WRAP-EM
Western Regional Alliance for Pediatric Emergency Management
AZ CA NV OR WA UT

https://wrap-em.org/

Just-in-Time Basic Clinical Guidance for Pediatric Respiratory Illness

Version 1

Background: This document addresses a unique educational need for physicians caring for pediatric patients in receiving center emergency departments. There are multiple facilities with limited pediatric capabilities that care for children as they await transfer or the opening of more high-level pediatric beds. Our intent is to provide basic clinical guidance for respiratory care for children to help in these circumstances. It is expected that this is most valuable as a "just in time" reference for providers with limited pediatric experience. It is not intended in scope to be a pediatric intensive care manual for respiratory illness, but rather the management of patients as they await transfer to a higher level or improvement in their clinical condition.

Critical disclosures:

*This document presents an evidence-based approach that is appropriate for most patients. It should be adapted to meet the needs of individual patients and situations and should not replace established protocols or clinical judgment.

*Ideal care for some of these children may be to transfer to a higher level of care and this guidance should not be used as a substitute for that when transfer is possible and clinically appropriate.

Clinical guidelines:

1) Assessment and monitoring:
   a) Physical Exam
   b) Vital Signs (important to note age appropriate normal for each child)
   c) Signs of respiratory distress
      i) Increased work of breathing
         (1) retractions (subcostal, intercostal, supraclavicular, tracheal tugging)
         (2) nasal flaring
         (3) head bobbing
      ii) Mental Status Changes
         (1) early: Irritable, agitated or inconsolable
         (2) Late: lethargic
      iii) Rapid Respiratory Rate
      iv) Sats less than 90%
      v) Low blood Pressure
      vi) Blue discoloration
   d) Auscultation
      i) Air entry
      ii) Focality of abnormal lung sounds
      iii) Presence of wheezes
         (1) OpenPediatrics: Playlist of open-access educational videos on recognizing and managing pediatric respiratory distress.

2) History
   a) Consider factors that may place the child at higher risk:
   b) Patient's medical co-morbidities
      i) Born less than 34 weeks and now less than 6 months old
      ii) Chronic Lung disease
      iii) Anatomic airway defect
      iv) Prior history of intubation for respiratory illness
      v) Cardiac disease requiring baseline medical therapies
      vi) Neuromuscular disease
      vii) Immunodeficiencies
3) Evaluation
   a) Radiology - consider if there is focality on lung exam or 1st time wheezing illness.
      i) Plain chest film - note: chest films are generally not required for patients with acute bronchiolitis or known asthma
         (1) Note presence of pleural effusions. Small effusions (less than 0.25% of the lung space) may be well tolerated without chest tubes. Unilateral process resulting in mediastinal shift needs decompression with a chest tube.
      ii) CT scan
         (1) Generally NOT performed; but may be performed in selective cases where complications are present or unclear diagnosis
   b) Labs
      i) CBC and Complete metabolic Panel
      ii) Blood gas
         (1) Important to follow Oxygenation, acidosis, and CO2 levels. Note, rising CO2 levels may be more apparent than low oxygen in many cases. Markedly elevated CO2 levels may be a sign of impending respiratory failure and the need for a ventilator.
      iii) CRP and Sed Rate
      iv) RVP (respiratory viral panel swab)
4) Management of Acute Respiratory Failure
   a) Oxygenation/Ventilatory Support - evaluate whether you need to support oxygenation vs ventilation. Oxygenation is needed for hypoxia and supported through the addition of supplemental oxygen. Ventilation is needed for work of breathing/hypercarbia and supported through high flow/non-invasive positive pressure support.
      i) Low flow nasal cannula
         (1) Supplemental oxygen should be provided if saturations persistently fall below 90%. The goal is to provide oxygen to maintain saturations at or above 90%.
         (2) Oxygen is supplied via nasal cannula, using the lowest flow possible.
         (3) Oxygen saturation drops to 88% are acceptable during sleep
         (4) <20 second drops in saturations to the 80s in the sleeping child do not require supplemental oxygen;these may occur in healthy infants (Hunt 1999)
         (5) Deeper self-resolving desaturations may not be clinically meaningful in mild-to-moderate bronchiolitis patients, who should therefore be taken off continuous pulse oximetry once off supplemental oxygen (Principi 2016)

ii) High flow nasal cannula
(1) HFNC Clinical Pathway options and resources https://files.asprtracie.hhs.gov/documents/aspr-tracie-ta---pediatrics-and-high-flow-nasal-cannulas.pdf
iii) CPAP
iv) Invasive airway
(1) LMA / Intubation

5) Medications that could be used in pediatric respiratory illness

Note: Refer to your institution guidelines for conservation plans for medications on shortage or anticipated shortage.

a) Tamiflu
i) Indications: Clinical benefit is greatest if initiated within 48 hours. In patients with severe, complicated, or progressive illness, hospitalized patients, or those at increased risk for complications, initiate treatment as soon as possible even if >48 hours have elapsed since illness onset and do not delay for laboratory confirmation. For symptomatic outpatients with mild illness not at increased risk for complications, treatment can be considered if it can be initiated ≤48 hours following illness onset. Usual duration of therapy is 5 days; a longer duration can be considered in severely ill or immunocompromised patients (CDC 2021a).
ii) Dosing:
(1) Infants
(a) ≤8 months: Oral: 3 mg/kg/dose twice daily (AAP 2021; CDC 2021a; IDSA [Uyeki 2019]).
(b) ≥9 months: Oral: 3.5 mg/kg/dose twice daily (AAP 2021; IDSA [Uyeki 2019]); some experts still recommend manufacturer labeled dosing of 3 mg/kg/dose twice daily (CDC 2021a; IDSA [Uyeki 2019]).
(2) Children and Adolescents:
(a) ≤15 kg: Oral: 30 mg twice daily.
(b) >15 to 23 kg: Oral: 45 mg twice daily.
(c) >23 to 40 kg: Oral: 60 mg twice daily.
(d) >40 kg: Oral: 75 mg twice daily.

b) Nebulized epinephrine
i) Consider inhaled epinephrine for stridor at rest
(1) Racemic <4 years 0.05mL/kg up to 0.5mL mixed with 3 mL NS given via nebulizer over 15 min prn q 1-2 hr; > or = 4 years 0.5 mL/dose inhaled
(2) Alternative to racemic epinephrine : Epinephrine (1:1000 or 1 mg/mL) < 4 years 2.5mL nebulized and 4 or greater 5mL nebulized
ii) Albuterol - used as trial for wheezing or for known asthma
(1) Indications: asthma or bronchospasm
(2) Dosing:
(a) Nebulized: 2.5 mg - 10 mg every 20 minutes to 4 hours as needed
(b) MDI: 2-8 inhalations, utilizing a spacer, every 20 minutes to 4 hours as needed
(c) Continuous administration
(i) <20 kg - 10 mg/hr
(ii) >20 kg - 20 mg/hr
(iii) mL/hr will depend on the method of administration.

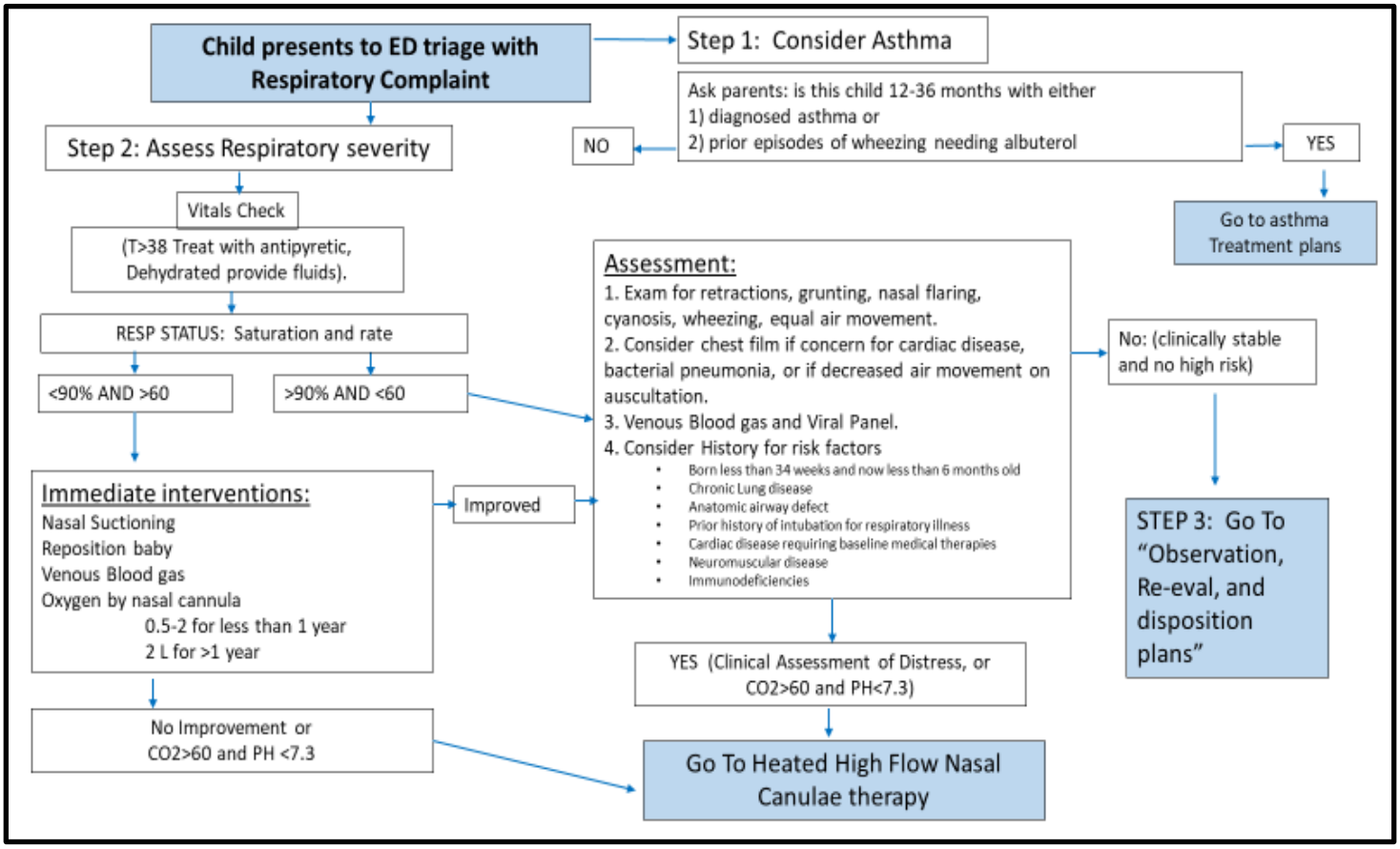
1. Examples: Mistifinity= 30mL/hr, Aerogen= 12mL/hr. Consult respiratory therapist to help determine the method and nebulization flow rate (mL/hr) of the albuterol in your positive pressure equipment
2. If using a standard nebulizer, the mL/hr rate will be determined by flow rate of medical air/oxygen and the actual nebulizer being used. Consult respiratory therapist to assist with the estimated nebulization flow rate (mL/hr)
3. Mistifinity calculations example:
   a. 1.25 mg/3 mL x#40 nebs= 50mg/120mL
      i. infused/nebulized at 30mL/hr=~10 mg/hr
   b. 2.5 mg/3 mL x#40 nebs= 100 mg/120mL
      i. infused/nebulized at 30mL/hr=~20 mg/hr

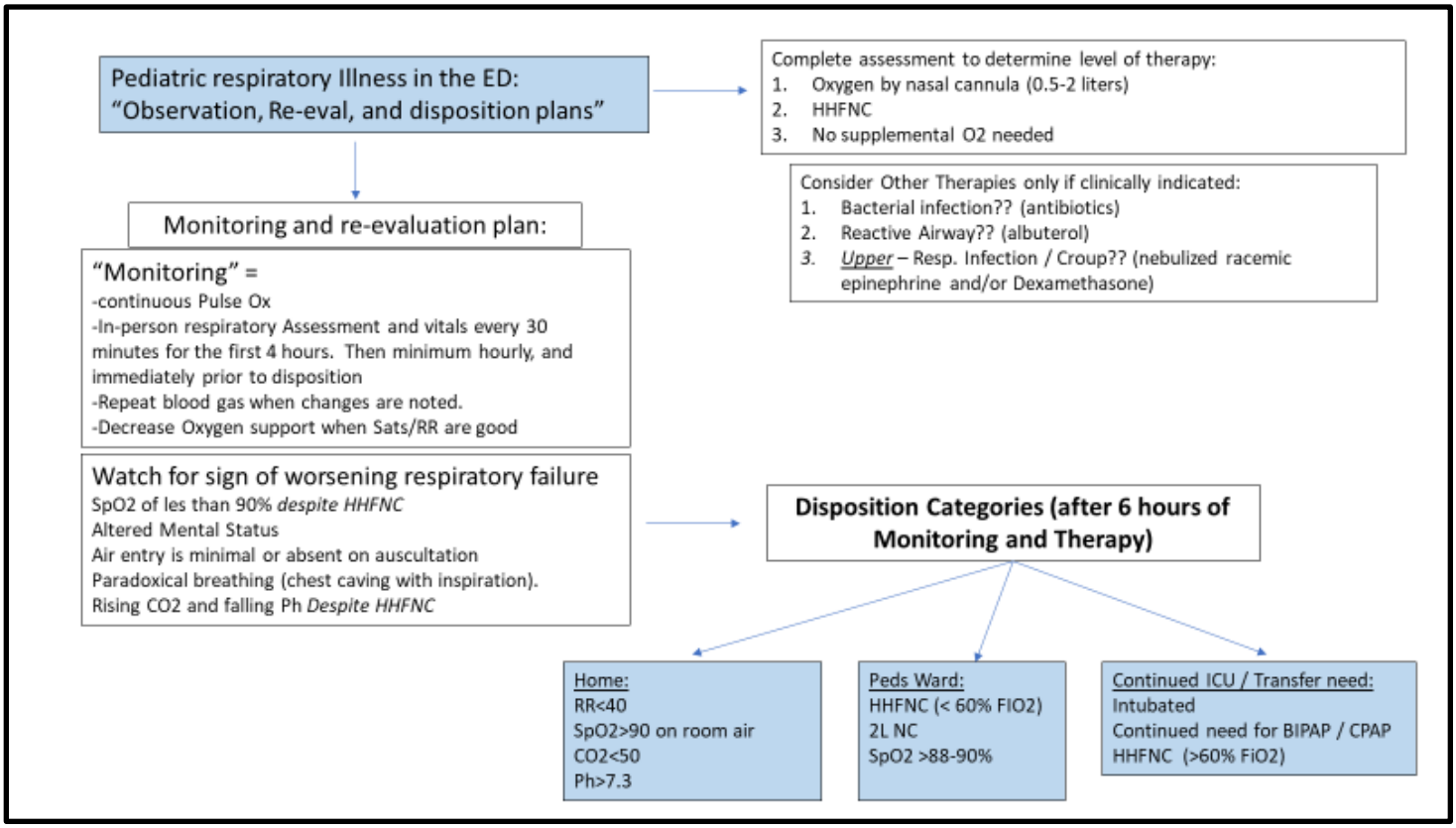
c) Steroids
   i) Indications: asthma, airway edema
      (1) Dexamethasone: 0.6mg/kg (Max 16mg) po once, may repeat in 24hr
      (2) Prednisolone:
         (a) Infants and Children <12 years: Oral: 1 to 2 mg/kg/day in 2 divided doses; continue until peak expiratory flow is 70% of predicted or personal best; maximum daily dose: 60 mg/day.
         (b) Children ≥12 years and Adolescents: Oral: 40 to 80 mg in divided doses 1 to 2 times daily until peak expiratory flow is 70% of predicted or personal best.

d) Dexmedetomidine 4 mcg/mL
   i) Indication: sedation to tolerate face mask or positive pressure
   ii) Dosing
      (1) Starting rate: 0.3 mcg/kg/hr
      (2) Minimum rate: 0 mcg/kg/hr
      (3) Max rate: 1 mcg/kg/hr
      (4) Titration: 0.1 mcg/kg/hr every 10 min to maintain SBS of -1 to 0 or NPASS of -3 to -4.
      (5) Additional: For bradycardia notify LIP for faster titration and order modification

e) IV fluids - use if patient has signs or symptoms of dehydration.
   i) Recommended maintenance IV fluids using Isotonic solutions (NS or LR)
      (1) Maintenance fluid calculation: “4-2-1 rule.”
         (a) 4 mL/kg/hr for the first 10 kg of weight, 2 mL/kg/hr for the next 10 kg, and 1 mL/kg/hr for each kilogram thereafter
      (2) Preferred maintenance fluid should contain dextrose in a NPO child.
         (a) D5 + 0.9% or 0.45% NS +/- KCl 20 mEq/L (KCl depends on age and labs)
         (b) D5LR
      (3) Bolus Fluids- isotonic fluids (NS or LR)

f) Antibiotics
   i) Not recommended unless there is clinical suspicion for a bacterial infection.
   ii) Community acquired Pneumonia antibiotics
      (1) Children’s Hospital of Philadelphia, Clinical Pathway for CAP
      (2) https://www.chop.edu/clinical-pathway/pneumonia-community-acquired-clinical-pathway
   iii) See Appendix E for recommended antibiotics from UpToDate.


Child presents to ED triage with Respiratory Complaint
Step 1: Consider Asthma
Ask parents: is this child 12-36 months with either
1) diagnosed asthma or
2) prior episodes of wheezing needing albuterol
NO
YES
Go to asthma Treatment plans
Step 2: Assess Respiratory severity
Vitals Check
(T>38 Treat with antipyretic, Dehydrated provide fluids).
RESP STATUS: Saturation and rate
<90% AND >60
>90% AND <60
Immediate interventions:
Nasal Suctioning
Reposition baby
Venous Blood gas
Oxygen by nasal cannula
0.5-2 for less than 1 year
2 L for >1 year
Improved
No Improvement or CO2>60 and PH <7.3
Assessment:
1. Exam for retractions, grunting, nasal flaring, cyanosis, wheezing, equal air movement.
2. Consider chest film if concern for cardiac disease, bacterial pneumonia, or if decreased air movement on auscultation.
3. Venous Blood gas and Viral Panel.
4. Consider History for risk factors
Born less than 34 weeks and now less than 6 months old
Chronic Lung disease
Anatomic airway defect
Prior history of intubation for respiratory illness
Cardiac disease requiring baseline medical therapies
Neuromuscular disease
Immunodeficiencies
No: (clinically stable and no high risk)
STEP 3: Go To "Observation, Re-eval, and disposition plans"
YES (Clinical Assessment of Distress, or CO2>60 and PH<7.3)
Go To Heated High Flow Nasal Canulae therapy


Pediatric respiratory Illness in the ED:
"Observation, Re-eval, and disposition plans"
Complete assessment to determine level of therapy:
1. Oxygen by nasal cannula (0.5-2 liters)
2. HHFNC
3. No supplemental O2 needed
Consider Other Therapies only if clinically indicated:
1. Bacterial infection?? (antibiotics)
2. Reactive Airway?? (albuterol)
3. Upper – Resp. Infection / Croup?? (nebulized racemic epinephrine and/or Dexamethasone)
Monitoring and re-evaluation plan:
"Monitoring" =
-continuous Pulse Ox
-In-person respiratory Assessment and vitals every 30 minutes for the first 4 hours. Then minimum hourly, and immediately prior to disposition
-Repeat blood gas when changes are noted.
-Decrease Oxygen support when Sats/RR are good
Watch for sign of worsening respiratory failure
SpO2 of les than 90% despite HHFNC
Altered Mental Status
Air entry is minimal or absent on auscultation
Paradoxical breathing (chest caving with inspiration).
Rising CO2 and falling Ph Despite HHFNC
Disposition Categories (after 6 hours of Monitoring and Therapy)
Home:
RR<40
SpO2>90 on room air
CO2<50
Ph>7.3
Peds Ward:
HHFNC (< 60% FIO2)
2L NC
SpO2 >88-90%
Continued ICU / Transfer need:
Intubated
Continued need for BIPAP / CPAP
HHFNC (>60% FiO2)

Additional Information and HHFNC Initiation

Definition & Mechanics

- Heated and highly humidified air-oxygen blend delivered via specialized cannula at high flow rates
- HFNC prongs are longer and more flexible than traditional prongs thereby reducing oxygen leakage
- The HFNC system has no audible alarms, so patients should remain on cardiopulmonary monitors.

HHFNC Mechanism of Action:

- Enhanced washout of CO_2
- Decreased inspiratory resistance by nasopharyngeal stenting
- Support of oxygenation by increasing mean airway pressure (MAP)
- Decreased work of breathing by enhanced humidification system

HHFNC Pre-Initiation Considerations:

- Optimize nasal suctioning
- Administer an antipyretic for comfort
- Address hydration needs, consider bolus if clinically hydrated
- Low-flow nasal cannula for decreased saturation
- Monitor patient for 15-30 minutes following interventions

↓

- HR, RR stable or improved when calm?
- O_2 sats 90% or higher
- No clinical signs of deterioration

Fail

- Escalate care to HFNC or non-invasive positive pressure ventilation

Pass

- Remains on RA or low-flow nasal cannula, if started

↓

High Flow Nasal Cannula Initiation

Initiate flow at weight-based settings
(weight x 2 = flow rate in L/min, max 20 L/min)

- **Initiate FiO2 at 0.4** and titrate FiO2 to keep SpO2 89-94%
- **Reevaluate after initiation** every 30 minutes until stable or improving, then hourly x 4 hours

Additional Care Considerations

Observation and Home Oxygen Therapy

- **Infants with bronchiolitis with hypoxia may be considered for home oxygen therapy by nasal cannula.**
- An observation period of a minimum of 6 hours to determine if a child on a small amount of oxygen (≤0.5 L/min NC O2 <12 mo old, ≤0.75 L/min NC O2 ≥12 mo old) can be discharged home with oxygen supplied by a home-health company and follow-up with a primary care provider within 48 hours. This period of observation can be safely completed in the emergency department, in a dedicated observation unit, or in a hospital unit.

Pulse Oximetry

- **Don't use continuous pulse oximetry routinely in children with acute respiratory illness unless they are on supplemental oxygen.**
- **Spot checks *are* indicated to help determine if supplemental oxygen might be beneficial. If on supplemental oxygen therapy, then continuous monitoring should be implemented.**
- The utility of *continuous* pulse oximetry in pediatric patients with acute respiratory illness is not well established. Use of continuous pulse oximetry has been previously associated with increased admission rates and increased length of stay. The clinical benefit of continuous pulse oximetry without a specific indication (supplemental oxygen is required) is not validated or well documented.

Bronchodilators

- **Don't routinely use bronchodilators in children with bronchiolitis.**
- Published guidelines do not advocate the routine use of bronchodilators in patients with bronchiolitis. Comprehensive reviews of the literature have demonstrated that the use of bronchodilators in children admitted to the hospital with bronchiolitis has no effect on any important outcomes. There is limited demonstration of clear impact of bronchodilator therapy upon the course of disease. Additionally, providers should consider the potential impact of adverse events upon the patient. However, bronchodilators remain an important part of therapy for reactive airway disease (asthma exacerbations).

Corticosteroids

- **Don't use systemic corticosteroids in children under 2 years of age with an uncomplicated lower respiratory tract infection.**
- Steroid therapy or Nebulized Racemic Epinepherine *might* be indicated for upper airway disease (croup).
- Published guidelines recommend that corticosteroid medications not be used routinely in the management of bronchiolitis. Furthermore, additional studies in patients with other viral lower respiratory tract infections have failed to demonstrate any benefits.

Chest Radiography

- **Don't order chest radiographs routinely in children with uncomplicated asthma or bronchiolitis.**
- National guidelines articulate a reliance on physical examination and patient history for diagnosis of asthma and bronchiolitis in the pediatric population. Multiple studies have established limited clinical utility of chest radiographs for patients with asthma or bronchiolitis. Omission of the use of chest radiography will reduce costs, but not compromise diagnostic accuracy and care. Chest radiography might be indicated for children requiring ICU care, with bacterial pneumonia, with cardiac disease, or in response to decreased air movement (evaluation for pneumothorax or pleural effusion).

Antibiotics

- **Don't administer or prescribe antibiotics for children with uncomplicated bronchiolitis.**
- Treatment with antibiotics has no effect on length of illness, length on supplemental oxygen, or length of hospitalization. In the emergency department, chest radiography is not helpful to determine if a child has pneumonia and would benefit from antibiotics. It is recommended to rely upon cultures, Viral panels, WBC levels, fevers, and clinical history all combined to help determine concern for bacterial vs viral etiology.

Sources 1-11 in the reference section

Appendix A: Heated High Flow Oxygen Therapy

Emergency Department Heated Humidified High Flow Nasal Cannula Respiratory Care Pathway

Consider initiation of HHHFNC in the EMERGENCY DEPARTMENT for any of the following situations *despite* diligent nasopharyngeal (infant) or oropharyngeal (older child) suctioning and repositioning to optimize respiratory status:

- Substantially increased work of breathing (work of breathing score ≥5 for patients less than 5 years old)
- SpO2 consistently <92% despite administration of supplemental oxygen at 4 L/min via conventional nasal cannula (FiO2 1.0)
- Acute hypercarbia with a capillary blood gas pH ≤7.30

START HHHFNC AT FiO2 = 50%

<5 kg: 6-8 L/min

5 to <10 kg: 8-10 L/min

10 to <15 kg: 10-12 L/min

≥15 kg: 12-15 L/min

- Consider a capillary blood gas prior to starting
- Place PIV and make patient NPO
- Repeat capillary blood gas within one hour of initiating HHHFNC

Appendix B: Respiratory distress / asthma severity score

Modified Pediatric Asthma Severity Score (MPASS)

	0	1	2	3
Oxygenation	> 98% on RA	95% - 97% in RA	90% - 94% on RA	< 90% on RA
Auscultation	No wheezing Normal breath sounds	End expiratory wheezes	Inspiratory and expiratory wheezes	Wheezing audible w/o stethoscope or silent chest
Retractions	No retractions	Intercostal retractions and/or diaphragmatic (belly) breathing	**2** of the following: • Intercostal • Suprasternal • Diaphragmatic (belly) breathing • Nasal flaring (infant)	**3** of the following: • Subcostal • Intercostal • Substernal • Supraclavicular • Nasal flaring or Head bobbing (infant)
Dyspnea	Absent dyspnea; speaks in complete sentences; alert; playful	Normal activity and speech. Some dyspnea, irritable, coughing after play	Decreased activity 5-8 word sentences. Moderate dyspnea; not sleeping or eating; coughing after play	Not speaking. Severe dyspnea; grunting; lethargic, stops playing
Resp Rate				
Infant (birth – yr)	< 60	60-80	81-99	≥ 100
Toddler (>1-3 yrs)	< 40	40-60	61-79	≥ 80
Preschool (>3-6 yrs)	< 30	30-40	41-59	≥ 60
School Age (>6 -12 yrs)	< 20	20-26	27- 30	≥ 31
Adolescent (>12-18 yrs)	< 18	18-23	24 - 27	≥ 28
Severity Scores	**0**	**1-5** **MILD**	**6-10** **MODERATE**	**11-15** **SEVERE**

Respiratory Management

Effective bag-mask ventilation skills are your best friend in pediatrics and may prevent unnecessary field intubations.

Remember:

Infants and young children have big occiputs, causing the neck to have a tendency towards flexion. Extension of the neck should be the first step in correcting an airway issue for these patients.

Try to avoid overventilation. Overventilation contributes to gastric distention, emesis, and potential aspiration which can further worsen a tenuous respiratory status.

Endotracheal tube size can be calculated by using the equation, "Age (in years)/4 + 4".

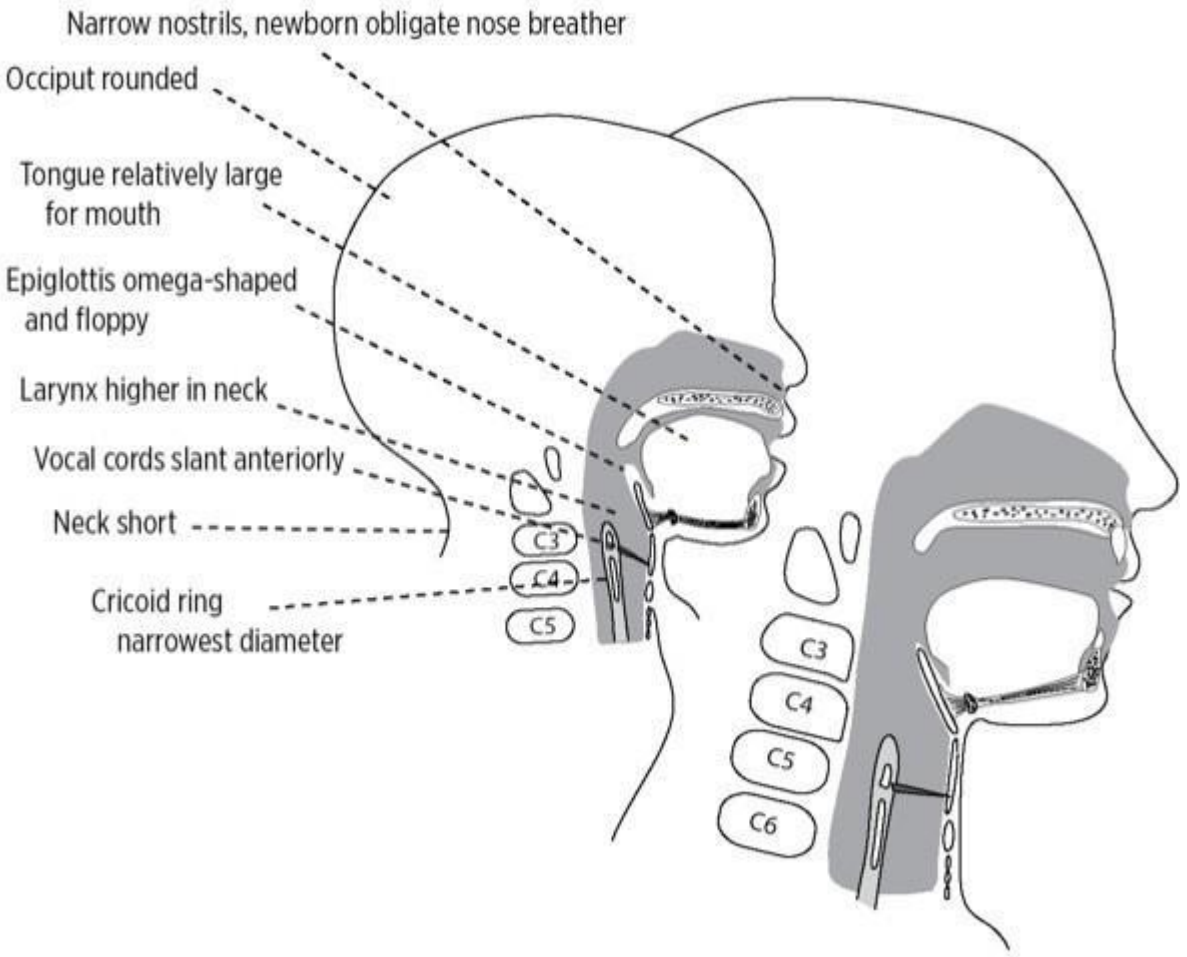
Remember: Big heads, big tongues, big tissues, and big forces can cause airway obstruction

You are already experienced in airway management for the adult population. Most of those skills can be applied to pediatric airway management with adjustments.
Therefore, this section will focus on the key differences for airway management in the pediatric population.

Anatomy:
Infants and young children:

1. Anatomic differences increase the opportunity for airway obstruction in this age group. See image below.
    a. In the supine position their large occiputs cause flexion of the neck
    b. Increased amounts of soft tissue, as well as a flexible trachea can add pressure to the tracheal rings
    c. External forces, like cricoid pressure can cause tracheal collapse
    d. Large tongues relative to the size of the oral cavity.

2. Anatomic differences predispose young infants to respiratory failure.
    a. Young infants preferentially breathe through their noses and during oral breathing, must use soft palate muscles to maintain an open oral airway
    b. Higher metabolic rates cause infants to use more oxygen per minute per kg of body weight than adults
    c. Compliant chest walls and other unique lung physiology means that this population has to increase their respiratory rate to increase their ventilation, placing them at risk for respiratory muscle fatigue



From:

https://www.anesthesiologynews.com/Review-Articles/Article/08-19/10-Common- Pediatric-Airway-Problems-And-Their-Solutions/55657?sub=B9BFD2B22AAB91C738BEFA44BD6987A27AB424466CD7E09740FF4A4786780, accessed 08/25/2021

By age 8, the pediatric airway is very similar to the adult airway.

Airway Management:

Non Invasive Interventions:

Reposition: Continue to use jaw thrust and/or chin lift techniques to maintain the neutral position of the airway, which will facilitate improved oxygenation and ventilation.

Use suction liberally but safely.

If croup or epiglottitis is suspected (exhibit Inspiratory stridor, do not suction. Use comforting measures to prevent crying and agitation that could result in further obstruction.

Oxygen Delivery:

a. Continue use of nasal cannulas, face masks, non rebreather masks

   Tip: Apply adhesive (e.g. tape/band-aids) to the oxygen piping that overlays the patient's cheeks in order keep the cannula in place and prevent removal.

Oral (OPA) and Nasal (NPA) Airways:

b. Particularly useful and often underused in pediatrics.
c. Oral airways should only be used in **unconscious** patients .
d. Oral airways can be helpful in lifting the large pediatric tongue that is obstructing an airway.
e. **OPA Sizing:** Measure the airway along the side of the patient's face from mouth to the angle of the mandible. EMTprep provides a useful video at https://youtu.be/D00IunbXP6g.
f. Nasopharyngeal airways can be used in **conscious** patients.
g. NPA should be used cautiously in young infants because their large adenoids and tonsils can be injured during insertion, resulting in bleeding
h. Insert NPA with bevel pointed away from septum to decrease risk of bleeding
i. **NPA Sizing:** To choose the correct size, be sure the airway extends from the nostril to the tragus of the ear. Lubrication improves ease of passage. Nostril size should be used as a guide for width. EMTprep provides a useful video at https://youtu.be/oJgpWPiH-Q4.
j. **Indications:** upper airway obstruction
k. **Contraindications:** NPA in patients with suspected basilar fracture, CSF leak, coagulopathy; OPA: alert/awake patients.

Bag-Mask Ventilation:

l. Remains an essential skill for pediatric providers and can be used as a temporizing measure.
m. E-C clamp is the most common technique used; **lift** the jaw into the mask or perform a chin lift; 2 hand technique is another option.
n. Avoid compression of neck soft tissues, as well as submental soft tissues when holding the jaw.
o. Start with approximately 5 cm H_2O of continuous positive airway pressure and titrate up as needed to maintain ventilation.
p. Normal tidal volume: 6-8ml/kg + dead space; estimate 10 ml/kg to cause chest rise.
q. If a 1 yr old 10 kg child requires 80 to 100 ml per breath, this is the equivalent of 6 tablespoons of air.
r. Ventilations with Bag Valve Mask (BVM) – breaths every 3-5 sec (12-20 breaths per minute).
s. Passive exhalation should be greater than inspiratory time. "Squeeze-release-release" is a helpful pacing technique.
t. Overventilation: The consequences of overventilation are particularly problematic in children. It can lead to gastric distention, emesis, difficulty ventilating because of elevation of the hemi-diaphragm.
u. CPAP and BiPAP are also options in pediatric patients; nasal prongs are used in infants and neonates.

To prevent overventilation, only squeeze until chest rise is seen.

Remember that repositioning, suctioning, supplemental oxygen, and adjuncts (OPA,NPA) can go a long way in managing the pediatric airway. Try these first before moving on to intubation.

Invasive Interventions:

Emergent Endotracheal Intubation

a. Equipment: Similar standard equipment as with adult intubation (oxygen, suction, ETCO2 detector, etc) with the exception of a choice in blade type and tube type.

Should a cuffed or uncuffed tube be used?

b. Previous concern was expressed over the use of cuffed tubes in children under 8 years old, due to a risk of ischemic damage to tracheal tissue from compression between the cuff and the cricoid ring. Adding to this risk is the narrow diameter at the cricoid.

c. This is now less of a risk because of the improved design of more modern ETTs, therefore use of cuffed tubes in younger ages is increasing. Microcuff tubes may be used for smaller pediatric patients as well.

Sizing:

d. Laryngoscope Blade:

Age	Weight (kg)	Laryngoscope Blade Size
Premature/ Newborn	1 - 3	Miller 0
1 month to 2 years	3.5 - 12	Miller 1
3 - 6 years	15 - 20	Miller 2, MacIntosh 2 (by 5 yo)
6 - 12 years	20 - 35	Miller 2, MacIntosh 2 or 3
>12 years	>35	MacIntosh 3

Endotracheal Tube (ETT):

e. Use a length based tape for endotracheal tube sizing (e.g., Broselow tape), but if not available, use the equations below:

Uncuffed tubes: [Age (in years)/4] + 4

Example: [4 years old/4] + 4 = 5 uncuffed Cuffed tubes: [Age (in years)/4] + 3.5

Example: [4 years old/4] + 3.5 = 4.5 cuffed

Use of the equations has been shown to be more accurate than using the width of the patient's fifth finger.

f. Depth of Insertion:

i. Neonates and Infants: The "1, 2,3, 4--7,8,9,10 rule" has been commonly used (cuffed tubes). For example, a 1 kg infant will have the tubed taped at

7 cm at the maxillary alveolar ridge (not lip), 2kg infant at 8 cm, etc.

ii. Older Children: Multiply the internal diameter (in mm) x 3

g. Cuffed Tube Inflation:

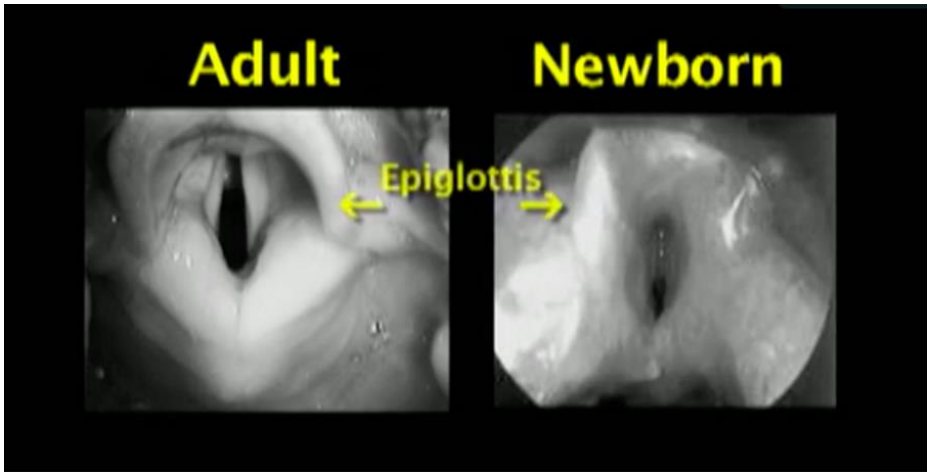
i. No more than 20 cm H_2O (mucosal blood flow to trachea is compromised at 30 cm H_2O)

ii. An acceptable air leak with a cuffed tube (deflated) is 15-25 cm H_2O

Adult airway diameter is narrowest at the level of the vocal cords, while in children, the narrowest diameter is at the cricoid ring. Therefore, an ETT may fit through the vocal cords but be too large to pass through the cricoid ring.

Endotracheal Intubation Technique

1. An infant's epiglottis is narrow, and short, angled into the airway lumen (see image below). The epiglottis descends to a lower cervical station as a child ages (C2-C3 at birth then C4-C5 by age 3).



2. Larynx position is higher in infancy.

Tip: Use a straight rather than a curved blade.

3. Large occiput can result in neck flexion and difficulty visualizing airway.

Tip: Apply "shoulder roll" if less than 2 years old.

Suboptimal airway positioning

Improved airway positioning

4. Simple extension of the head as opposed to the traditional "sniffing position" may improve alignment of oral, pharyngeal, and tracheal a

5.The recommendation to use a Miller blade in infants in young children is based on anatomical studies NOT comparative studies with the McIntosh blade.

Tip: Miller blade can be placed BEHIND the epiglottis to lift it up or by moving the tip of the blade just behind the epiglottis; if using a Macintosh, place the place the tip behind the epiglottis, in the vallecula.

6.Miller blade may help with tongue displacement and better control, but it is **most important** to use the blade you are most experienced using.

7.iv.If there is difficulty visualizing the glottis, external manipulation can improve the view using the **"backwards-upward-rightward pressure"** on the thyroid (BURP maneuver).

The difficult airway mnemonic, DOPES, is applicable in pediatrics also. DOPES stands for Displacement, Obstruction, Pneumothorax, Esophageal placement/Equipment malfunction, Stacking (breath stacking). Consider these five elements when a patient fails to respond appropriately to ventilation via an endotracheal tube.

Commonly used Rapid Sequence Intubation (RSI) Medications:

RAPID SEQUENCE INTUBATION (RSI) Medications: SEDATION			
Medication	Dose	Side Effects	Contraindication
Etomidate	0.3mg/kg IV	Transient adrenal suppression	Septic Shock
Ketamine	1-2 mg/kg, 3-7mg/kg IM	Controversy over effect in increased intracranial pressure	
Propofol	1-1.5 mg/kg IV	Hypotension	Avoid in infants
Midazolam	0.2-0.3mg/kg IV (max 10 mg)	May cause hemodynamic instability at doses needed for sedation	
Fentanyl	1-5mcg/kg	Give over 30 to 60 sec to avoid chest wall rigidity and respiratory depression	

RAPID SEQUENCE INTUBATION (RSI) Medications: Paralytic			
Medication	Dose	Side Effects	Contraindication
Rocuronium	1mg/kg IV	--	---
Succinylcholine	Infants and children ≤2 years old: 2 mg/kg IV >2 years old: 1.5 mg/kg (4 mg/kg IM)	Controversy over effect in increased intracranial pressure	Do not use with crush injury (extensive), rhabdomyolysis, Becker Muscular Dystrophy, Cerebral Palsy with paralysis, 48-72 hours after burn injury, multiple trauma, history of malignant hyperthermia, hyperkalemia

Source: UptoDate, "Rapid Sequence Intubation in Emergency Settings"

Appendix D: Pocket Medication Reference

https://www.utahptn.org/wp-content/uploads/2022/08/Drug-Reference-with-Safety-version-2.2.pdf

Pediatric Emergency Room Pocket Drug Reference

Version 2.2

Poison Control 1-800-222-1222

Common Medications

Medication	Route	Dose	Max
Acetaminophen	PO	15 mg/kg	650 mg
Fentanyl	IV	1 mcg/kg	50 mcg
	Nasal	2 mcg/kg	100 mcg
Ibuprofen	PO	10 mg/kg	600 mg
Ketamine	IV	1mg/kg	
-Alternative	IV	1.5 mg/kgx1 then 0.75mg/kg	
Midazolam	IV	0.05 mg/kg	5 mg
-Min sedation	Nasal	0.4 mg/kg	10 mg
Morphine	IV	0.05-0.1mg/kg	4 mg
Ondansetron	IV	0.1mg/kg	4 mg
Propofol*	IV	1 mg/kg	40 mg
	*may repeat up to 5 total doses		

Written medication order correct format:
Medication--Dose (mg/kg)--Total Dose--Route--Frequency

Do not use these abbreviations:
U, IU, QD, QOD, MS, MSO4, MGSO4

No leading decimal, use 0.1 mg, **NOT** .1 mg
No trailing zero, use 1 mg, **NOT** 1.0 mg

Pediatric Advanced Life Support

Medication	Route	Dose	Max
Adenosine	IV	0.1 mg/kg	First-6 mg
-Second Dose	IV	0.2 mg/kg	Second-12mg
Amiodarone	IV	5 mg/kg	300 mg
Atropine	IV	0.02 mg/kg	Max 0.5 mg
Calcium GLUC	IV	100 mg/kg	2000 mg
Epinephrine --0.1mg/mL	IV	0.01 mg/kg (0.1 mL/kg)	1mg(or>50kg) (10 mL)

Rapid Sequence Intubation

Medication	Route	Dose	Max
Atropine	IV	0.02 mg/kg	Max 0.5 mg
Etomidate	IV	0.3 mg/kg	20mg
Lidocaine (↑ICP)	IV	1 mg/kg	100 mg
Rocuronium	IV	1 mg/kg	--
Succinylcholine	IV	2 mg/kg	150 mg
Vecuronium	IV	0.1 mg/kg	--

Anaphylaxis

Medication	Route	Dose	Max
Epinephrine 1mg/mL	IM	0.01 mg/kg	0.3 mg
Dexamethasone	PO	0.6 mg/kg	16 mg
Diphenhydramine	IV/PO	1 mg/kg	50 mg
Ranitidine	IV	1 mg/kg	50mg
	PO	2 mg/kg	150mg
Famotidine	IV/PO	0.5 mg/kg	20mg
Methylprednisolone	IV	1 mg/kg	

Other

Medication	Route	Dose	Max
Dextrose 10%	IV	5 mL/kg	250 mL
NACL 3%	IV	5 mL/kg	500 mL
Mannitol	IV	0.5-1 gm/kg	50 gm
Sodium Bicarb	IV	1 mEq/kg	50 mEq
	<5kg use 4.2%		

Cardiovascular Drips

Medication	Route	Starting Range
Dopamine	IV	5-20 mcg/kg/min
Epinephrine	IV	0.05-1 mcg/kg/min
Milrinone	IV	0.25-0.75 mcg/kg/min
Norepinephrine	IV	0.05-1 mcg/kg/min
Alprostadil	IV	0.05-0.1 mcg/kg/min

Reversal Agents

Medication	Route	Dose	Max
Naloxone-Partial	IV	0.01 mg/kg	0.2 mg
Naloxone-Full	IV/IM	0.1 mg/kg	2 mg
Flumazenil	IV	0.01 mg/kg	0.2 mg

Respiratory

Medication	Route	Dose	Max
Albuterol	Neb	2.5mg/3mL	10 mg
Ipratropium	Neb	0.5 mg	1 mg
Magnesium -Give over 20 min	IV	50 mg/kg	2000 mg
Albuterol -Continuous	Neb	<20 kg- 10 mg/hr ≥20 kg- 20 mg/hr	
Racemic Epi	Neb	0.5 mL	In 3 mL NS
Dexamethasone	PO	0.6mg/kg	16 mg

Seizures

Medication	Route	Dose	Max
Fosphenytoin	IV	20 mg/kg	1500 mg
Levetiracetam	IV	20 mg/kg	2000 mg
-Benzo refractory	IV	60 mg/kg	4500 mg
Lorazepam	IV	0.1 mg/kg	4 mg
Phenobarbital	IV	20 mg/kg	1000 mg
Valproic Acid	IV	20-40 mg/kg	
Midazolam	IN	0.2 mg/kg	10mg

This document presents an evidenced-based approach that is appropriate for most patients. It should be adapted to meet the needs of individual

Nausea

Medication	Route	Dose	Max
Metoclopramide	IV	0.1-0.2 mg/kg	10 mg
Ondansetron	IV/PO	0.1 mg/kg	4 mg
Prochlorperazine ≥ 2 years old	IV	0.1-0.15 mg/kg	10 mg
Promethazine **NOT IN HAND IV!!!**	IV/PO	0.25-1 mg/kg	25 mg

Pain

Medication	Route	Dose	Max
Acetaminophen	PO/PR	15 mg/kg	650 mg
Diazepam-Spasms	IV	0.05 mg/kg	5 mg
Fentanyl	IV	1 mcg/kg	50 mcg
	IN	2 mcg/kg	100mcg
Hydrocodone/APAP	PO	0.1-0.2 mg/kg	10mg
Hydromorphone	IV	10-15 mcg/kg	500mcg
Ibuprofen	PO	10 mg/kg	600 mg
Ketorolac	IV	0.5-1 mg/kg	30 mg
Morphine	IV	0.05-0.1 mg/kg	4 mg
Oxycodone<6month	PO	0.025- 0.05 mg/kg	5 mg
>6month	PO	0.05- 0.15 mg/kg	10 mg

Sedation

Medication	Route	Dose	Max
Midazolam	IV	0.05-0.1 mg/kg	3 mg
	IN	0.4 mg/kg	10 mg
Ketamine	IV	1 mg/kg	
Alternative	IV	1.5 mg/kg x1 then 0.5 mg/kg	
Ondansetron	IV	0.1 mg/kg	4 mg
Propofol	IV	1 mg/kg	40 mg
	*may repeat up to 5 total doses		

Antibiotics

Medication	Route	Dose	Max
Acyclovir AdjBW->	IV	10-15 mg/kg	
HSV<90 days	IV	20 mg/kg	
	PO	20 mg/kg	800mg
AMOXicillin	PO	25-50 mg/kg	1000 mg
Dosage forms: 250, 500 mg caps, 400mg/5mL			
AMOXacillin/Clav (Augmentin)	PO	20-45 mg/kg	2000 mg
Dosage Forms: 250mg,500mg,875mg tabs; 400mg, 600mg/5mL			
AMPicillin	IV	50 mg/kg	2000 mg
Ampicillin/sulbact (Unasyn)	IV	50 mg/kg	2000 mg (amp)
Azithromycin (Zithromax)	IV/PO	10 mg/kg STD→	500 mg 1000mg
Dosage Forms:250mg tabs, 200 mg/5mL			
Cefazolin (Ancef)	IV	33-50 mg/kg	2000 mg
Cefdinir (Omnicef)	PO	7-14 mg/kg	600 mg
Dosage Forms: 300mg cap 125 mg/5mL 250 mg/5mL			
Ceftazidime (Fortaz)	IV	50 mg/kg	2000 mg
Cefotaxime (Claforan)	IV	50-75mg/kg	2000 mg
Cefoxitin (Mefoxin)	IV	40 mg/kg	2000 mg
Ceftriaxone (Rocephin)	IV	50-100 mg/kg	2000 mg
Cephalexin (Keflex)	PO	12.5-25 mg/kg	1000 mg
Dosage Forms: 250mg 500mg caps, 250mg/5mL			
Clindamycin (Cleocin)	IV/PO	13 mg/kg Toxic Shock->	600 mg 900 mg
Gentamicin	IV	5-7.5 mg/kg	IBW
Metronidazole (Flagyl)	IV	10 mg/kg	500 mg
Appendicitis	IV	30 mg/kg	1500 mg
Piperacillin/Tazo (Zosyn)	IV	75 mg/kg	3000 mg (pip)
Vancomycin	IV	20 mg/kg	2000 mg

Common Combinations

Medication	Route	Dose	Max
Appendicitis			
Ceftriaxone	IV	75mg/kg	2000 mg
Metronidazole	IV	30 mg/kg	1500 mg
Asthma LVN		TV=17ml	
Albuterol	Neb	10 mg	
Ipratropium	Neb	1 mg	
Croup			
Racemic Epi	Neb	0.5 mL	TV=3.5ml
Dexamethasone	PO/IV/ IM	0.6 mg/kg	16 mg
Migraine			
Prochlorperazine	IV	0.15mg/kg	10 mg
Diphenhydramine	IV	1 mg/kg	50 mg
Ketorolac	IV	1 mg/kg	30 mg
Choosing Augmentin Conc			
High Dose--90mg/kg/day		AugmentinES 600mg/5ml	
All other dosing		Augmentin NON ES	

Zero Harm Safety Techniques
ARCC-Ask, Request, Concern, Chain of Command
Standardized Handoff
SBAR-Situation, Background, Assessment, Recommendation
STAR- Stop, Think, Act, Resolve
Stop and Resolve
Clarifying Question-Repeat Back/Read Back

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Concerning vital signs by age	HR		RR		Systolic BP	Temp	
0 days – <1 mo	< 80	> 205	< 30	> 60	< 60	< 36	> 38
≥ 1 mo – < 3 mos	< 80	> 205	< 30	> 60	< 70	< 36	> 38
≥ 3 mos – < 1 yr	< 75	> 190	< 30	> 60	< 70	< 36	> 38.5
≥ 1 yr – < 2 yrs	< 75	> 190	< 24	> 40	< 70 + (age x 2)	< 36	> 38.5
≥ 2 yrs – < 4 yrs	< 75	> 190	< 24	> 40	< 70 + (age x 2)	< 36	> 38.5
≥ 4 yrs – 6 yrs	< 60	> 140	< 22	> 34	< 70 + (age x 2)	< 36	> 38.5
≥ 6 yrs – < 10 yrs	< 60	> 140	< 18	> 30	< 70 + (age x 2)	< 36	> 38.5
≥ 10 yrs – < 13 yrs	< 60	> 100	< 18	> 30	< 90	< 36	> 38.5
≥ 13 yrs – < 18 yrs	< 60	> 100	< 12	> 16	< 90	< 36	> 38.5

Additional Resources

ASPR TRACIE: Pediatric Surge Resources page and technical report on using high flow nasal cannulas in pediatric patients.

FDA: Guidance on navigating a shortage of tracheostomy tubes (Nov. 1)

Appendix E

Initial oral empiric antibiotics for outpatient treatment of pediatric community-acquired pneumonia (UpToDate 11/18/2022)

Age group	Empiric regimen
1 to 6 months	
Bacterial (not *Chlamydia trachomatis*)	**Infants <3 to 6 months of age with suspected bacterial pneumonia should be hospitalized**
C. trachomatis	Refer to UpToDate topic on *C. trachomatis* infections in the newborn
6 months to 5 years	
Typical bacterial*	Amoxicillin[¶] 90 mg/kg per day in 2 or 3 divided doses (MAX 4 g/day), **or**
	Amoxicillin-clavulanate 90 mg/kg per day of the amoxicillin component in 2 or 3 divided doses (MAX 4 g/day amoxicillin component)
	For children with mild reactions to a penicillin and no features of an IgE-mediated reaction[Δ]:
	▪ Amoxicillin 90 mg/kg per day in 2 or 3 divided doses (MAX 4 g/day), **or**
	▪ Amoxicillin-clavulanate 90 mg/kg per day of the amoxicillin component in 2 or 3 divided doses (MAX 4 g/day amoxicillin component), **or**
	▪ A third-generation cephalosporin, such as cefdinir 14 mg/kg per day in 2 divided doses (MAX 600 mg/day) in communities with a low rate of pneumococcal resistance to penicillin
	For children with IgE-mediated or serious delayed reaction to a penicillin:
	▪ Levofloxacin[◊] 16 to 20 mg/kg per day in 2 divided doses (MAX 750 mg/day), **or**
	▪ Clindamycin 30 to 40 mg/kg per day in 3 or 4 divided doses (MAX 1.8 g/day), **or**
	▪ Linezolid 30 mg/kg per day in 3 divided doses (MAX 1.8 g/day)
	In communities with a high rate of pneumococcal resistance to penicillin:

	▪ Levofloxacin[◊] 16 to 20 mg/kg per day in 2 divided doses (MAX 750 mg/day), **or**
	▪ Linezolid 30 mg/kg per day in 3 divided doses (MAX 1.8 g/day)
≥5 years	
Mycoplasma pneumoniae or *Chlamydia pneumoniae*	Azithromycin[¶] 10 mg/kg on day 1 followed by 5 mg/kg daily for 4 more days (MAX 500 mg on day 1 and 250 mg thereafter), **or**
	Clarithromycin 15 mg/kg per day in 2 divided doses (MAX 1 g/day), **or**
	Erythromycin 40 to 50 mg/kg per day in 4 divided doses (MAX 2 g/day as base, 3.2 g/day as ethylsuccinate), **or**
	Doxycycline 4 mg/kg per day in 2 divided doses (MAX 200 mg/day), **or**
	Levofloxacin[◊] 8 to 10 mg/kg once daily for children 5 to 16 years (MAX 500 mg/day); 500 mg once daily for children ≥16 years, **or**
	Moxifloxacin[◊§] 400 mg once daily (≥18 years)
Typical bacterial*	Amoxicillin[¶] 90 mg/kg per day in 2 or 3 divided doses (MAX 4 g/day)
	For children with mild reactions to a penicillin and no features of an IgE-mediated reaction[Δ]:
	▪ Amoxicillin 90 mg/kg per day in 2 or 3 divided doses (MAX 4 g/day), **or**
	▪ A third-generation cephalosporin, such as cefdinir 14 mg/kg per day in 2 divided doses (MAX 600 mg/day)
	For children with IgE-mediated or serious delayed reaction to a penicillin:
	▪ Levofloxacin[◊] 8 to 10 mg/kg once daily for children 5 to 16 years (MAX 750 mg/day); 750 mg once daily for children ≥16 years, **or**
	▪ Clindamycin 30 to 40 mg/kg per day in 3 or 4 divided doses (MAX 1.8 g/day), **or**
	▪ Linezolid 30 mg/kg per day in 3 divided doses (MAX 1.8 g/day) for children <12 years; 20 mg/kg per day divided in 2 doses (MAX 1.2 g/day) for children ≥12 years
	In communities with a high rate of pneumococcal resistance to penicillin:
	▪ Levofloxacin[◊] 8 to 10 mg/kg once daily for children 5 to 16 years (MAX 750 mg/day); 750 mg once daily for children ≥16 years, **or**

	▪ Linezolid 30 mg/kg per day divided in 3 doses (MAX 1.8 g/day) for children <12 years; 20 mg/kg per day divided in 2 doses (MAX 1.2 g/day) for children ≥12 years
Aspiration pneumonia	
Community-acquired	Amoxicillin-clavulanate 40 to 50 mg/kg per day in 2 or 3 divided doses (MAX 1.75 g/day amoxicillin component)
	For children with mild reactions to a penicillin and no features of an IgE-mediated reaction[Δ]:
	▪ Amoxicillin-clavulanate 40 to 50 mg/kg per day in 2 or 3 divided doses (MAX 1.75 g/day amoxicillin component)
	For children with IgE-mediated or serious delayed reaction to amoxicillin:
	▪ Clindamycin 30 to 40 mg/kg per day divided in 3 or 4 doses (MAX 1.8 g/day)
	▪ Moxifloxacin[◊] 400 mg once daily (for ≥18 years)

https://www.uptodate.com/contents/image/print?topicKey=PEDS%2F5987&view=machineLearning&search=community%20acquired%20pneumonia%20treatment%20children&sectionRank=1&usage_type=default&imageKey=PEDS%2F80561&rank=1~150&source=machineLearning&display_rank=1

Links, References, and Acknowledgements:

This document can be found and referenced at: https://wrap-em.org/

The content and evidence based resources have been consolidated in this document from multiple other pediatric respiratory protocols from numerous children's Hospitals. We would like to recognize with gratitude the sharing of these individual guidelines!

CHLA

Primary Utah

Seattle Children's

Stanford - LPCH

UC Davis

UCSF-Oakland and San Francisco

LINKS

ASPR Tracie list of resources for Respiratory care with High Flow Oxygen for children:

https://files.asprtracie.hhs.gov/documents/aspr-tracie-ta---pediatrics-and-high-flow-nasal-cannulas.pdf

Stanford University - pediatric ICU mechanical ventilation education module:
http://www.learnpicu.com/respiratory/Mechanical-Ventilation

CHOP https://www.chop.edu/clinical-pathway/bronchiolitis-inpatient-treatment-clinical-pathway

Heated High flow nasal Cannula ventilation "how to" video: https://youtu.be/Z9JDTHo9yUM

Open Pediatrics: Numerous videos, simulations, and training modules on pediatric respiratory care. Free registration on the site is required to access content. https://www.openpediatrics.org/

"10 common pediatric airway problems - and their solutions" :

https://www.anesthesiologynews.com/Review-Articles/Article/08-19/10-Common-Pediatric-Airway-Problems-And-Their-Solutions/55657?sub=B9BFD2B22AAB91C738BEFA44BD6987A27AB424466CD7E09740FF4A4786780

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