



Practical Approach to Pediatric Respiratory Distress


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Objectives

Practical approach to respiratory distress in children

- Case illustrations
- Goals of care
- Tools
- Red flags



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Case 1

It's a cold November day
16-month child with 1 week of cough and congestion and 2 days of worsening difficulty breathing

- Fever to 102F for 1 day
- Decreased feeding
- Post tussive emesis
- No meds at home
- Full term, no history of respiratory illnesses

39 F HR 180 RR 60 BP100/60 SpO2 83% RA

Exam: hoarse cry, inspiratory stridor at rest, moderate retractions, coarse breath sounds.

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Approach to Respiratory Distress

Common Respiratory Illness	Uncommon Respiratory Illness	Non-Respiratory Illness	Underlying Illness
<ul style="list-style-type: none"> • Croup • Bronchiolitis • Pneumonitis • Asthma 	<ul style="list-style-type: none"> • Pneumonia • Foreign body aspiration • Bacterial tracheitis • Anaphylaxis 	<ul style="list-style-type: none"> • DKA • Cardiac Disease • Intra-Abdominal process (infants) 	<ul style="list-style-type: none"> • Neuromuscular disease • Cystic Fibrosis • Mediastinal Mass

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Most children have a Common Respiratory Illness

History	Assessment	Tools
<ul style="list-style-type: none"> • Recurrent illnesses • Atopic history • Chocking • Systemic symptoms • Overall health 	<ul style="list-style-type: none"> • Upper airway vs Lower airway disease • Murmur/pulses • Abdominal exam • Mental status • Work of breathing • Hydration 	<ul style="list-style-type: none"> • Suction • Antipyretics • Oxygen/Flow/Pressure delivery systems • Aerosols • Steroids • Antibiotics • Imaging


Look for Red Flags

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Red Flags in Respiratory Illnesses

Uncommon Respiratory Illnesses	Red flags	Non-respiratory illness	Red flags
Allergic reaction	Rapid onset Rash, stridor, vomiting, facial swelling	Congestive heart failure myocarditis	Persistent tachycardia Hepatomegaly Heart Murmur
FB aspiration	History/choking Persistently asymmetric exam no URI Sx	DKA	Tachypnea with normal breath sounds Vomiting Abdominal pain
Bacterial tracheitis	Poor response to racemic epinephrine High fever Ill appearance Unvaccinated	Underlying illness	Red Flags
Pneumonia	Fever in kids <60 days Prolonged fever Prolonged illness Immunosuppressive state* History or risk for aspiration	Vascular ring TF fistula Cystic fibrosis NM disease	Persistent, recurrent or subacute symptoms Poor growth

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Case 1

It's a cold November day
16-month child with 1 week of cough and congestion and 2 days of worsening difficulty breathing

- Fever to 102F for 1 day
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39 F HR 180 RR 60 BP100/60 SpO2 83% RA

Exam: hoarse cry, inspiratory stridor at rest, moderate retractions, coarse breath sounds.

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Poll 1


Patient is presenting with signs of

- Upper respiratory disease
- Lower respiratory disease
- Both upper and lower respiratory disease

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Poll 1
Patient is presenting with signs of


- A. Upper respiratory disease
- B. Lower respiratory disease
- C. Both upper and lower respiratory disease



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Poll 2
The next steps in managing respiratory distress in this patient are: (check all that apply)


- A. Inhaled epinephrine
- B. Inhaled albuterol
- C. Antipyretics
- D. Steroids
- E. Antibiotics
- F. Fluids
- G. Oxygen
- H. Suction
- I. Imaging



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Poll 2
The next steps in managing respiratory distress in this patient are: (check all that apply)


- A. Inhaled epinephrine
- B. Inhaled albuterol
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- D. Steroids
- E. Antibiotics
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- H. Suction
- I. Imaging



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CROUP

Children's Hospital Colorado Croup Clinical Pathway



Common respiratory illness

- (U)Croup
- (L) Bronchiolitis
- Pneumonitis Asthma



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Croup Goals of Care


Oral steroid administration

- Symptoms reduction at 2 hours, last at least 24 hours
- Reduce return visits
- Shorten hospital stays by about 15 hours
- Serious adverse events are infrequent
- No difference in high vs low dose of steroids
- Second dose does not prevent readmission

Observation after racemic epinephrine

- Admission rate 5%,
- most local guidelines recommend admission after 3nebs

Lefchak B. Impact of Clinical Guidelines on Hospital Utilization in Children With Croup. *Hosp Pediatr.* 2023
 Gates A. Glucocorticoids for croup in children. *Cochrane Database Syst Rev.* 2023.
 Lashhab S. Should a second dose of dexamethasone be given for the treatment of croup? *Archives of Disease in Childhood* 2019.




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Croup Red Flags

Uncommon Respiratory illnesses	Red flags	Underlying Uncommon illness	Red flags
Anaphylaxis	Rapid onset Rash, stridor, vomiting, facial swelling	Airway malformation	Age <6 months
FB aspiration	History of choking Persistently asymmetric exam No initial URI symptoms Suspect in nonverbal mobile children Hypoxia	Increased ICP	
Bacterial tracheitis	Poor response to racemic epinephrine High fever Ill appearance Unvaccinated	Hypocalcemia	

Hypoxia
Age <6 months



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Case 1

16-month child with 1 week of cough and congestion and 2 days of worsening respiratory distress

39 F HR 180 RR 60 BP100/60 SpO2 83% RA

Exam: hoarse cry, inspiratory stridor at rest, moderate retractions, coarse breath sounds.

Intervention:
Racemic epinephrine
Dexamethasone
Ibuprofen

37.5 F HR 150 RR 60 BP100/60 SpO2 83% RA

Exam: hoarse cry, no stridor, mild-moderate retractions, coarse breath sounds, wheezing

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Poll 3

The most effective next steps to manage this child's respiratory distress are (check all that apply)

- A. Suction
- B. Oxygen/Flow/Pressure delivery systems
- C. Fluids
- D. Albuterol
- E. Antibiotics
- F. Imaging

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Poll 3


The most effective next steps to manage this child's respiratory distress are (check all that apply)

- A. Suction
- B. Oxygen/Flow/Pressure delivery systems
- C. Fluids
- D. Albuterol
- E. Antibiotics
- F. Imaging


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Acute Bronchiolitis

National guideline
AAP Clinical Practice Guideline the Diagnosis



Local guideline
Children's Hospital Colorado Clinical Pathway





Common respiratory illness

- (U)Croup
- (L) Bronchiolitis
- Pneumonitis
- Asthma

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Suctioning

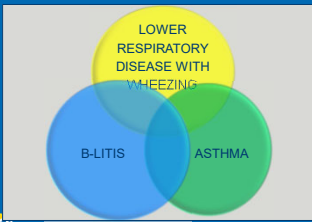
Avoid invasive suctioning when possible

<https://www.suprememed.com/nasal-aspirator-08g-0rumb-valve-30037>
<https://babyepemarket.com/products/owf0a-nasal-aspirator>

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Bronchiolitis vs Asthma

Bronchiolitis 30 days to 23 months	Asthma 12 months and older
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Risk Factors

- Prolonged symptoms
- Over 3 episodes of wheezing
- Wheezing or cough between colds
- Eczema
- Food allergies
- Family history of asthma

Levy ML. Key recommendations for primary care from the 2022 Global Initiative for Asthma (GINA) update. NPJ Prim Care Respir Med. 2023 Feb 8;33(1):7.

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Oxygen Delivery Devices

O ₂ Delivery Device	Minimum Flow, L	Maximum Flow, L	Approximate FiO ₂
Blow-by	0	15	< 0.3
Infant Nasal Canula	0	1	0.24- 0.44
Pediatric Nasal Canula	0	3	0.24- 0.44
Adult Nasal Canula	0	6	0.24- 0.44
Oxy (low flow)Mask	1	15	0.24- 0.8
Venturi Mask	2	15	0.24- 0.6
Simple Mask	6	10	0.4- 0.6
Non-Rebreather	10	15	0.9- 1.00

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Interventions cause more interventions

Patients with a CXR were

- 64% more likely to receive antibiotics
- 68% more likely to have viral testing sent

Patients who had viral testing

- Were 60% more likely to get a CXR
- Had a 48% longer LOS

Patients who received either viral testing or CXR had a longer LOS regardless of severity level!

* Children's Hospital Colorado Data 2014

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High Flow Nasal Cannula

- Benefits
 - Decreases airway resistance
 - Washout of nasopharyngeal dead space
 - Improves Ventilation and oxygenation
 - Positive pressure
- Issues
 - HFNC use increased over time
 - Utility in bronchiolitis is unclear

M Rogerson. Correlates of Pediatric High-Flow Nasal Cannula Use for Bronchiolitis, Asthma, and Pneumonia. Respir Care. 2022
Fainardi V. Update on the Role of High-Flow Nasal Cannula in Infants with Bronchiolitis. Children (Basel). 2021

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High Flow Nasal Cannula

2021 Review (123 studies)

- HFNC vs LFNC
 - If no severe distress, HFNC can be used for persistent hypoxia despite LFNC to obtain normal O2 saturations
- HFNC vs Non-Invasive Ventilation (CPAP/BIPAP)
 - Use CPAP or BIPAP for severe distress

2022 Meta-analysis (5 RCTs)

- No difference between HFNC and CPAP for risk of intubation

2023 systematic review (28 studies)

- No advantage over LFNC for initial therapy
- No advantage over NIV for rescue therapy

Fainardi V. Update on the Role of High-Flow Nasal Cannula in Infants with Bronchiolitis. *Children (Basel)*. 2021
 Buendia JA. Systematic review and meta-analysis of efficacy and safety of continuous positive airways pressure versus high flow oxygen cannula in acute bronchiolitis. *BMC Pediatr*. 2022
 Gutiérrez Moreno M. High-Flow Oxygen and Other Noninvasive Respiratory Support Therapies in Bronchiolitis: Systematic Review and Network Meta-Analyses. *Pediatr Crit Care Med*. 2023

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High Flow Nasal Cannula

M Rogerson. Correlates of Pediatric High-Flow Nasal Cannula Use for Bronchiolitis, Asthma, and Pneumonia. *Respir Care*. 2022

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Case 1 37.5 F HR 150 RR 60 BP100/60 SpO2 83% RA

Exam: hoarse cry, no stridor, mild-moderate retractions, coarse breath sounds, wheezing


Intervention:

- Racemic epinephrine
- Dexamethasone
- Ibuprofen
- Suction
- IV Fluids
- LFNC
- Admission

37.5 HR 140 Sats 95% 2L, RR 40, BP 90/50

Exam: no stridor, no retractions, coarse breath sounds, no wheezing

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Case 1

37.5 HR 140 Sats 95% 2L, RR 40, BP 90/50

Exam: no stridor, no retractions, coarse breath sounds, no wheezing

Intervention:

- Racemic epinephrine
- Dexamethasone
- Ibuprofen
- Suction
- IV Fluids
- LFNC
- Admission

FINAL DIAGNOSIS:
VIRAL CROUP
ACUTE BRONCHIOLITIS

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Interventions cause more interventions

Patients with a CXR were

- 64% more likely to receive antibiotics
- 68% more likely to have viral testing sent

Patients who had viral testing

- Were 60% more likely to get a CXR
- Had a 48% longer LOS

Patients who received either viral testing or CXR had a longer LOS regardless of severity level!

* Children's Hospital Colorado Data 2014

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Bronchiolitis Red Flags

Uncommon Respiratory illnesses	Red flags	Non respiratory illness	Red flags
FB aspiration	History/choking Persistently asymmetric exam no URI Sx	Congestive heart failure myocarditis	Persistent tachycardia Hepatomegaly Heart Murmur
Pneumonia	Fever in kids <60 days Prolonged fever Prolonged illness Immunosuppressive state* History or risk for aspiration	Underlying illness	Red Flags
		Vascular ring TF fistula Cystic fibrosis NM disease	Persistent, recurrent or subacute symptoms Poor growth

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Utility of Radiography in Acute Bronchiolitis

256 infants received CXR
 Only 1.8 % had CXR inconsistent with bronchiolitis
 Pre CXR: (2.6%) infants were identified for abx
 Post CXR: 14.7%

Conclusion:
 Infants with typical bronchiolitis have imaging consistent with bronchiolitis. Therefore, not necessary.
 Risk of airspace disease appears particularly low in children with saturation higher than 92% and mild to moderate distress.

Schuh S. Evaluation of the utility of radiography in acute bronchiolitis. J Pediatr. 2007.

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Common Respiratory Illnesses


Bottom Line

- Upper vs lower respiratory disease vs both
- Croup goals of care
 - oral steroids, racemic epinephrine, think about FB, tracheitis, **caution if hypoxia or infants under 6 months**
- Bronchiolitis goal of care
 - Hydration, airway clearance with suctioning
 - Escalate care as needed, start with least invasive options, use antipyretics
 - Avoid unnecessary interventions; bronchodilators, x-rays, viral testing
- Note asthma risk factors in recurrent bronchiolitis

Common respiratory illness

- (U)Croup
- (L) Bronchiolitis
- Pneumonitis
- Asthma

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Case 2

5-year-old child with history of eczema and peanut allergies presents with 1 day of difficulty breathing, cough after 1 week of URI symptoms. No fever.

37.1 RR 50, HR 150, BP 110/55, 90% RA


Exam:
 Diffuse wheezing bilaterally, retractions, tachypnea

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Poll 4

The next steps in managing this child's respiratory distress are: (select all that apply)

- A. Inhaled epinephrine
- B. Inhaled albuterol
- C. Suction
- D. Antipyretics
- E. Oxygen
- F. Fluids
- G. Steroids
- H. Antibiotics
- I. Imaging




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Poll 4

The next steps in managing this child's respiratory distress are: (select all that apply)



- A. Inhaled epinephrine
- B. Inhaled albuterol
- C. Suction
- D. Antipyretics
- E. Oxygen
- F. Fluids
- G. Steroids
- H. Antibiotics
- I. Imaging





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Asthma

National guidelines
[GINA Asthma Report](#) [2022 Focused Asthma Updates](#)

Local guideline
[Children's Hospital Colorado Clinical Pathways](#)


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Asthma Goals of Care

- Early administration of oral corticosteroid
- Dexamethasone is preferred steroid
- Bronchodilators—inhaler is as effective as nebulizer

Keeney GE. Dexamethasone for acute asthma exacerbations in children: a meta-analysis. Pediatrics. 2014.
 Rowe BH. Early emergency department treatment of acute asthma with systemic corticosteroids. Cochrane Database Syst Rev. 2001 Jan.
 Delgado A. Nebulizers vs Metered-Dose Inhalers With Spacers for Bronchodilator Therapy to Treat Wheezing in Children Aged 2 to 24 Months in a Pediatric Emergency Department. Arch Pediatr Adolesc Med. 2003.
 Plom D. High-dose albuterol by metered-dose inhaler plus a spacer device versus nebulization in preschool children with recurrent wheezing: A double-blind, randomized equivalence trial. Pediatrics. 2000.

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Case 2 **37.1 RR 50, HR 150, BP 110/55, 90% RA**

Exam:
Diffuse wheezing bilaterally, retractions, tachypnea

Intervention:
3 Albuterol/Atrovent nebulizer treatments
Dexamethasone

37.1 RR 48, HR 150, BP 110/55, 90% RA

Exam
Diffuse wheezing bilaterally, retractions, tachypnea

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Severe asthma and non responders

- Continuous albuterol
- Magnesium sulfate
- Fluids
- Noninvasive ventilation

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HFNC in asthma

2023 Retrospective matched cohort study

- HFNC use was associated with increased hospital LOS compared to matched controls.
- No change in intubations

2023 Review

- Decreased delivery of aerosol
- Need for vibrating mesh device

Rogerson C. High flow nasal cannula use is associated with increased hospital length of stay for pediatric asthma. *Pediatr Pulmonol.* 2023
 Calabrese C. Aerosol delivery through high-flow nasal therapy: Technical issues and clinical benefits. *Front Med (Lausanne).* 2023.

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Asthma Red Flags

Uncommon Respiratory illnesses	Red flags	Underlying illness	Red Flags
Allergic reaction	Rapid onset Rash, stridor, vomiting, facial swelling	Vascular ring TF fistula Cystic fibrosis NMJ disease Mediastinal mass	Persistent, recurrent or subacute symptoms Poor growth
FB aspiration	History/choking Persistently asymmetric exam no URI Sx		
Pneumonia	Fever in kids <60 days Prolonged fever Prolonged illness Immunosuppressive state History or risk for aspiration		Chest pain High fever Prolonged illness Check for crepitus

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Chest Xray in Asthma

- Low utility, even in first time wheezing
- Maybe used if red flags are present
 - High fever
 - Asymmetric wheezing –consider FB (inspiratory/expiratory Xray)
 - Chest pain
 - Severe disease

Quinonez RA. Choosing wisely in pediatric hospital medicine: five opportunities for improved healthcare value. *J Hosp Med.* 2013

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Case 2

37.1 RR 48, HR 150, BP 110/55, 90% RA

Exam:
Diffuse wheezing bilaterally, retractions, tachypnea

Intervention:
3 Albuterol/Atrovent nebulizer
Dexamethasone
Continuous albuterol
Magnesium
Fluids
Admission

37.1 RR 30, HR 150, BP 110/55,
96% on continuous albuterol
Exam
Resolved retractions and tachypnea

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Case 2

37.1 RR 30, HR 150, BP 110/55,
96% on continuous albuterol
Exam
Resolved retractions and tachypnea

Intervention:
3 Albuterol/Atrovent nebulizer
Dexamethasone
Continuous albuterol
Magnesium
Fluids
Admission


FINAL DIAGNOSIS
ASTHMA EXACERBATION

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Asthma
Bottom line

- Bronchospasm is the most common cause of wheezing
- Rapid initiation of bronchodilators and steroids
- Look for red flags especially in severe disease and non-responders
- Targeted use of radiography

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Case 3

4-year-old child with with 2 days of fast breathing, abdominal pain, sore throat, vomiting and poor PO intake. 1 day of fever, No history of respiratory illness, fully vaccinated

39F HR 140, RR 52, SpO2 93% RA, BP 110/60

Exam:
 Ill appearing
 Clear lungs, No stridor
 Tachypnea, no retractions
 Soft mildly tender abdomen

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Poll 5

The next steps in addressing child's respiratory distress are:
 (select all that apply)

- A. Bronchodilators
- B. Suction
- C. Antipyretics
- D. Oxygen
- E. Fluids
- F. Steroids
- G. Antibiotics
- H. Imaging

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Poll 5

The next steps in addressing child's respiratory distress are:
 (select all that apply)


- A. Bronchodilators
- B. Suction
- C. Antipyretics
- D. Oxygen
- E. Fluids
- F. Steroids
- G. Antibiotics
- H. Imaging

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Isolated Tachypnea

Uncommon Respiratory illnesses	Red flags	Non respiratory illness	Red flags
FB aspiration	History/choking Persistently asymmetric exam no URI Symptoms	Congestive heart failure Myocarditis	Persistent tachycardia Hepatomegaly Heart Murmur
Pneumonia	Fever in kids <60 days Prolonged illness Immunosuppressive state* History or risk for aspiration	DKA	Tachypnea with normal breath sounds Vomiting Abdominal pain

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Case 3

39F HR 140, RR 52, SpO2 93% RA BP 110/60


Ill appearing
Clear lungs, No stridor
Tachypnea, no retractions
Soft mildly tender abdomen

Intervention:
CXR normal
Ibuprofen
Rapid strep positive

37.8F HR 160, RR 52, Sats 96% RA BP 110/60

Exam:
Lungs are clear
No stridor
Tachypnea, no retractions

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Case 3


37.8F HR 160, RR 52, Sats 96% RA BP 110/60

Exam:
Lungs are clear
No stridor
Tachypnea, no retractions

Intervention:
CXR normal
Ibuprofen
Rapid strep positive

Additional history obtained:
1 month of polyuria and polydipsia
Point of care glucose 450, + urine ketones
pH 7.1, HCO3 10
Started on Insulin and IVF

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Case 3

37.8F HR 160, RR 52, Sats 96% RA BP 110/60

Exam:
Lungs are clear
No stridor
Tachypnea, no retractions

Additional history obtained:
1 week of polyuria and polydipsia
Point of care glucose 450, + urine ketones
pH 7.1, HCO3 10
Started on Insulin and IVF


FINAL DIAGNOSIS
DKA AND STREP PHARYNGITIS

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CONCLUSION

Most children presenting with respiratory distress have a common respiratory illness

- **Step 1:** upper vs lower airway disease or both
- **Step 2:** Look for red flags and signs of uncommon or underlying illness
- **Step 3.** Use common tools for respiratory distress: suction, LFNC, antipyretics BEFORE other meds, HFNC and imaging



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References

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- 7) M Rogerson C, E Carroll A, Tu W, He T, K Schleyer T, M Rowan C, H Owora A, A Mendonca E. Frequency and Correlates of Pediatric High-Flow Nasal Cannula Use for Bronchiolitis, Asthma, and Pneumonia. *Respir Care*. 2022 Aug;67(8):976-984. doi: 10.4187/respcare.09777. Epub 2022 May 24. PMID: 35610026; PMCID: PMC9451493.
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