



OBJECTIVE

Alberta clinicians understand and practice appropriate diagnosis, differential diagnosis, treatment and management of croup.

TARGET POPULATION

Primarily children six months to three years old but may include all ages from three months to 18 years

EXCLUSIONS

None

RECOMMENDATIONS

*Denotes expert opinion only

PRACTICE POINT

Croup occurs most commonly in children between six months and three years of age, but can also occur in children as young as three months and in older children and teens.¹ It has been reported that croup occurs very rarely in adults.² Croup occurs predominantly in late autumn, but can occur during any season, including summer.¹

DIAGNOSIS

- ✓ Suspect croup if a child presents with:
 - Clinical features
 - Seal-like barky cough
 - Hoarseness
 - No to moderately high fever
 - Irritability
 - Stridor
 - Chest wall indrawing of varying severity
 - Absence of drooling
 - Non-toxic appearance
 - History
 - With or without antecedent upper respiratory symptoms of cough, rhinorrhea, fever
 - Late evening/night and abrupt onset
 - Symptoms frequently improve while on route to medical care and can fluctuate significantly depending on whether the child is calm or agitated
 - Symptoms usually improve during the day and often recur again the following night³
 - Symptoms in the majority of children resolve within 48 hours – a small proportion of children have symptoms that persist for up to one week³

- Resolving croup symptoms are usually followed with typical 'URTI'-like symptoms and occasionally a secondary bacterial-induced otitis media^{3,4}

DIFFERENTIAL DIAGNOSIS⁵

- ✓ Suspect bacterial tracheitis if high fever, toxic appearance and poor response to epinephrine
- ✓ Suspect epiglottitis if sudden onset of symptoms with high fever, absence of barks cough, dysphagia, drooling, anxious appearance and sitting forward in 'sniffing position'
- ✓ Consider other rare causes of stridor:
 - Foreign body lodged in upper esophagus
 - Retropharyngeal or peritonsillar abscess
 - Hereditary angioedema

PRACTICE POINT

Impending respiratory failure is indicated by:

- *Change in mental status such as fatigue and listlessness*
- *Pallor or cyanosis*
- *Dusky appearance*
- *Decreased retractions or asynchronous chest wall and abdominal movement*
- *Decreased breath sounds with decreasing stridor*

INVESTIGATION

- X Laboratory and radiological assessments ARE NOT necessary to diagnose croup. The diagnosis can be reliably made based on the clinical presentation in combination with a careful history and physical examination
- ✓ Defer any well justified laboratory tests while the patient is in respiratory distress
- X Imaging studies ARE NOT required in patients with a typical history that respond to treatment. However, lateral and anteroposterior (AP) soft tissue neck film may be helpful in clarifying the diagnosis in children with croup-like symptoms
 - Cone-shaped narrowing ("steeping") instead of the normal squared shoulder appearance of the subglottic area suggests croup.
 - The AP neck radiograph may be helpful to establish an alternative diagnosis for patients with atypical disease.⁶ The following radiological findings are consistent with these alternative diseases:
 - A ragged edge or a membrane spanning the trachea suggests bacterial tracheitis
 - Thickening of epiglottis and aryepiglottic folds suggests epiglottitis
 - Bulging posterior pharynx soft tissues suggests retropharyngeal abscess

PRACTICE POINT

If a radiograph is obtained:

Progression of airway obstruction may be rapid therefore patients should be monitored during imaging by health care personnel trained to manage a child's airway

Contraindicated if clinical suspicion of epiglottitis or bacterial tracheitis as manipulation of the neck or agitation to the child may precipitate increased airway obstruction⁴

- ✓ Pulse oximetry is indicated in children with moderate to severe croup (see [Table 1](#)). Occasionally children without severe croup may have low oxygen saturation from intrapulmonary involvement⁷
- X Pulse oximetry IS NOT essential in patients with mild croup (see [Table 1](#))
- X Viral cultures or rapid antigen tests ARE NOT helpful for routine management, especially during the epidemic period

Levels of Severity for Children with Croup	
Mild	<ul style="list-style-type: none"> • Occasional barky cough • No audible stridor at rest • No to mild suprasternal and/or intercostal indrawing (retractions of the skin of the chest wall)
Moderate	<ul style="list-style-type: none"> • Frequent barky cough • Easily audible stridor at rest • Suprasternal and sternal wall retraction at rest • No or little distress or agitation
Severe	<ul style="list-style-type: none"> • Frequent barky cough • Prominent inspiratory – and occasionally – expiratory stridor • Marked sternal wall retractions • Significant distress and agitation
Impending respiratory failure	<ul style="list-style-type: none"> • Barky cough (often not prominent) • Audible stridor at rest (occasionally hard to hear) • Sternal wall retractions (may not be marked as respiratory failure progresses) • Lethargy or decreased level of consciousness • Often dusky appearance without supplemental oxygen

Table 1: Levels of Severity for Children with Croup

MANAGEMENT

EMERGENCY CARE (SEE [APPENDIX A](#) – ALGORITHM: CROUP IN THE OUTPATIENT SETTING AND [TABLE 2](#) - PHARMACOLOGY)

- ✓ Provide physical comfort

- Usually achieved by contact with one parent/caretaker*
- Avoid agitating the child with unnecessary procedures
- ✓ Provide blow-by humidified oxygen to children who are in respiratory distress*
- X Mist therapy has not been shown to have any measurable benefit^{8,9}
- ✓ Administer **epinephrine** for severe respiratory distress (i.e., marked sternal wall indrawing and agitation) for the **temporary** relief of symptoms of airway obstruction
 - L-epinephrine 1:1000 is as effective as racemic epinephrine – institutional preference may guide the decision as L-epinephrine is no longer readily available in North America¹⁰
 - Nebulized epinephrine therapy does not mandate admission to hospital, but children should not be discharged home before two hours after treatment^{11,12}
- ✓ Administer **dexamethasone** for all children diagnosed with croup (including those with a barking cough without any other signs of respiratory distress)
 - Relative contraindications (use with caution) include the child with a known immune deficiency or recent exposure to varicella^{13,14}
 - Oral administration preferred to intramuscular, except in children with very severe croup (see [Table 1](#))
- X Nebulized budesonide IS NOT routinely indicated for the treatment of croup
 - Exceptions include patients with:
 - Persistent vomiting
 - Severe respiratory distress
 - Budesonide may be mixed with epinephrine and administered simultaneously
 - The appropriate dose concentration of budesonide is 2mg (0.5mg/ml)
- X Antibiotics, oral decongestants, and beta-2 agonists ARE NOT indicated
- X Sedation is CONTRAINDICATED

INDICATIONS FOR ADMISSION

- ✓ Significant respiratory distress persisting four or more hours after treatment with corticosteroids
 - Sternal wall indrawing
 - Easily audible stridor at rest
- ✓ Consider admission*if:

* Expert opinion only

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- Lack of timely access to care, risk of no observation and follow-up, e.g., distance to medical facility, lack of transportation
- Significant parental anxiety
- Multiple emergency department (ED) visits within 24 hours

IN-PATIENT CARE

- ✓ Monitor respiratory status frequently, including vital signs and sequential clinical examinations focused on the child's degree of respiratory distress*
- ✓ Administer intravenous fluids usually only on children with severe respiratory distress*
- ✓ Prescribe appropriate medications (see [Appendix B](#))
- X DO NOT apply mist therapy^{8,9}
- ✓ Be alert for complications
 - Intubation may be required in a small number (<1%) of hospitalized patients^{15,16}
 - Bacterial tracheitis can cause a precipitous deterioration in patients initially diagnosed as having croup^{17,18}
 - Cardiopulmonary arrest can occur in patients who are not adequately monitored and managed
 - Pneumonia is a rare complication of croup¹⁹

CRITERIA FOR DISCHARGE FROM ED

- ✓ Presence of mild symptoms during initial evaluation or after a period of observation^{20,21}
- ✓ If symptoms have not recurred within two to four hours of observation after treatment with epinephrine^{11,12,22-25}
- ✓ Parents can return child for care if respiratory distress recurs at home*
- ✓ Parents have been advised when to seek medical intervention* and referred to the 'My Health Alberta' website:
<https://myhealth.alberta.ca/health/pages/conditions.aspx?Hwid=hw31906#hw31908>
 for more parent education and information on croup

FOLLOW-UP

- X NOT required for most children with croup³

* Expert opinion only
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- ✓ Children with prolonged stridor (> one week) should have follow-up by a primary care provider or an ED physician*

BACKGROUND

DIAGNOSIS

EPIDEMIOLOGY

Croup (laryngotracheobronchitis) is a very common cause of upper airway obstruction in children and has an annual incidence in Alberta of 6 % in children under six years of age.²⁶ Croup is most prevalent in the late fall to early winter months, but can occur year-round. Croup is usually caused by the parainfluenza virus; however, other viruses have been implicated.^{27,28}

Croup occurs most commonly in children between six months and three years of age, but can also occur in children as young as three months and as old as 15 years.¹ Boys are affected more often than girls. Croup is reported to be rare in adults.²⁹ The major concern of parents and health practitioners is the potential for respiratory compromise,³⁰ however, the vast majority of children can be safely managed at home, and very few require artificial support of their airway.²⁶ In Alberta, more than 60% of children diagnosed to have croup have mild symptoms, about four percent are hospitalized, and approximately one in 4,500 children are intubated (approximately one in 170 hospitalized children).^{2,26,31}

DIFFERENTIAL DIAGNOSIS

The vast majority of children who present with acute onset of upper airway obstruction characterized by stridor and indrawing have croup. In general, the diagnosis of croup is straight forward however rare but problematic causes of stridor must be considered and excluded.

BACTERIAL TRACHEITIS

The most common alternative diagnosis is bacterial tracheitis, a serious, potentially life-threatening bacterial infection thought to be a super-infection of croup.¹⁵⁻¹⁸ This disease is also the most difficult to distinguish from croup. Bacterial tracheitis usually presents as a sudden worsening of symptoms following a mild-to-moderate episode of croup, and can be most readily distinguished from croup by the acute onset of high fever, toxic appearance, and poor response to epinephrine.¹⁷ The presence of thick tracheal secretions in bacterial tracheitis have the potential to cause airway occlusion. Management of bacterial tracheitis includes broad-spectrum intravenous antibiotics, and close monitoring of the airway, as intubation and respiratory support is frequently required.

EPIGLOTTITIS

The second most likely alternative diagnosis is epiglottitis. This disease, primarily caused by haemophilus influenzae, was once relatively common in children; however, with the advent of the

* Expert opinion only

HIB vaccine, is now relatively rare. A young child with epiglottitis most commonly presents with sudden onset of high fever, dysphagia, drooling, toxic appearance, and is anxious and sitting forward in a “sniffing position.” There is an *absence* of a barking cough. The most crucial aspect of management is to secure the airway, and should only be attempted by physicians highly experienced in airway management. Any child considered to have epiglottitis should be taken by ambulance to hospital and accompanied by a physician skilled in pediatric airway management.

OTHER DIAGNOSES PRESENTING WITH STRIDOR

Obstruction of the upper airway by a foreign object will most commonly be revealed during the history; however, rarely, children can present with acute onset of stridor with an occult foreign body lodged in the upper esophagus.³²

Occasionally retropharyngeal abscess and peritonsillar abscess can present with stridor (although most children with these problems do not present with stridor). Both of these presentations are very rare. Other extremely rare causes of *acute onset* of stridor include airway trauma, diphtheria, hereditary angioedema, hypocalcemic tetany, and ingestion of corrosives.

PATHOGENESIS AND PATHOPHYSIOLOGY

Viral infection of the laryngeal mucosa leads to inflammation, hyperemia, edema, epithelial necrosis and shedding,³³ which results in narrowing of the subglottic region. Children compensate for narrowing of upper airway by breathing more rapidly and deeply. As the narrowing progresses, the child’s increased effort to breathe becomes counterproductive. Airflow through the upper airway becomes turbulent (stridor) and their compliant chest wall begins to “cave-in” during inspiration. This leads to inefficient asynchronous chest and abdominal movement, and the child becomes fatigued. At this point, the child becomes hypoxic and hypercapneic, and quickly develops respiratory failure and arrest.^{34,35}

Acute laryngotracheobronchitis is caused by a variety of viral agents and occasionally by *Mycoplasma pneumoniae*.¹ Parainfluenza type 1 is the most common cause of croup in North America, and parainfluenza type 3 is the second most frequent cause.³⁶ Influenza A and B, adenovirus, respiratory syncytial virus (RSV), human metapneumovirus, coronavirus, echovirus, and mycoplasma have also been isolated.^{1,27,28} Rare pathogens include enterovirus, measles, mumps, rhinovirus and *corynebacterium diphtheriae*.

PRESENTATION

The symptoms of croup are commonly preceded by non-specific cough, rhinorrhea, and fever. The characteristic barking cough, stridor, and respiratory distress most commonly develops suddenly during the evening or at night, but occasionally can develop gradually through the day. Stridor typically occurs only during inspiration; but with more severe distress, can be biphasic, occurring during expiration as well. Fever can occur and be high (up to 40°C).

Symptoms typically are much worse at night, and improve during the day. The majority of children with croup resolve their obstructive symptoms within 48 hours, though a small percentage of children remain symptomatic for up to five or six days.³ Although onset of respiratory distress often occurs suddenly, it is rare for children to develop respiratory failure immediately i.e. within minutes.

Respiratory failure typically occurs over several hours. Signs of respiratory failure and imminent respiratory arrest include reduction in respiratory effort, lethargy, pallor and dusky appearance.

Many medical experts distinguish several types of croup. The most common distinction made is between acute laryngotracheobronchitis (LTB) and spasmodic croup.³³ Acute LTB is described as an illness in which children have a viral prodrome (non-specific cough, rhinorrhea, and fever) for 12 to 48 hours, whereas spasmodic croup is described as an illness in which symptoms occur precipitously without a viral prodrome.³³ This latter type of croup is not characterized by fever, and symptoms are thought to be more transient than in children with acute LTB. Children with spasmodic croup are also thought to have recurrent episodes. Though these types of croup are generally described in medical textbooks, there are no well-designed cohort studies published that provide evidence of the differences or support the clinical importance of making these distinctions.

MANAGEMENT

Because croup symptoms often occur precipitously at night, many parents become panicked and immediately visit an emergency department.³⁰ As a result, it is important to educate parents about the self-limited nature of the disease, as well as the benefit of exposing their symptomatic child to cold air for a few minutes to reduce symptoms. Refer to the 'My Health Alberta' website for parent education on croup:

<https://myhealth.alberta.ca/health/pages/conditions.aspx?Hwid=hw31906#hw31908resources>

MIST

Children with croup have been treated with humidified air for more than a hundred years, dating back to the use of “croup kettles.” However, there is no evidence to support its use.⁸ A systematic review found no significant difference in croup score following humidified air treatment.⁸ Following this systematic review, a subsequent randomized controlled trial of 140 children with moderate to severe croup in an emergency department setting was published. The study compared treatment with humidified ‘blow-by’ oxygen (considered placebo as this delivery system was shown to have ambient humidity equal to room air), to two other arms including a 40% humidified oxygen and a 100% humidified oxygen arm. The data showed no significant benefit to humidity, as there were no differences in croup score, admission to hospital or need for additional medical care, nor treatment with epinephrine or dexamethasone among the groups.⁹ Given the absence of evidence for its benefit, mist wands, bedside humidifiers, nor mist tents should be recommended. Mist tents in particular should not be used because they create an uncomfortable wet, cold, “caged” environment; separate the child from their parents, and results in agitating the child.³⁷ Furthermore, mist tents are often improperly cleaned between use and may disperse contaminants into the child’s room.

OXYGEN

Oxygen should only be administered to children with hypoxia (oxygen saturation on room air less than 92%) and significant respiratory distress. Oxygen should never be forced on a child who is significantly agitated. “Blow-by” (administration of oxygen through a plastic hose with the end opening held near the child’s nose and mouth) is often the most beneficial way of administering oxygen.

HELIUM-OXYGEN MIXTURES

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.³⁸⁻⁴²

A systematic review of data from three randomized clinical trials⁴³ concluded that heliox may provide short-term benefit in children with moderate to severe croup who had received corticosteroid treatment. Note that 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.

PHARMACOTHERAPY (SEE [TABLE 2](#))

ANALGESICS/ANTIPYRETICS

There are no published controlled trials to support the use of analgesics or antipyretics specifically for treating children with croup; however, reducing fever and pain should provide more comfort.

ANTITUSSIVES AND DECONGESTANTS

There are no published studies to support use of and potential benefit from antitussives or decongestants for children with croup. Furthermore, there is no clinical basis for their use and they should not be administered or recommended.

ANTIBIOTICS

There are no published controlled trials demonstrating the potential benefit of antibiotics in children with croup. As croup is virtually always a viral infection, empiric antibiotic therapy is not recommended. Furthermore, because prevalence of “super-infection” in children with croup (most commonly bacterial tracheitis and occasionally pneumonia) is so rare (less than one in 1,000) that the use of an antibiotic for “prophylaxis” is also not indicated.

BETA-2 AGONISTS

Given that croup is an upper airway disease, there is no physiological basis or evidence to support the use of beta-2 agonists in its treatment.

EPINEPHRINE

Based on historical data, epinephrine administered to children with severe croup substantially reduces the number requiring an artificial airway.⁴⁴ Epinephrine has been shown to substantially reduce respiratory distress within 10 minutes of administration and to last for more than an hour.^{22,45-50} The effects from epinephrine dissipate within two hours after administration.²² Patients treated with epinephrine return to their “baseline” severity but do not routinely develop worse symptoms (‘rebound’ effect) prior to the treatment.²² A number of retrospective and prospective studies have been published that suggest patients treated with epinephrine may be safely discharged home as long as their symptoms do not recur for at least two to three hours after treatment.^{11,12,23-25,51} A systematic review of data from eight randomized controlled clinical trials concluded that nebulized epinephrine treatment was associated with improvement in croup score 30

minutes following administration, and that length of stay in children admitted to hospital with croup was shorter in the group receiving the nebulized epinephrine treatment.⁵

The racemate form of epinephrine was traditionally used to treat patients with croup; in North America, the racemate form of epinephrine is no longer readily available. However, epinephrine 1:1000 is comparably effective and as safe as the racemate form.¹⁰ A single size dose (0.5 ml of 2.25% racemic epinephrine and 5.0 ml of epinephrine 1:1000) is used in all children regardless of weight. Children's relative size of tidal volume is thought to modulate the dose of drug actually delivered to the upper airway.

"Continuous" epinephrine is reported to be used in some pediatric intensive care units. However, one published paper reported that an otherwise "normal" child with severe croup was treated with three nebulizations of epinephrine within one hour. The child developed ventricular tachycardia and had a myocardial infarction.⁵² Therefore, repeat doses of epinephrine should never be used unless a child is approaching respiratory failure. If "back-to-back" therapy is considered necessary, the attending physician should contact a pediatric intensivist as soon as possible regarding further treatment and transport.

GLUCOCORTICOIDS

Steroids are the mainstay of therapy for croup given that a recent systematic review of 38 randomized controlled trials including more than 4,000 patients, an older meta-analysis and select randomized controlled trials have demonstrated corticosteroids reduce the number and duration of intubations, the need for re-intubation, the decreased rate and duration of hospitalizations, and a reduced number of visits to a health care practitioner for persistent croup symptoms.^{51,53-56}

A large multi-centre Canadian study involving 720 children with mild croup demonstrated that children treated with dexamethasone, as compared with placebo, had half the rate of return to a health care practitioner (7% vs. 15%), had substantially less severe croup symptoms and had more sleep in the 48 hours after treatment. Further, their parents experienced less stress in the 24 hours following treatment, and both families and the health care system incurred slightly fewer costs - on average, \$21 per child.⁵⁴ The benefits were similar in those children with very mild symptoms (barky cough only) and those who had had croup symptoms for several days at the time of assessment. No adverse effects occurred in either treatment group. Therefore all children diagnosed to have croup (as evidenced by the presence of a seal-like barky cough) should be treated with corticosteroids, with the rare exception of a child with known immune deficiencies or recent definite exposure to varicella.

Dexamethasone appears to be equally effective if given orally or parenterally.^{57,58} However, oral administration is preferred as it is generally less traumatic. Oral dexamethasone (using a parenteral/injectable preparation mixed with a flavoured syrup) is rapidly absorbed with less than 5% of children vomiting the drug.^{59,60} Symptoms improve within one to three hours and persist for 24 to 48 hours after a single dose is administered.^{53,61}

The traditional dose of dexamethasone is 0.6 mg/kg.⁶² However, four randomized clinical trials including doses of 0.15 mg/kg have concluded that lower doses (0.15 mg/kg) are equally effective, though sample sizes were small and none of the trials were designed to show non-inferiority.⁶³⁻⁶⁷ On the other hand, a meta-analysis of controlled trials suggests higher doses of corticosteroids yield a clinically important response in a greater proportion of patients.⁵⁶ Therefore, pending further clinical

trials, definite recommendations of dosing range cannot be made, and the use of either standard (0.6 mg/kg) or lower-dose (0.15 mg/kg) are reasonable.

No controlled trials have been published that examine whether or not multiple doses of corticosteroids provide greater benefit than a single dose. However, given the short duration of croup symptoms in the majority of patients, a single dose of corticosteroid is probably sufficient for most patients. Children admitted to hospital who have longer-lasting symptoms might derive benefit from further doses, however, further study is needed.

Inhaled budesonide has been shown to be effective and equivalent to oral dexamethasone.^{59,63} However, budesonide is no more effective than dexamethasone, is generally more traumatic to administer, and is substantially more expensive, therefore it should not be routinely used. The exception is for patients with severe or near respiratory failure, the simultaneous administration of budesonide and epinephrine is appropriate and may be more effective than epinephrine alone. In addition, for those children who vomit oral medication, inhalational administration of steroids may be a reasonable alternative.

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For more information see www.topalbertadoctors.org

GUIDELINE COMMITTEE

The committee consisted of representatives of family medicine, emergency medicine and pediatrics.

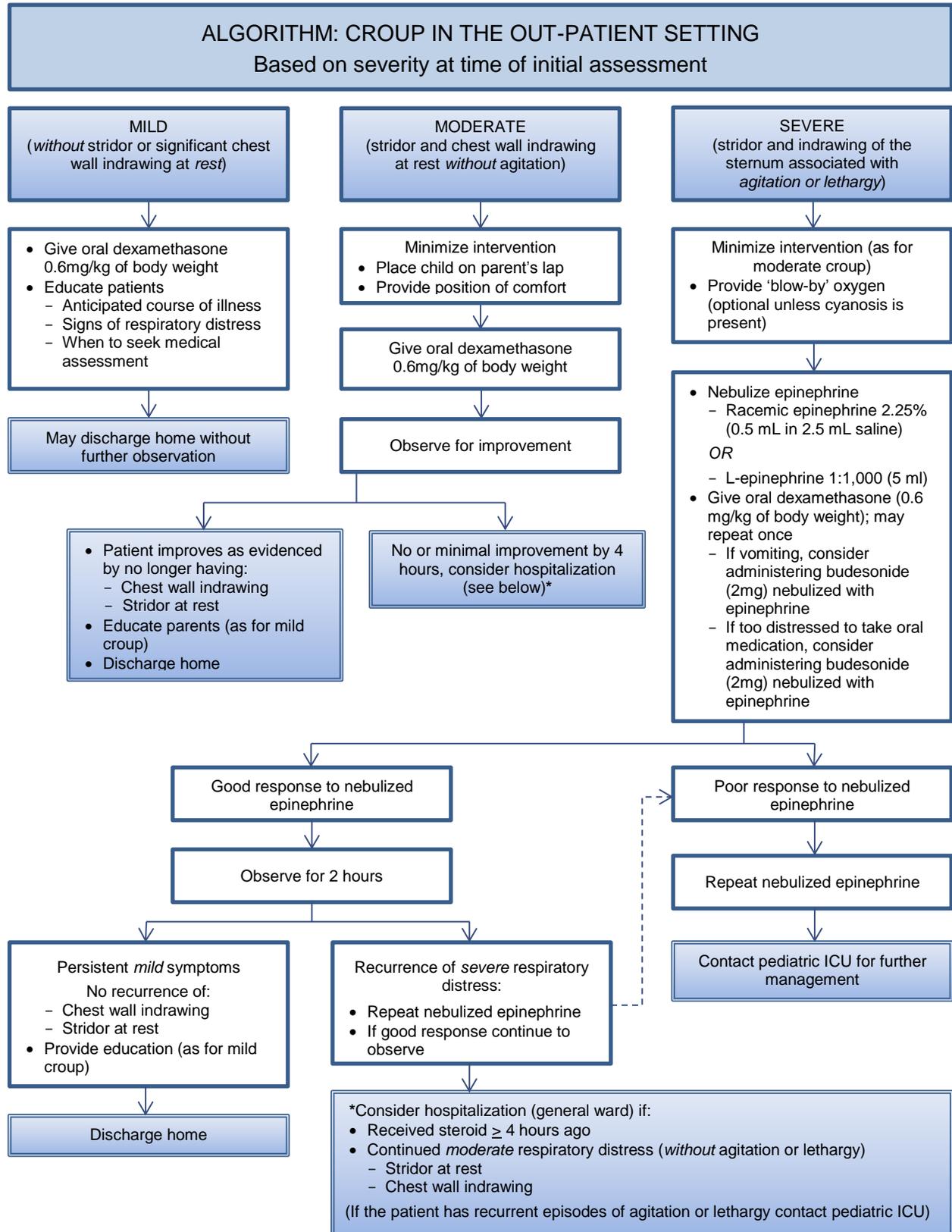
July 2003

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APPENDIX A



APPENDIX B

PHARMACOLOGY

Drug Category	Dose and Duration	Comments
<p>Adrenergic Agonist</p> <ul style="list-style-type: none"> Epinephrine 	<ul style="list-style-type: none"> Racemic epinephrine 0.5 mL of 2.25% solution diluted in 2.5 mL of NS or sterile water via nebulizer L Epinephrine 1:1,000 solution 5 ml via nebulizer May be repeated back to back in children with severe respiratory distress 	<ul style="list-style-type: none"> Racemic epinephrine and L Epinephrine are equivalent in terms of effect and safety Racemic epinephrine is no longer readily available in North America The duration of effect of epinephrine does not exceed two hours. This patient should not be discharged from medical care for at least two hours after receiving a dose of epinephrine. In a child with persistent vomiting, nebulized budesonide may be combined and administered simultaneously with epinephrine
<p>Corticosteroids</p> <ul style="list-style-type: none"> Dexamethasone 	<ul style="list-style-type: none"> 0.6 mg/kg PO/IM once May repeat dose in six to 24 hours 	<ul style="list-style-type: none"> Oral dexamethasone is well-absorbed and achieves peak serum concentrations as rapidly as with intramuscular administration (without pain!) Several controlled trials suggest oral and intramuscular administration yield equivalent results Experience suggests clinical improvement will begin as early as two to three hours after treatment Lower dose (0.15 mg/kgPO/IM) may be considered No evidence to suggest multiple doses provide additional benefit over a single dose Reduces: <ul style="list-style-type: none"> Rate & duration of intubation Rate & duration hospitalization Rate of return to medical care Duration of symptoms in children with mild, moderate and severe symptoms
<ul style="list-style-type: none"> Budesonide 	<ul style="list-style-type: none"> 0.6 mg/kg PO/IM once May repeat dose in six to 24 hours 	<ul style="list-style-type: none"> In the vast majority of cases, budesonide offers no advantages over dexamethasone and is substantially more expensive May be useful in patients with vomiting, severe respiratory distress; budesonide and epinephrine can be administered simultaneously

Table 2: Pharmacology