturation monitoring: Continuous

☑ Notify physician immediately if:
- oxygen required to maintain oxygen saturation greater than 92%
- increased stridor or increased work of breathing
- there is ongoing stridor at rest following a nebulized epiNEPHrine dose

☐ Intake and output: Monitor fluid volume intake and output every shift

Medications

Dexamethasone

Every child with croup should receive an initial dose of dexamethasone as soon as the diagnosis is suspected/made (typically given in the ED).

If not given in Emergency Department:

☐ dexamethasone *(recommended dose 0.6 mg/kg/dose, Max 10 mg*) _____ mg _____ (*specific route; PO recommended; IM or IV only if PO not possible*) ONCE

Repeat dexamethasone doses should be ordered AS NEEDED on a case by case basis (e.g. ongoing symptoms requiring epinephrine administration)**.** Dosing frequency (e.g. every 24 hours) of repeat doses should also be considered on a cases by case basis.

Nebulized epinephrine

Use for stridor occurring at rest AND accompanied by perceived distress or discomfort or increased work of breathing

***Standing or PRN nebulized epinephrine orders should not be ordered** in the inpatient setting. Repeat doses may be needed in varying frequencies but should be ordered after discussion/assessment of the child to help the clinician be aware of/gauge severity and the possible need for further consultations or interventions to support airway safety*.

☐ epiNEPHrine 1 mg/mL neb solution 5 mL (5 mg) via nebulizer ONCE, STAT

Antipyretics/Analgesics:

☐ acetaminophen liquid (*recommended dose 15 mg/kg//dose)* _____ mg PO/PR every 4 hours PRN for discomfort. (*Maximum 75 mg/kg/day, 1000 mg/dose AND 4 grams/day whichever is less*)

☐ ibuprofen liquid *(recommended dose10 mg/kg/dose)* _____ mg PO every 6 hours PRN for discomfort. *(Maximum 400 mg/dose, less than 6 months, acetaminophen is preferred)*

Transfers and Referrals

☐ MD Consult Respiratory. Reason for referral _____.

☐ MD Consult ENT. Reason for referral _____.

☐ MD Consult: Other _____

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