

**Pediatric Talk:
Pediatric
Asthma**

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Objectives

- Epidemiology, Disparities and SDOH
- Etiology and Pathophysiology
- Signs and symptoms
- Diagnosis
- Initiating and stepping-up treatment
- Acute Exacerbations: home and in office management

Epidemiology

Over 6 million (6.5%) of children in US have asthma

20% infants experience wheezing with URI but 60% will outgrow it by age 6

Gender: More prevalent in boys <10 and girls after puberty

Asthma leads to more school absences and hospitalizations than any other chronic illness

Disparities and SDOH in Asthma

Race:

- Black and Latinx Americans have higher asthma prevalence and greater morbidity than white Americans

Socioeconomic Status

- Low income has been linked to increased asthma prevalence, exacerbation, hospitalization and ICU admission

Childhood asthma Asthma Prevalence in 2021

| Poverty Level ⁵ | | |
|---|-----------|-------------|
| Below 100% of the poverty threshold | 3,812,653 | 10.4 (0.61) |
| 100% to less than 250% of the poverty threshold | 7,264,566 | 8.2 (0.35) |
| 250% to less than 450% of the poverty threshold | 6,155,634 | 7.1 (0.31) |
| 450% of poverty threshold or higher | 7,731,021 | 6.8 (0.28) |

Disparities and SDOH

Education and Employment

- Low health literacy on asthma leads to inability to follow asthma action plan, poorer asthma control, more missed school days, increased ER and hospitalization, lower likelihood of being treated by specialist

Environment

- Housing quality and exposure to pest allergens , mold and pollution increase risk of childhood wheezing and asthma prevalence and morbidity

Healthcare Access and Quality

- Even among individuals with the same military health care insurance, Black and Latinx children were significantly less likely to see a specialist for asthma than White children

Etiology

1) Genetic

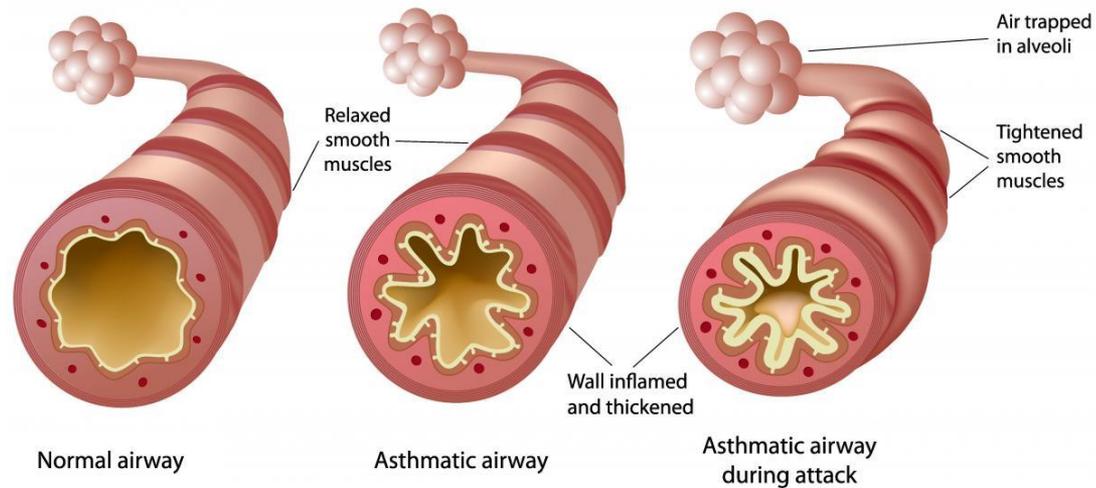
- Some genes affecting asthma development and others affecting severity/ response to treatment

2) Risk Factors

- Atopy
- Prenatal/Perinatal: Prematurity (birth before 36 weeks) , maternal smoking, low birth weight, maternal age <20 years old, +/- maternal vit. D deficiency
- Viral respiratory tract infection (RSV and human rhinovirus) during infancy
- Early-life exposure to air pollution, exposure to secondhand smoke

Pathophysiology

Chronic inflammatory disease throughout the airways: peripheral and central airways, alveoli and bronchi



History and Physical

- Symptoms: wheezing, cough, nocturnal cough, shortness of breath, chest tightness, sputum production
- Pattern of symptoms
- Precipitating factors/triggers
 - Unavoidable
 - Infections
 - Exercise
 - Avoidable
 - Cigarette smoking
 - Allergens (pollen, mold, pets, carpets)
 - Airborne environmental irritants (cold air)
 - Dietary triggers

Differential Diagnosis for wheezing

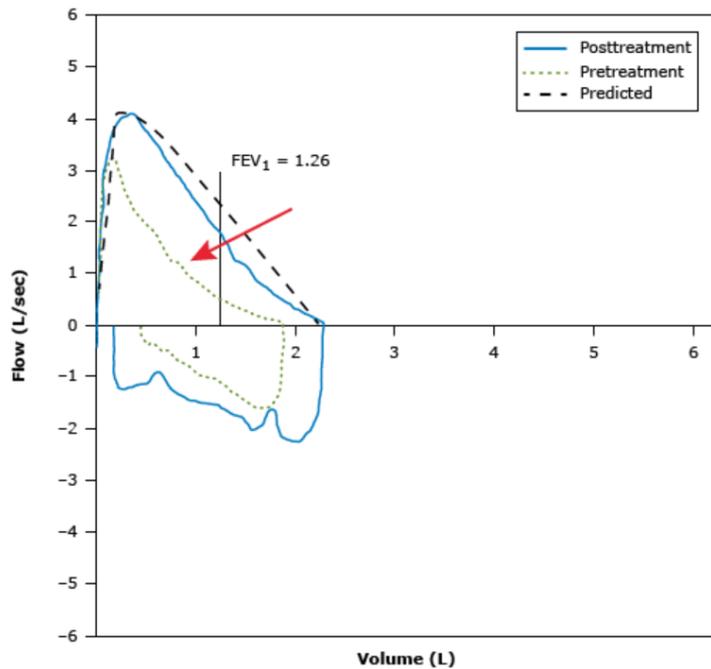
- Viral bronchiolitis: prodrome with rhinitis, seasonal pattern
- Tracheomalacia: poor response to bronchodilators, varies with position, persistent wheeze in early life
- CF: productive cough, crackles, recurrent infections, digestive problems, FTT
- Swallowing dysfunction: choking with eating, worse with feeding
- GERD: related to eating
- Mediastinal nodule or mass: localized wheezing, persistent wheeze

Making Diagnosis

- Characteristic symptom pattern: episodic cough, wheeze, chest tightness AND
- Evidence of reversible airway obstruction
 - Under 5-6 years old: clinical history and exam +response to trial of SABA and/or ICS
 - Over 5-6 years: spirometry demonstrating obstructive airflow and bronchodilator reversibility of at least 12%

Ancillary Studies

- Allergy testing: limit triggers
- Bronchoprovocation testing
- Peak flow
- Exhaled nitric oxide
- Chest Radiograph: usually unnecessary



Spirometry

| Parameter | Units | Predicted value | Observed | | Observed | | Percent change |
|-----------------------|-------|-----------------|-------------------|-------------------|--------------------|-------------------|----------------|
| | | | Prebronchodilator | Percent predicted | Postbronchodilator | Percent predicted | |
| FVC | L | 2.23 | 1.92 | 86 | 2.30 | 103 | 20 |
| FEV ₁ | L | 1.95 | 1.26 | 65 | 1.81 | 93 | 44 |
| FEV ₁ /FVC | % | 89 | 66 | --- | 79 | --- | --- |

Asthma Severity

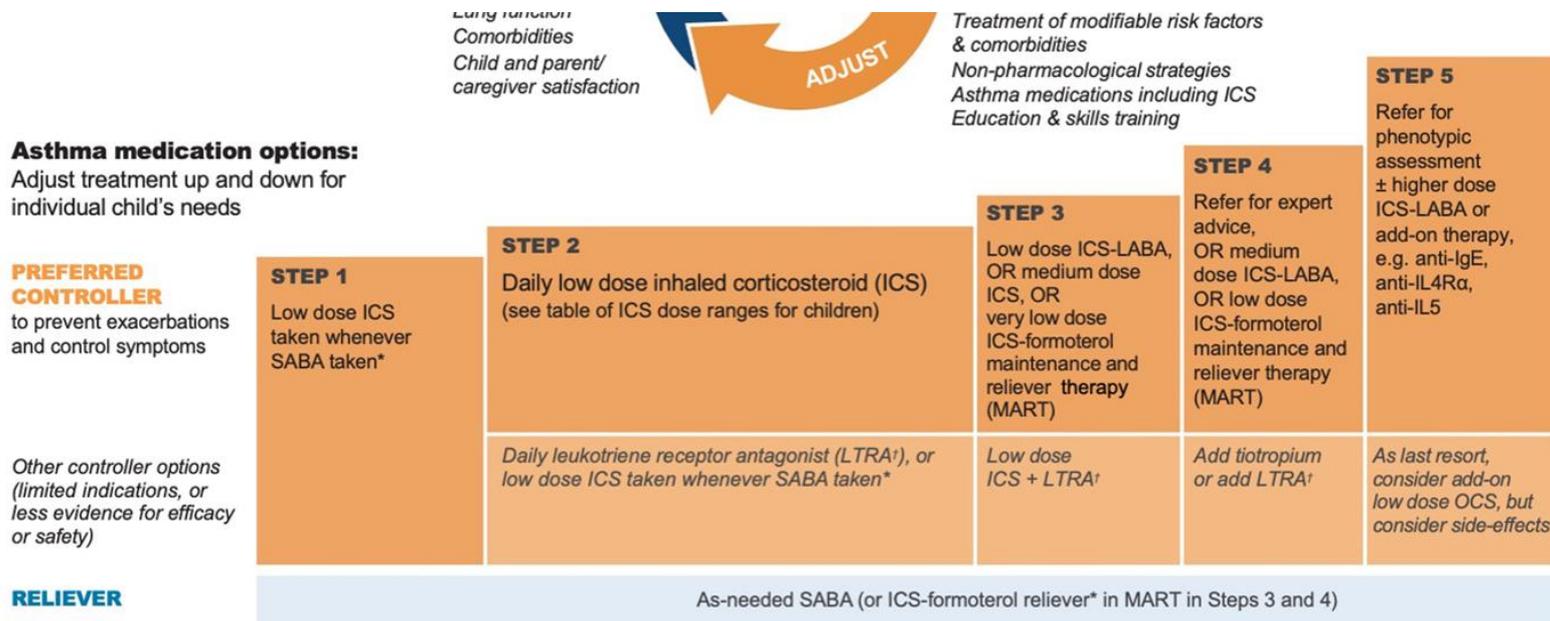
| Components of severity | | Classification of asthma severity (children 5 to 11 years of age) | | | |
|------------------------|---|--|--|--|--|
| | | Intermittent | Persistent | | |
| | | | Mild | Moderate | Severe |
| Impairment | Symptoms | ≤2 days/week | >2 days/week, but not daily | Daily | Throughout the day |
| | Nighttime awakenings | ≤2 times/month | 3 to 4 times/month | >1 time/week, but not nightly | Often 7 times/week |
| | Short-acting beta ₂ -agonist use for symptom control (not prevention of EIB) | ≤2 days/week | >2 days/week, but not daily | Daily | Several times per day |
| | Interference with normal activity | None | Minor limitation | Some limitation | Extremely limited |
| | Lung function | <ul style="list-style-type: none"> ▪ Normal FEV₁ between exacerbations ▪ FEV₁ >80% predicted ▪ FEV₁/FVC >85% | <ul style="list-style-type: none"> ▪ FEV₁ >80% predicted ▪ FEV₁/FVC >80% | <ul style="list-style-type: none"> ▪ FEV₁ = 60 to 80% predicted ▪ FEV₁/FVC = 75 to 80% | <ul style="list-style-type: none"> ▪ FEV₁ <60% predicted ▪ FEV₁/FVC <75% |
| Risk | Exacerbations requiring oral systemic glucocorticoids | 0 to 1/year (refer to legend) | ≥2 in 1 year (refer to legend) | | |
| | | Consider severity and interval since last exacerbation | | | |
| | | Frequency and severity may fluctuate over time for patients in any severity category | | | |
| | | Relative annual risk of exacerbations may be related to FEV₁ | | | |

Treatment: Fundamental Change in 2019

GINA Guidelines

- Treatment with SABA alone is no longer recommended for adults and adolescents (6+)
- SABA treats symptoms not disease
- Trains patient to regard SABA as primary asthma treatment

Step up treatment 6-11 years old



*Anti-inflammatory reliever; [†]advise about risk of neuropsychiatric adverse effects

Treatment for 5 years and younger

Asthma medication options:

Adjust treatment up and down for individual child's needs

Child and parent/
caregiver satisfaction

ADJUST

Non-pharmacological strategies
Asthma medications
Education & skills training

PREFERRED CONTROLLER CHOICE

Other controller options
(limited indications, or less evidence for efficacy or safety)

RELIEVER

CONSIDER THIS STEP FOR CHILDREN WITH:

| | STEP 1 | STEP 2 | STEP 3 | STEP 4 |
|---|--|---|---|--|
| | <i>(Insufficient evidence for daily controller)</i> | Daily low dose inhaled corticosteroid (ICS) (see Box 11-3 for ICS dose ranges for pre-school children) | Double 'low dose' ICS (See Box 11-3) | Continue controller & refer for specialist assessment |
| | Consider intermittent short course ICS at onset of viral illness | Daily leukotriene receptor antagonist (LTRA [†]), or intermittent short course of ICS at onset of respiratory illness | Low dose ICS + LTRA [†] Consider specialist referral | Add LTRA [†] , or increase ICS frequency, or add intermittent ICS |
| | As-needed short-acting beta ₂ -agonist | | | |
| Infrequent viral wheezing and no or few interval symptoms | | Symptom pattern not consistent with asthma but wheezing episodes requiring SABA occur frequently, e.g. ≥3 per year. Give diagnostic trial for 3 months. Consider specialist referral. | Asthma diagnosis, and asthma not well-controlled on low dose ICS | Asthma not well-controlled on double ICS |
| | | Symptom pattern consistent with asthma, and asthma symptoms not well-controlled or ≥3 exacerbations per year. | Before stepping up, check for alternative diagnosis, check inhaler skills, review adherence and exposures | |

[†]Advise about risk of neuropsychiatric adverse effects

Inhaler devices

0-3 years: pressurized metered dose inhaler PLUS spacer with **face mask**

4 year and older: pressurized metered dose inhaler PLUS dedicated spacer with **mouthpiece**

Dry powder inhalers (6-12 years old)

*Most patients (up to 70-80%) do not use inhaler correctly

https://youtu.be/ma_cmlU9DxU?si=vlxazqob8rsKBsXD



Stepping down treatment

- Review asthma: 1-3 months after starting treatment, every 3-12 months thereafter, after/during exacerbation
- Goal: minimum effective treatment
- When: symptoms and lung function has been stable for at least 3 months
 - Choose an appropriate time: no infection, not traveling, summer time
- Stepping down ICS does by 25-50% at 3 month intervals is feasible and safe
- Close follow-up
- Asthma action plan if patient has to resume previous dose

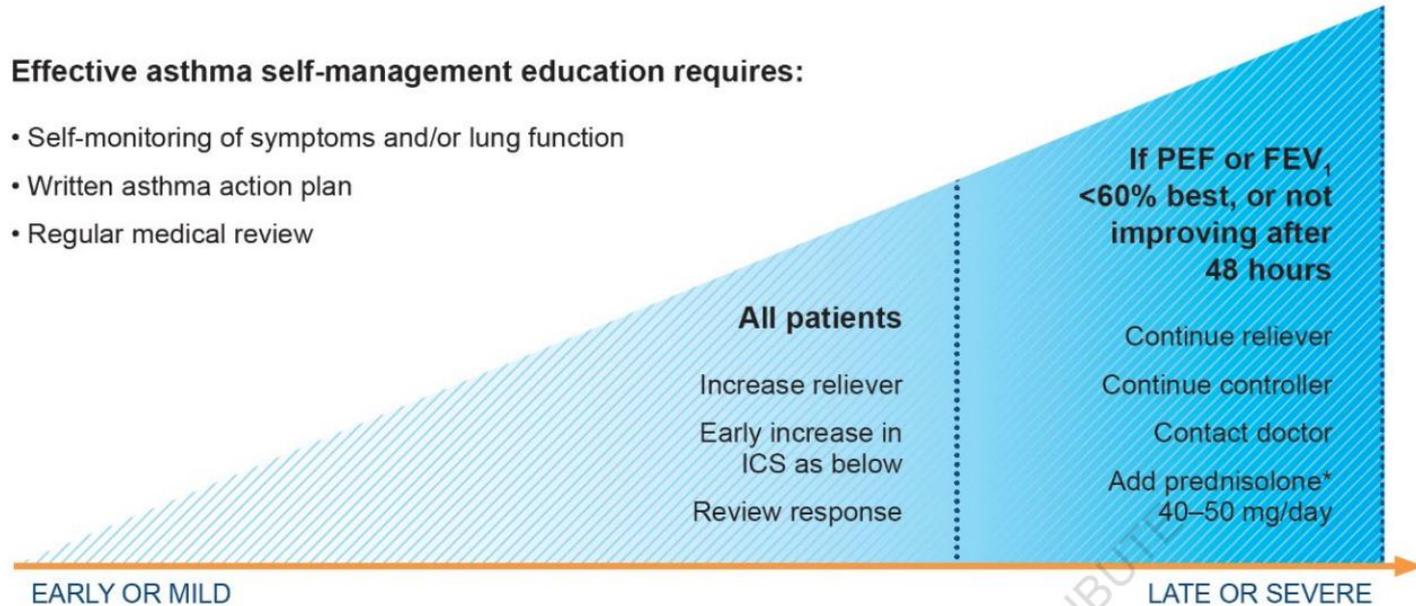
Home management of Exacerbation in ≤ 5 years

- Inhaled SABA via mask and spacer
 - 2 puffs SABA and can be repeated 2 times at 20-minute intervals
- Seek urgent medical care
 - More than 6 puffs of SABA needed within first 2 hours
 - No recovery in 24 hours
 - Period of relief after SABA becomes shorter
- Evidence to support OCS treatment in home management is weak → seek urgent medical care

Home management of Exacerbation (6-11 year)

Effective asthma self-management education requires:

- Self-monitoring of symptoms and/or lung function
- Written asthma action plan
- Regular medical review



ASTHMA ACTION PLAN

For: _____ Doctor: _____ Date: _____

Doctor's Phone Number: _____ Hospital/Emergency Department Phone Number: _____

GREEN ZONE

DOING WELL

- No cough, wheeze, chest tightness, or shortness of breath during the day or night
- Can do usual activities

And, if a peak flow meter is used,

Peak flow: more than _____
(80 percent or more of my best peak flow)

My best peak flow is: _____

Daily Medications

Medicine



How much to take



When to take it

Before exercise

2 or 4 puffs

5 minutes before exercise

YELLOW ZONE

ASTHMA IS GETTING WORSE

- Cough, wheeze, chest tightness, or shortness of breath, or
- Waking at night due to asthma, or
- Can do some, but not all, usual activities

-Or-

Peak flow: _____ to _____
(50 to 79 percent of my best peak flow)



Add: quick-relief medicine—and keep taking your GREEN ZONE medicine.

_____ (quick-relief medicine)

_____ Number of puffs

Can repeat every _____ minutes

or Nebulizer, once

up to maximum of _____ doses



If your symptoms (and peak flow, if used) return to GREEN ZONE after 1 hour of above treatment:

Continue monitoring to be sure you stay in the green zone.

-Or-

If your symptoms (and peak flow, if used) do not return to GREEN ZONE after 1 hour of above treatment:

Take: _____ (quick-relief medicine) _____ Number of puffs or Nebulizer

Add: _____ mg per day For _____ (3-10) days
(oral steroid)

Call the doctor before/ within _____ hours after taking the oral steroid.

RED ZONE

MEDICAL ALERT!

- Very short of breath, or
- Quick-relief medicines have not helped,
- Cannot do usual activities, or
- Symptoms are same or get worse after 24 hours in Yellow Zone

-Or-

Peak flow: less than _____
(50 percent of my best peak flow)

Take this medicine:

_____ (quick-relief medicine)

_____ Number of puffs or Nebulizer

_____ mg
(oral steroid)

Then call your doctor NOW. Go to the hospital or call an ambulance if:

- You are still in the red zone after 15 minutes AND
- You have not reached your doctor.

DANGER SIGNS

- Trouble walking and talking due to shortness of breath
- Lips or fingernails are blue



- Take _____ puffs of _____ (quick relief medicine) AND
- Go to the hospital or call for an ambulance _____ NOW!
(phone)

Interventions using SDOH framework

- Understand non-medical factors affecting patient health: screen for SDOH
- Patient and family education
 - Inhaler technique
 - Action plan: in native language, low-literacy options
 - Identifying trigger: smoking cessation
- Understand resources available that address SDOH

Name: _____

Date: _____



15 minutes before



Morning

_____ puffs with spacer



_____ puffs with spacer



Night

_____ chewable tablets

_____ chewable tablets



- Trouble breathing
- Cough in day or night
- Wheeze
- Tightness in chest

Triggers:



Morning



Night

Every 4 hours



_____ puffs with spacer

If not feeling better in 1 day, call your doctor.



- Can't stop coughing
- Breathing is hard and fast
- Can't walk or talk well
- Ribs show when breathing

_____ puffs with spacer

OR



This action plan incorporates elements from Yin et al. written asthma action plan with their permission.

Date: 6/17/12

Asthma Medicine for Jason

Everyday Keep your child healthy.
Give **everyday medicine** when healthy or sick.

Your child is feeling good:

- No trouble breathing
- No cough or wheeze
- Sleeps well
- Can play as usual

Morning

Flovent
2 puffs with spacer

Night

Singular
1 chewable tablet

Flovent
2 puffs with spacer

and

Your child has any of these:

- Some trouble breathing
- Cough in the day or night
- Mild wheeze
- Feels tightness in chest

Sick Give sick medicine and add everyday medicine.
If not feeling better in 1 day, call your doctor.

Albuterol
2 puffs with spacer

If needed, give every 4 hours

Everyday

Morning

Flovent
2 puffs with spacer

Night

Singular
1 chewable tablet

and

Flovent
2 puffs with spacer

Your child has any of these:

- Breathing is hard and fast
- Can't stop coughing
- Ribs show when breathing
- Neck pulls in
- Can't talk or walk well

Very sick The asthma is getting worse.
Give sick medicine. **Get help now!**

Albuterol
2 puffs with spacer

and

Call a doctor or 911
Go to the hospital

Use of at-home Peak Flow

Green zone: 80-100% of personal best

Yellow zone: 50-79% with symptoms

Red Zone: <50%

Teaching:

- Measure normal peak flow when having no symptoms, repeat 3x about 2-4 times for 2 weeks
- Person best: highest measurement achieved

Asthma exacerbation in office (6-11 years)

MILD/MODERATE: talking in phrases, RR increased, no accessory muscles, HR 100-120, O₂ on RA >90%, PEF>50%

- SABA: 4-10 puffs every 20 minutes for 1 hour
- Prednisone: 1-2mg/kg, max 40mg
- Oxygen if available

Assess response in 1 hour→ if symptoms improving, PEF >60%, Oxygen >94% on RA can be discharged

- Reliever PRN + start or step up ICS therapy, continue prednisone for 3-5 days, follow-up 2-7 days

SEVERE: talking in words, hunched forward, agitated, RR>30, accessory muscles in use, HR >120, O₂ on RA <90%, PEF ≤ 50% expected OR

Not responding to treatment in office after 1 hour OR

Life-threatening: drowsy or confused

- Transfer to acute care facility and give SABA, ipratropium bromide, O₂ and prednisone while waiting

Asthma exacerbation in office (≤ 5 years)

MILD/MODERATE: breathless, agitate, HR <180 (0-3) or <150 (4-5), O₂ $\geq 92\%$

- Salbutamol 100mcg two puffs by MDI + spacer or 2.5mg by nebulizer; repeat every 20 minutes for 1st hour
- Oxygen if available (goal 94-98%)
- Consider ipratropium 1-2 puffs

*If improving but symptoms recur within 3-4 hours: give extra Salbutamol 2-3 puffs per hour and give prednisolone 2mg/kg (max 20mg <2 , max 30 for 2-5)

- DC with 3-5 days of steroid, continue reliever as needed, consider controller, follow-up in 1-2 days

SEVERE or Life threatening: unable to speak or drink, central cyanosis, confusion, RR >40 , O₂ $<92\%$, silent chest on auscultation, HR >180 (0-3 yrs) or >150 (4-5)

Not responding to treatment in office or failure to respond to 10 puff salbutamol over 3-4 hours

- Transfer to acute care facility and 6 puffs Salbutamol 100mcg (repeat every 20 minutes), O₂ and prednisolone 2mg/kg as starting dose, consider 1-2 doses of nebulized, ipratropium bromide 250mcg while waiting

Resources

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3. Lizzo JM, Goldin J, Cortes S. Pediatric Asthma. In: *StatPearls*. StatPearls Publishing; 2025. Accessed January 6, 2025. <http://www.ncbi.nlm.nih.gov/books/NBK551631/>
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