

**INTEGRATING EVIDENCE-BASED PEDIATRIC PREHOSPITAL PROTOCOLS INTO PRACTICE  
EMSC TARGETED ISSUES GRANT #H34MC19347**

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**CHILDREN IN RESPIRATORY DISTRESS  
PREHOSPITAL PROTOCOL**

**Guideline Eligibility Criteria:**

Children treated by Emergency Medical Service (EMS) agencies for the Houston Fire Department (HFD), Bio Tel (Dallas) and the City of Austin/Travis County with respiratory distress.

**Guideline Exclusion Criteria:**

Foreign body  
Submersion  
Anaphylaxis

**Differential Diagnosis:**

Asthma  
Bronchiolitis  
Croup/Epiglottitis  
Pneumonia  
Upper respiratory infections

***History: Assess for***

- Time of onset
- Foreign body aspiration
- Fever or infection
- Sick contacts
- Asthma
- Treatment (e.g., O<sub>2</sub>, nebulizer)
- Medications (e.g., steroids, inhalers)
- Toxic exposure
- Trauma

***Physical Examination: Assess for***

- Shortness of breath
- Decreased ability to speak
- Abnormal respiratory rate and effort
- Wheezing, rhonchi, rales, stridor
- Use of accessory muscles
- Cough
- Tachycardia
- Anxious appearance
- Abnormal color (cyanosis, pallor)
- Abnormal mental status
- Abnormal oxygen saturation
- Adequacy of air entry

### Practice Recommendations

#### **Respiratory Assessment Tools**

Prehospital providers should be taught to assess and document components of the Respiratory Distress Assessment Instrument (RDAI), Pediatric Asthma Severity Score (PASS), and Westley Croup respiratory scores. – Strong recommendation, Moderate quality evidence <sup>(1-9)</sup>

#### **Monitoring**

Pulse oximetry should be routinely used in children with respiratory distress as an adjunct to other forms of respiratory monitoring. – Strong recommendation, Low quality evidence <sup>(10,11)</sup>

Electrocardiogram (ECG) should not be routinely used for children with respiratory distress. If there are no signs of clinical improvement after treating the respiratory distress, consider ECG monitoring to assess for cardiac concerns. – Weak recommendation, Very low quality evidence <sup>(12)</sup>

Measuring end-tidal CO<sub>2</sub> (ETCO<sub>2</sub>) is safe, reliable and non-invasive and demonstrates a strong correlation with pulse oximetry; it should be used as an adjunct to other forms of respiratory monitoring. – Strong recommendation, Low quality evidence <sup>(13-16)</sup>

#### **Treatment**

Supplemental oxygen should be provided to all children with respiratory distress. – Strong recommendation, Very low quality evidence <sup>(17)</sup>

A child's nose and/or mouth should be suctioned (via bulb, Yankauer, suction catheter) if excessive secretions are present. – Strong recommendation, Very low quality evidence <sup>(17)</sup>

#### **Inhaled Medications**

Beta-agonists should be administered to all children in respiratory distress with signs of bronchospasm (e.g. known asthmatics, quiet wheezers) in the prehospital setting, either via nebulized route or metered-dose inhaler, by basic life support (BLS) or advanced life support (ALS) providers. – Strong recommendation, Moderate quality evidence <sup>(18-24)</sup>

Nebulized anticholinergic medication (i.e., ipratropium) should be administered in multiple doses with short acting beta-agonist to children ≥ 2 years of age with known asthma who are in severe respiratory distress in the prehospital setting. – Strong recommendation, Moderate quality evidence <sup>(25-27)</sup>

Hypertonic saline should not be administered to children in respiratory distress in the prehospital setting. – Weak recommendation, Low quality evidence <sup>(3,28,29)</sup>

Nebulized epinephrine should be administered to children in severe respiratory distress with presumed croup (e.g., have stridor at rest or barking cough) or refractory bronchiolitis (e.g. coarse breath sounds) in the prehospital setting if other treatments (e.g., suctioning, oxygen) fail to result in clinical improvement. – Strong recommendation, Moderate quality evidence <sup>(30,31)</sup>

Inhaled magnesium sulfate should not be administered to children in respiratory distress in the prehospital setting. – Weak recommendation, Low quality evidence <sup>(32)</sup>

Inhaled steam via a mist tent should not be administered to children in respiratory distress in the prehospital setting. – Weak recommendation, Moderate quality evidence <sup>(33)</sup>

#### **Intravenous Magnesium**

Intravenous magnesium sulfate should be administered to children with presumed asthma in impending respiratory failure. – Strong recommendation, Moderate quality evidence <sup>(32,34,35)</sup>

#### **Utility of IV Placement and Fluids**

IVs should only be placed in children with respiratory distress for clinical concerns of dehydration, or when administering IV medications. – Weak recommendation, Very low quality evidence <sup>(36-38)</sup>

#### **Steroids**

Oral or parenteral steroids should be administered to children in respiratory distress with presumed asthma in the prehospital setting. – Strong recommendation, Moderate quality evidence <sup>(39-52)</sup>

Steroids administered either IV or IM are no more effective than steroids administered orally in improving pulmonary function, asthma scores, and reducing readmission rates. – Strong recommendation, Moderate quality evidence <sup>(40,43-45,48,51,52)</sup>

### **Epinephrine (IM/SQ/IV)**

Epinephrine should only be administered to children with impending respiratory failure as adjunct therapy to albuterol when there are no clinical signs of improvement. – Strong recommendation, Moderate quality evidence <sup>(4,53-56)</sup>

### **Improvement of Oxygenation and/or Respiratory Distress with Non-invasive Airway Adjuncts**

Continuous Positive Airway Pressure (CPAP) for bronchospasm should be administered to children in severe respiratory distress. – Weak recommendation, Low quality evidence <sup>(57-61)</sup>

Bag-Valve-Mask Ventilation should be utilized in children with respiratory failure. – Strong recommendation, Moderate quality evidence <sup>(62,63)</sup>

Heliox should not be routinely administered to children with respiratory distress. – Strong recommendation, Moderate quality evidence <sup>(64-68)</sup>

### **Supraglottic Devices and Intubation**

Supraglottic devices and intubation should be utilized only if bag-valve-mask ventilation fails. The airway should be managed in the least invasive way possible. – Weak recommendation, Very low quality evidence <sup>(37,63,69)</sup>

### **Transport**

Routine use of lights and sirens (Code 3 transport) is not recommended during transport. – Strong recommendation, Low quality evidence <sup>(70-72)</sup>

## **Measures**

### **Process**

Prehospital on-scene time

Prehospital transport time

CPAP utilization

IV/IO placement

Time to administration of specified interventions in the protocol

Rate of administration of accepted therapy (Y/N: whether or not certain medications/interventions were given)

### **Outcome**

ED length of stay (LOS)

Hospital admission rate

LOS in ED observation unit

LOS in hospital

LOS in Pediatric Intensive Care Unit (PICU)

Change in vital signs (i.e., heart rate, blood pressure, temperature, respiratory rate, pulse oximeter, capnography values)

Time to administration of specified interventions in the protocol

Rate of administration of accepted therapy

Number of advanced airway attempts

Cost of hospital care

Knowledge retention of prehospital providers

Mortality

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**Protocol Preparation**

This protocol was funded by a Health Resources and Services Administration (HRSA) Emergency Medical Services for Children (EMSC) Targeted Issues grant. All documents were prepared by the Evidence-Based Outcomes Center (EBOC) Team in collaboration with content experts from Texas Children's Hospital (TCH), HFD, City of Austin/Travis County EMS, Hospital Physicians in Clinical Research, Dell Children's Medical Center of Central Texas, BioTel EMS, and Children's Medical Center Dallas. Development of this guideline supports the TCH Quality and Patient Safety Program initiative to promote clinical guidelines and outcomes.

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**Development Process**

This protocol was developed using a modification to the process outlined in the EBOC Manual (2010). The review summary documents the following steps:

1. Review Preparation
  - PICO questions established
  - Evidence search confirmed with protocol committee
2. Review of Existing Internal and External Guidelines
  - HFD Breathing Difficulty: Wheezes (Asthma/Bronchiolitis); UT Southwestern Medical Center at Dallas/BioTel EMS System Respiratory Distress; City of Austin/Travis County EMS System Pediatric Respiratory Distress
3. Literature Review of Relevant Evidence
  - Searched: PubMed, Cochrane Library, Emergency Medicine Journal: EMJ, Emergency Medical Services, EMS Magazine, EMS World, International Journal of Emergency Medicine (aka Emergency Medicine)
4. Critically Analyze the Evidence
  - 24 Systematic Reviews; 19 Randomized Controlled Trials; 30 Non-Randomized Trials
5. Summarize the Evidence by preparing the protocol
  - Materials used in the development of this protocol are maintained by the Primary Investigator in a Children with Respiratory Distress Evidence-based (EB) development binder.

**Evaluating the Quality of the Evidence**

Published clinical guidelines were evaluated for this review using the **AGREE** criteria. The summary of these guidelines are included in the evidence summary. AGREE criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 1-4 point Likert scale. The higher the score, the more comprehensive the guideline.

The **Critical Appraisal Skills Program (CASP)** criteria were used to evaluate the quality of individual articles. Application of the CASP

criteria are used to rate each study, meta-analysis, or systematic review as:

**Strong study/systematic review** – well designed, well conducted, adequate sample size, reliable measures, valid results, appropriate analysis, and clinically applicable/relevant

**Study/Systematic review** with minor limitations – specifically lacking in one of the above criteria

**Study/Systematic review** with major limitations – specifically lacking in several of the above criteria

This guideline specifically summarizes the evidence *in support of or against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions.

**“Evidence that supports”** the guideline provides clear evidence from well-designed randomized controlled trial(s) [RCT(s)] that the benefits of the intervention exceed harm.

**“Evidence against”** provides clear evidence from more than one well-done RCT that the intervention is likely to be ineffective or that it is harmful.

**“Evidence lacking/inconclusive”** indicates there is currently insufficient data or inadequate data to support or refute a specific intervention.

The **GRADE** criteria were utilized to evaluate the body of evidence used to make clinical recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The evidence summary reflects the critical points of evidence.

Recommendation	
<b>STRONG</b>	Desirable effects clearly outweigh undesirable effects or vice versa
<b>WEAK</b>	Desirable effects closely balanced with undesirable effects
Quality	Type of Evidence
<b>High</b>	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
<b>Moderate</b>	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
<b>Low</b>	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
<b>Very Low</b>	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence

**Recommendations**

Recommendations for the guidelines were directed by the existing evidence, protocol committee members, and consensus. Patient and family preference were included when possible. The Protocol Committee and EBOC Team remain aware of the controversies in treating children in respiratory distress. When evidence is lacking, options in care are provided in the protocol.

**Approval Process**

Developed content was reviewed and approved by the Protocol Committee members previously listed. Content and recommendations were shared with respective EMS and ER colleagues for feedback and review.

**Disclaimer**

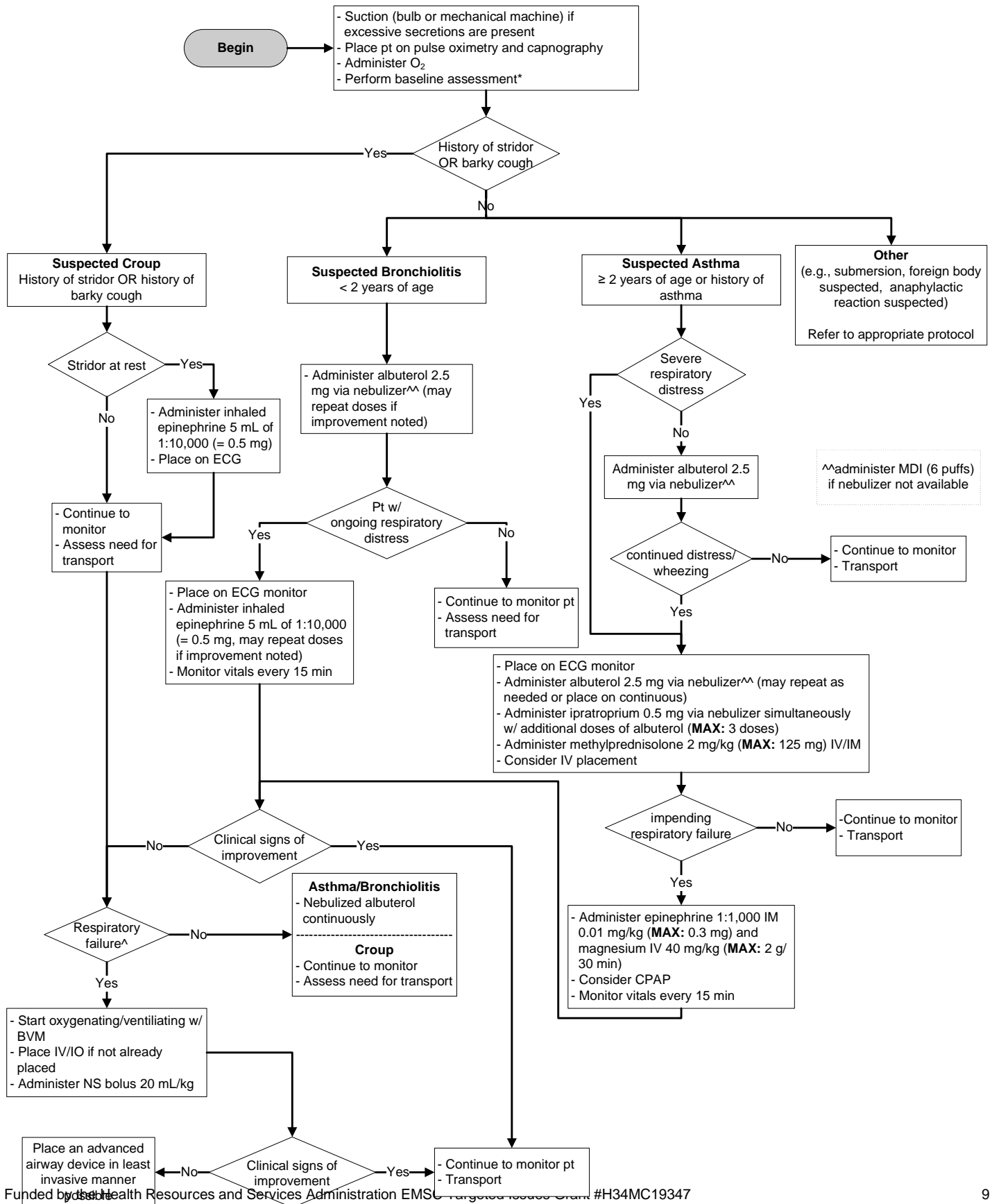
Guideline recommendations are made from the best evidence, clinical expertise and consensus, in addition to thoughtful consideration for the patients and families cared for within the Integrated Delivery System. When evidence was lacking or inconclusive, content experts made recommendations based on consensus. Expert consensus is implied when a reference is not otherwise indicated. The guideline is not intended to impose standards of care preventing selective variation in practice that is necessary to meet the unique needs of individual patients. The physician must consider each patient and family's circumstance to make the ultimate judgment regarding best care.

## **Appendix A**

### **Children with Respiratory Distress- Algorithm**



## Integrating Evidence-Based Pediatric Prehospital Protocols into Practice Children with Respiratory Distress



**\*Baseline Assessment**

- Vital signs
- Work of breathing (retractions, supraclavicular, intercostal, subcostal)
- Breath sounds
  - wheezing - expiratory, inspiratory, # of lung fields involved
  - expiratory phase
  - other sounds - rales, crackles
  - stridor
- Air entry (good, diminished, absent)
- Skin color (normal, pale, cyanotic w/ agitation, cyanotic at rest)
- Mental status (normal, restless, lethargic/depressed)

**^Respiratory failure (per PALS)**

- inadequate ventilation
- insufficient oxygenation
- Anticipate respiratory failure if:*
  - increased respiratory rate, particularly w/ signs of distress (e.g., nasal flaring, retractions, seesaw breathing, grunting)
  - inadequate respiratory rate, effort, or chest excursion (e.g., diminished breath sounds, gasping)
  - cyanosis w/ abnormal breathing despite suppl O<sub>2</sub>

Baseline Assessment Category	No Respiratory Distress	Respiratory Distress
<b>Vital signs</b>	Normal RR and O <sub>2</sub>	Fast or slow RR for age O <sub>2</sub> < 90%
<b>Work of breathing</b>	No accessory muscle use	Supraclavicular, subcostal, or intercostals retractions
<b>Breath sounds</b> - <i>Adventitial sounds</i>  - <i>Wheezing</i>   - <i>Stridor</i>	Clear  No wheezing with normal expiratory phase  Stridor absent	Rales, rhonchi, or crackles  Expiratory, inspiratory, or both; also document lobes affected  Prolonged expiratory phase  Inspiratory or expiratory stridor present
<b>Air entry</b>	Good	Diminished or absent
<b>Skin color</b>	Pink	Pale or dusky/cyanotic
<b>Mental status</b>	Alert/normal	Restless or lethargic/depressed

## **Appendix B**

### **Children with Respiratory Distress- Evidence Summary**

### PICO Questions

The following PICO questions were addressed by the content experts from Texas Children's Hospital, HFD, City of Austin/Travis County EMS, Hospital Physicians in Clinical Research, Dell Children's Medical Center of Central Texas, BioTel EMS, and Children's Medical Center Dallas in creation of the evidence-based Children with Respiratory Distress Prehospital Protocol. Refer to the Evidence-Based Practice Summary for the complete evidence summary including GRADE tables.

**Question 1:** In children with respiratory distress, which validated respiratory assessment tools can be used in the prehospital setting?

**Question 2:** In children with respiratory distress, is pulse oximetry sufficient in monitoring a child's respiratory status in the prehospital setting?

- a. In children with respiratory distress, should pulse oximetry be routinely used?
- b. In children with respiratory distress, what are the limitations of solely utilizing pulse oximetry monitoring?

**Question 3:** In children with respiratory distress, is it clinically efficacious to use electrocardiogram (ECG) monitoring?

**Question 4:** In children with respiratory distress, is the routine application of oxygen in the absence of hypoxia clinically effective?

**Question 5:** In children with respiratory distress, is airway suctioning effective in improving:

- a. Oxygenation
- b. Clinical signs of distress

**Question 6:** In children with respiratory distress, are the following inhaled medications clinically effective (i.e., decreased distress, shorter ED length of stay, decreased admission rates to the hospital):

- a. Albuterol
- b. Levalbuterol (Xopenex)
- c. Ipratropium (Atrovent)
- d. Hypertonic saline (3%, 5%.)
- e. Racemic epinephrine
- f. Magnesium sulfate
- g. Steam

**Question 7:** In children with respiratory distress, does the use of intravenous magnesium sulfate in the prehospital setting result in clinical improvement (e.g. decreased stress, shorter ED length of stay, decreased admission rates to the hospital)?

**Question 8:** In children with respiratory distress in the prehospital setting, is it efficacious (e.g., lead to better clinical outcomes) to place an IV?

**Question 9:** In children with respiratory distress in the prehospital setting, do steroids (any route) lead to improved clinical outcomes? What is the preferred route?

**Question 10:** In children with respiratory distress in the prehospital setting, when are IV fluids clinically effective and useful?

**Question 11:** In children with respiratory distress in the prehospital setting, does epinephrine (IM/SQ/IV) lead to improved clinical outcomes?

**Question 12:** In children with respiratory distress, what are the clinical situations in which the following non-invasive airway adjuncts improve oxygenation and/or respiratory distress:

- a: Continuous positive airway pressure (CPAP)
- b: Bag valve mask ventilation
- c: Heliox

**Question 13:** In children with respiratory distress in the prehospital setting, do supraglottic devices and intubation lead to improved clinical outcomes? What are the indications and contraindications for using a supraglottic device or intubating?

**Question 14:** In children with respiratory distress, is the use of capnography efficacious and clinically useful?



**Question 15:** In children with respiratory distress, are there improved patient outcomes when an online medical direction is contacted versus no online medical direction is contacted?

**Question 16:** In children with respiratory distress, are there improved patient outcomes when patients are transported by Advanced Life Support (ALS) providers as compared to Basic Life Support (BLS) providers?

**Question 17:** In children with respiratory distress, is it clinically efficacious to transport with lights and sirens?