



# Asthma

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# Disclosures

- I have no disclosures



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# Learning Objectives

- Review pathophysiology and etiologies of Asthma
- Review diagnosis of Asthma and other causes of chronic cough
- Discuss classification of asthma with asthma therapies
- Discuss Asthma exacerbations



# Asthma in the US and locally: Major health and economic burden to patients, families, society

## US (CDC data 2021)

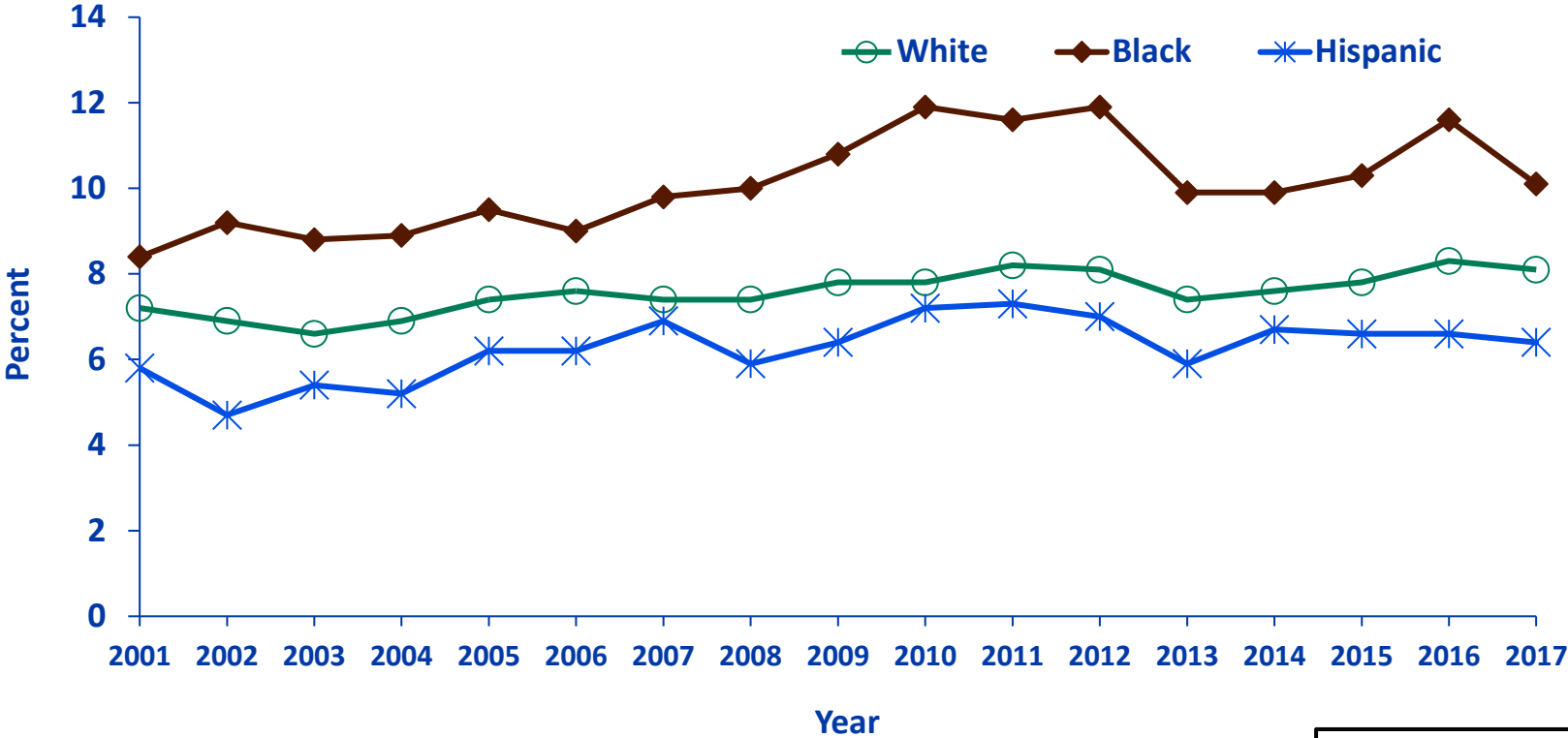
- 25 million people with asthma, including 4.6 million children <18 yr
- 145 children died from asthma in the US in 2021
- Asthma rates have slowly increased since the 1980s, but has recently plateaued.

## ACH Asthma Registry (July 2024 data)

- 31,492 children (age 2-18 years with an asthma diagnosis on their problem list who have been seen in our system in the past 2 years)



# Race and ethnicity differences in prevalence in US (2017)



African Americans in US consistently have highest prevalence except those from Puerto Rico

Data



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# ED Rates in US, Ohio and ACH

- **US:** 716K people went to ED for asthma in 2020
  - 27% of these were kids <18 years old
- **Ohio:** 18,885 asthma ED visits for <18 years [2016 data, latest]
  - Kids <5 years old had highest rate of asthma ED visits
  - 15% of Ohio's children are African American but African American children account for about 50% of asthma ED visits
- **ACH:** [Asthma registry with 31K patients]
  - 1864 ED asthma visits in the past 12 months

Data from CDC  
Health data a  
Re



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# Hospitalization Rates in US, Ohio and ACH

- **US:** 94K people were hospitalized because of asthma [2020 data]
  - 29% were kids <18 years old
- **Ohio:** 3,031 hospitalizations for asthma in kids <18 years [2016 data]
  - Kids <5 years old had highest rate of asthma ED visits
  - African American children had twice the admission rate of white children
- **ACH:**
  - 706 asthma admissions in the past year

Data from CDC  
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# Asthma Etiology?

- Heterogeneous condition with complex, multiple etiologies
  - Latest classification by “phenotype” and “endotype”
- Most asthma is associated with airway inflammation (classically: eosinophilic, Th2, “allergic asthma”)
  - **Not all asthma is allergy-related**
    - **"Non-Th2 asthma" is more difficult to treat**
- Both genetic and environmental factors play role





# Asthma: Pathogenesis

**Genetic factors**  
(i.e. HLA gene mutations, defects in bronchial airway epithelium)

**Environmental factors:**  
(i.e. excess hygiene, few siblings, antibiotics within the first two years)

**Atopy:**  
predisposition to allergic hyper-sensitivity in airways

**First exposure to triggers\***  
sensitizes helper T cells

Stimulation of B-cells to produce IgE, which binds to mast cell surfaces

Activated Helper-T cells & IgE-sensitized mast cells now line the airways

**Second exposure to triggers**

**Early response (0-2 hrs)**

Allergens cross-link IgEs on mast cells

Mast cells release histamines, leukotrienes, and other inflammatory mediators

- Vasodilation → edema
- Goblet cell hyperplasia → ↑ mucus secretion
- Bronchial smooth muscle contraction

**Airway obstruction**

**Delayed response (4-12 hrs)**

Activated mast cells & helper T cells release cytokines

Induce maturation of granular WBCs like eosinophils

Eosinophils migrate into:

- Airways → **Bronchiole constriction**
- Eyes → **Conjunctivitis**
- Nose → **Rhinitis**

**Asthma**

## TRIGGERS for an ASTHMA ATTACK

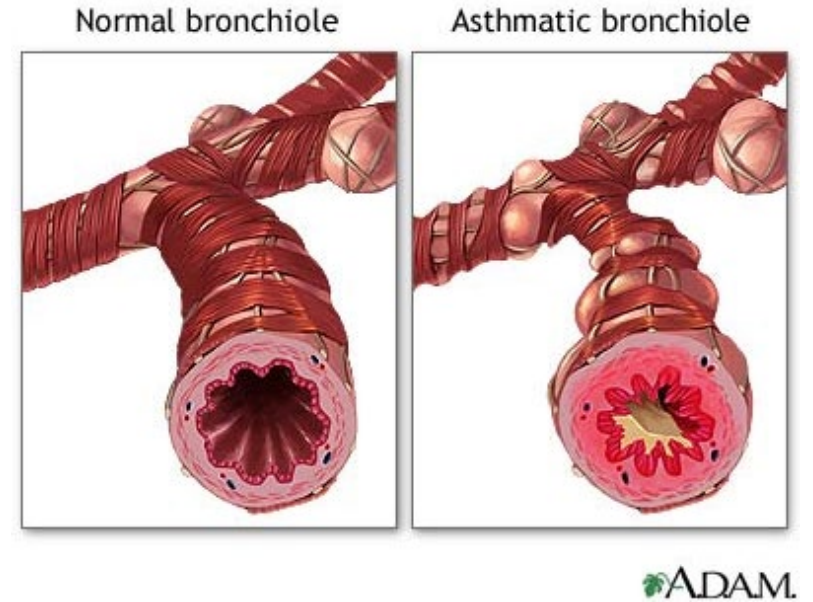


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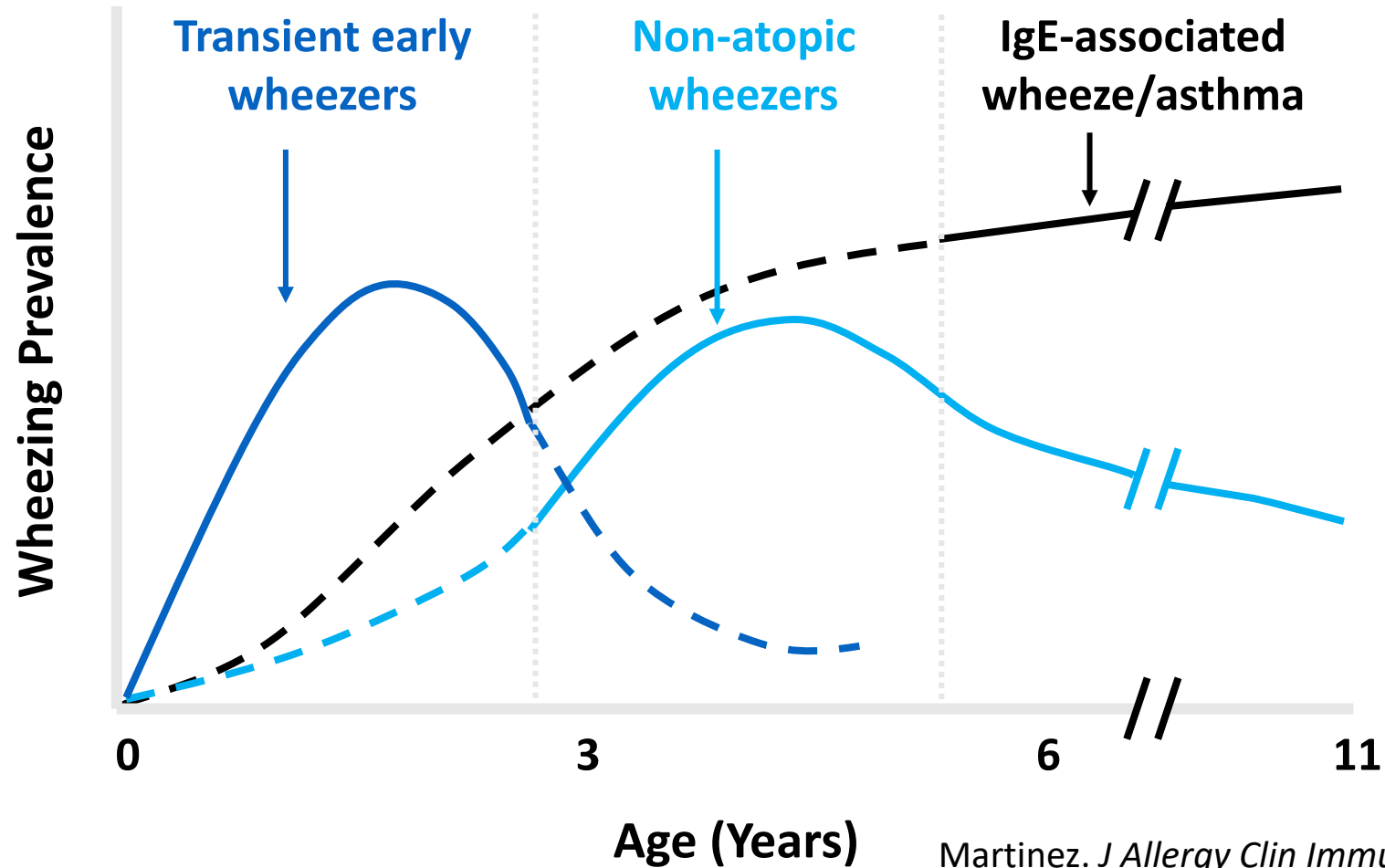


# Asthma Pathophysiology

- Chronic inflammatory disorder
- **Reversible** airflow **obstruction** due to airway hyperresponsiveness
- Bronchoconstriction leads to:
  - Air trapping with hyperinflation
  - Altered breathing mechanics
  - Airflow limitation airway wall edema and mucous production
- Results in increased coughing, wheezing, and increased work of breathing
- Periods of time without symptoms



# Natural History of Childhood Asthma



Martinez. *J Allergy Clin Immunol* 19



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# Important Questions to Ask

- Previous Wheezing
- Family History of Asthma
- Eczema
- Allergies
- Response to steroids or Albuterol
- Nocturnal Cough
- Daytime Cough
- Cough with exertion

- Asthma Predictive Index:

- [Asthma Predictive Index \(API\) Calculator \(mdapp.co\)](https://mdapp.co/asthma-predictive-index-calculator)

## Asthma Predictive Index (API)

♥ Evaluates risk of asthma diagnosis in the future for children aged three or less suffering from recurrent wheezing. +

Purpose ▾ Key Facts ▾ Jump To ▾

### 1 Number of wheezing episodes per year\*

- Less than three
- Three or more

### 2 API major criteria

- Family history (parent) with asthma
- Patient diagnosed with eczema (atopic dermatitis)

### 3 API minor criteria

- Diagnosed sensitivity to allergens in the air (allergic rhinitis)
- Wheezing present apart from colds
- Eosinophilia (4% or more eosinophils on complete blood count)

Calculate Reset

☆ </>Embed

■ Asthma Predictive Index (API) Result: Positive By Stringent Criteria

■ Interpretation: This result is associated with a 77% chance of diagnosed active asthma in the next 5 school years.

Disclaimer: This tool should NOT be considered as a substitute for any professional medical service, NOR as a substitute for clinical judgment. Please read the full disclaimer.



# Other Important Questions to Ask



- History of intubation
- ED Visits
- Hospitalizations
- Smoke exposure

**TABLE 1. RISK FACTORS FOR DEATH FROM ASTHMA  
(ORIGINALLY PUBLISHED AS FIGURE 5-2A IN THE EPR3 [1])**

## Asthma history

- Previous severe exacerbation (e.g., intubation or ICU admission for asthma)
- Two or more hospitalizations for asthma in the past year
- Three or more ED visits for asthma in the past year
- Hospitalization or ED visit for asthma in the past month
- Using > 2 canisters of SABA per month
- Difficulty perceiving asthma symptoms or severity of exacerbations
- Other risk factors: lack of a written asthma action plan, sensitivity to *Alternaria*

## Social history

- Low socioeconomic status or inner-city residence
- Illicit drug use
- Major psychosocial problems

## Comorbidities

- Cardiovascular disease
- Other chronic lung disease
- Chronic psychiatric disease



# Are You Sure It's Asthma?

- Recurrent Pneumonia
- Hemoptysis
- Recurrent sinusitis
- Sleep related issues
- Failure to Thrive

TABLE 6 Diseases which can masquerade as severe asthma

## Children

Dysfunctional breathing/vocal cord dysfunction  
Bronchiolitis  
Recurrent (micro)aspiration, reflux, swallowing dysfunction  
Prematurity and related lung disease  
Cystic fibrosis  
Congenital or acquired immune deficiency  
Primary ciliary dyskinesia  
Central airways obstruction/compression  
Foreign body  
Congenital malformations including vascular ring  
Tracheobronchomalacia  
Carcinoid or other tumour  
Mediastinal mass/enlarged lymph node  
Congenital heart disease  
Interstitial lung disease  
Connective tissue disease

## Adults

Dysfunctional breathlessness/vocal cord dysfunction  
Chronic obstructive pulmonary disease  
Hyperventilation with panic attacks  
Bronchiolitis obliterans  
Congestive heart failure  
Adverse drug reaction (e.g. angiotensin-converting enzyme inhibitors)  
Bronchiectasis/cystic fibrosis  
Hypersensitivity pneumonitis  
Hypereosinophilic syndromes  
Pulmonary embolus  
Herpetic tracheobronchitis  
Endobronchial lesion/foreign body (e.g. amyloid, carcinoma)  
Allergic bronchopulmonary aspergillosis  
Acquired tracheobronchomalacia  
Churg-Strauss syndrome



# Evaluation of Cough

- From CHEST Guidelines and Expert Panel Report

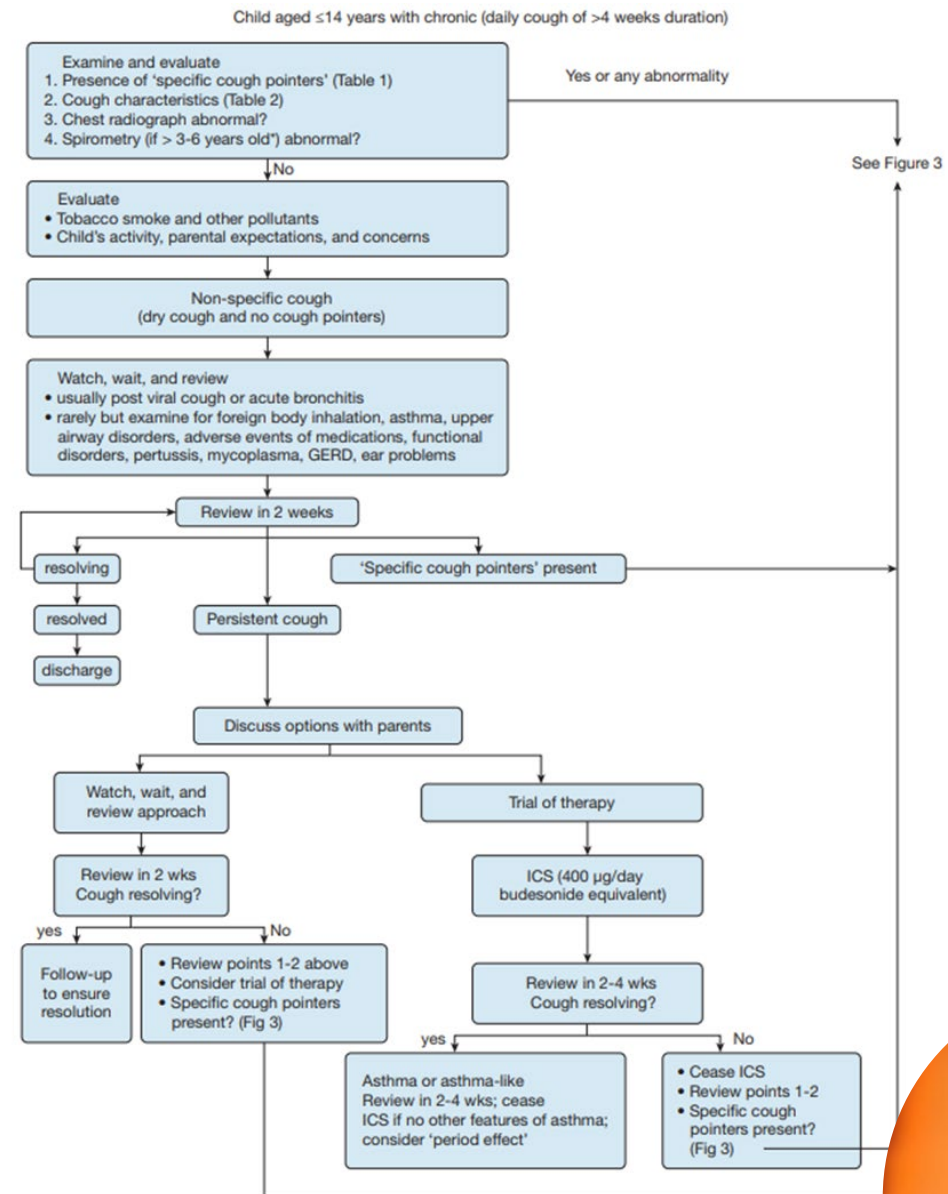


Figure 2 – Approach to a child aged  $\leq 14$  years with chronic cough. Children aged  $> 14$  years should be managed as outlined in adult guidelines. There is no good evidence when the age cutoff should be. The algorithm should be read with the accompanying text. \*Spirometry can usually be performed in children aged  $> 6$  years and in some children  $> 3$  years if trained pediatric personnel are present. <sup>33</sup> GERD = gastroesophageal disease; ICS = inhaled corticosteroids.

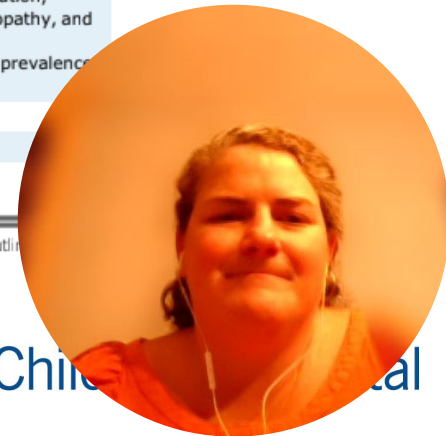


# Table 1

**TABLE 1 ]** Pointers to Presence of Specific Cough<sup>a</sup>

Abnormality	Examples of etiology
<b>Symptoms or signs</b>	
Auscultatory findings	Wheeze—see below Crepitations—any airway lesions (from secretions) or parenchyma disease such as interstitial disease
Cardiac abnormalities	Associated airway abnormalities, cardiac failure, arrhythmia
Chest pain	Arrhythmia, asthma
Choked	Foreign body inhalation
Dyspnea or tachypnea	Any pulmonary airway or parenchyma disease
Chest wall deformity	Any pulmonary airway or parenchyma disease
Digital clubbing	Suppurative lung disease
Daily wet/productive cough	Protracted bacterial bronchitis, suppurative lung disease, recurrent aspiration, atypical infections, TB, diffuse panbronchiolitis
Exertional dyspnea	Any airway or parenchymal disease
Facial pain/purulent nasal discharge	Chronic sinusitis (protracted bacterial bronchitis), primary ciliary dyskinesia
Feeding difficulties	Any serious systemic including pulmonary illness, aspiration
Growth failure	Any serious systemic including pulmonary illness such as cystic fibrosis
Hoarse voice/stridor	Laryngeal cleft/problems, airway abnormalities
Hemoptysis	Suppurative lung disease, vascular abnormalities
Hypoxia/cyanosis	Any airway or parenchyma disease, cardiac disease
Neurodevelopmental abnormality	Aspiration lung disease
Recurrent pneumonia	Immunodeficiency, atypical infections, suppurative lung disease, congenital lung abnormalities, trachea-esophageal H-type fistulas
Recurrent infections	Immunodeficiency
Previous history of chronic lung or esophageal disease (eg, neonatal lung disease, esophageal atresia)	Multiple causes (eg, second H-type fistula, bronchiectasis, aspiration, asthma)
Wheeze—monophonic	Large airway obstruction (eg, from foreign body aspiration, malacia and/or stenosis, vascular rings, lymphadenopathy, and mediastinal tumors) TB should be considered in selected settings (eg, high prevalence or HIV)
Wheeze—polyphonic	Asthma, bronchiolitis obliterans, bronchiolitis
<b>Tests</b>	
Chest radiograph (other than peribronchial changes) or spirometry abnormality	Any cardiopulmonary disease

<sup>a</sup>As the causes of chronic cough encompasses the entire spectrum of pediatric pulmonology and extrapulmonary diseases, this list outlines common symptoms and signs and is not exhaustive.





# Further Evaluation

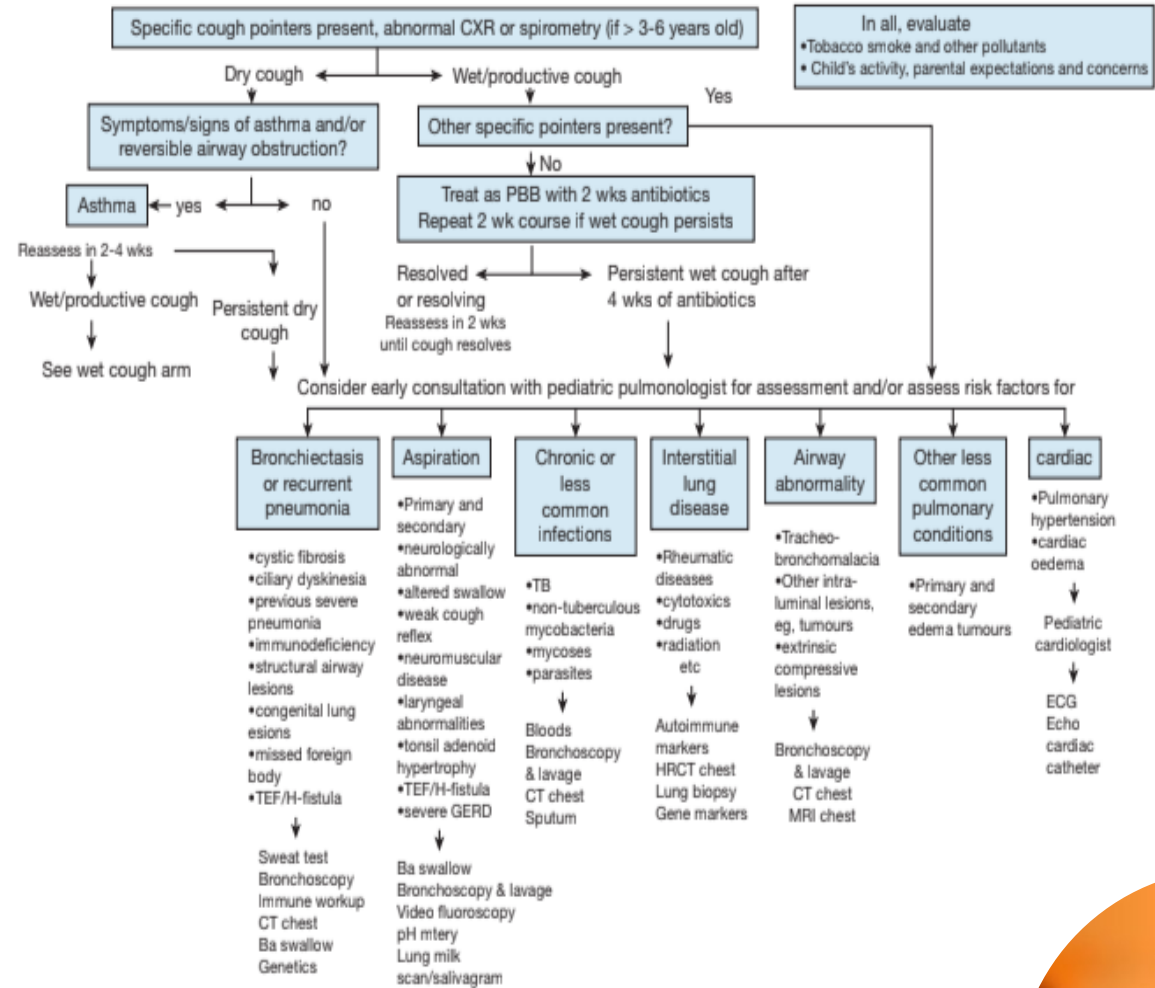


Figure 3 – Approach to a child aged ≤ 14 years with chronic specific cough (ie, cough associated with other features suggestive of pulmonary and/or systemic abnormality). CXR = chest radiograph; HRCT = high-resolution CT; PBB = protracted bacterial bronchitis; TEF = tracheal-esophageal fistula. See Figure 2 legend for expansion of other abbreviation.



# EPR-3 Asthma Guidelines

- (Expert Panel Report) Guidelines for Diagnosis and management of Asthma through NHLBI – 2007
- Previous guidelines before 2020 that is quoted frequently.
- <https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma>



# Asthma Management: NHLBI guidelines

[National Heart, Lung and Blood Institute]

- **Goal of therapy:** reduce impairment and reduce risk
  - ↓ **impairment:** reduce chronic Sx, maintain normal activity and function
  - ↓ **risk:** reduce exacerbations, ED visits, hospitalizations, side effects
- NHLBI December 2020 update:
  - FeNO (Fractional exhaled Nitric Oxide)
  - Indoor allergen mitigation
  - Immunotherapy for allergic asthma
  - LAMA as add-on therapy
  - Bronchial thermoplasty
  - **Intermittent inhaled steroids [ICS]**
  - **SMART Therapy**
- <https://www.nhlbi.nih.gov/health-topics/asthma-management-guidelines-2020-updates>



# GINA (Global Initiative for Asthma)

- International, updated annually
- Oriented toward adults
  - Pediatric recommendations are mostly based on extrapolated adult data
- Aim to include considerations for resource-poor areas
- No significant changes 2007 to 2018
- 2019: Concept of intermittent SMART\* with ICS+LABA
- Additional changes each year
- <https://ginasthma.org/2024-report/>

\*SMART = Single  
and Relieve



# INITIAL VISIT: CLASSIFYING ASTHMA SEVERITY AND INITIATING THERAPY

(in patients who are not currently taking long-term control medications)

Level of severity (Columns 2-5) is determined by events listed in Column 1 for both impairment (frequency and intensity of symptoms and functional limitations) and risk (of exacerbations). Assess impairment by patient's or caregiver's recall of events during the previous 2-4 weeks; assess risk over the last year. Recommendations for initiating therapy based on level of severity are presented in the last row.

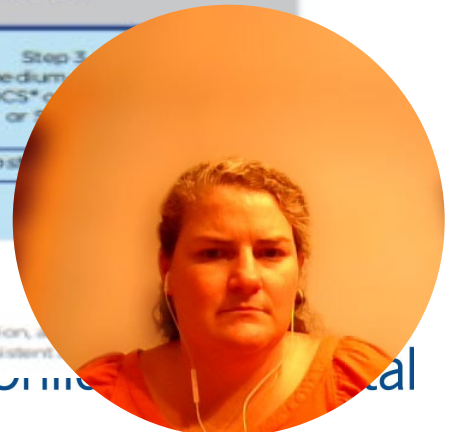
Components of Severity	Intermittent			Persistent												
				Mild			Moderate			Severe						
	Ages 0-4 years	Ages 5-11 years	Ages ≥12 years	Ages 0-4 years	Ages 5-11 years	Ages ≥12 years	Ages 0-4 years	Ages 5-11 years	Ages ≥12 years	Ages 0-4 years	Ages 5-11 years	Ages ≥12 years				
Impairment	Symptoms	≤2 days/week			>2 days/week but not daily			Daily			Throughout the day					
	Nighttime awakenings	0	≤2x/month		1-2x/month	3-4x/month		3-4x/month	>1x/week but not nightly			1x/week	Often 7x/week			
	SABA* use for symptom control (not to prevent EIB†)	≤2 days/week			>2 days/week but not daily			>2 days/week but not daily and not more than once on any day			Daily			Several times per week		
	Interference with normal activity	None			Minor limitation			Some limitation			Significant limitation			Severe limitation		
	Lung function	Not applicable	Normal FEV <sub>1</sub> between exacerbations	Normal FEV <sub>1</sub> between exacerbations	Not applicable	>80%	>80%	Not applicable	60-80%	60-80%	60-70%	Not applicable	<60%	<60%	Reduced >5%†	
→ FEV <sub>1</sub> * (% predicted)	>80%		Normal†	>80%		Normal†	75%		Reduced 5%†	<75%	Reduced >5%†					
Risk	Asthma exacerbations requiring oral systemic corticosteroids‡	≤1/year			1-2/year			≥2/year			≥2/year					
		Consider severity level of last asthma exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. Relative annual risk of exacerbations may be related to FEV <sub>1</sub> *.			Generally, more frequent and intense events indicate greater severity.			Generally, more frequent and intense events indicate greater severity.			Generally, more frequent and intense events indicate greater severity.					
Recommended Step for Initiating Therapy		Step 1			Step 2			Step 3	Step 3 medium-dose ICS* option	Step 3	Step 3	Step 3 medium-dose ICS* or LTRA* or LABA*				
<p>(See "Stepwise Approach for Managing Asthma Long-term" page 7)</p> <p>The stepwise approach is intended to help, not replace, the clinician's decisionmaking. Consider the individual patient's clinical picture.</p>		<p>Consider short course of oral systemic corticosteroids in 2-6 weeks, depending on severity; assess level of asthma control achieved and adjust therapy as needed. For children 0-4 years old, if no clear benefit is observed in 4-6 weeks, consider adjusting the therapy or alternate diagnoses.</p>														

No Changes in Diagnosis or Classification with the 2020 Update

\* Abbreviations: EIB, exercise-induced bronchospasm; FEV<sub>1</sub>, forced expiratory volume in 1 second; FVC, forced vital capacity; ICS, inhaled corticosteroid; SABA, short-acting beta<sub>2</sub>-agonist.

† Normal FEV<sub>1</sub>/FVC by age: 8-19 years, 85%; 20-39 years, 90%; 40-59 years, 75%; 60-80 years, 70%.

‡ Data are insufficient to link frequencies of exacerbations with different levels of asthma severity. Generally, more frequent and intense exacerbations (e.g., requiring urgent care, hospital or intensive care admission, or hospital or intensive care admission) indicate greater underlying disease severity. For treatment purposes, patients with ≥2 exacerbations may be considered to have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.





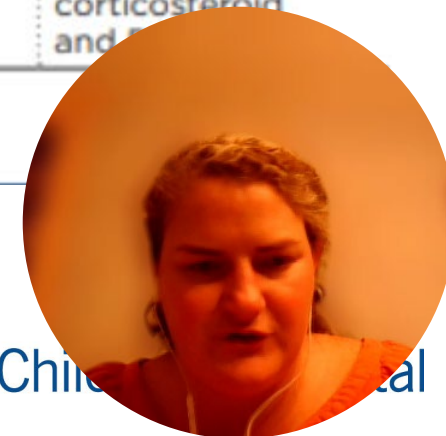
# Treatment



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	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 0-4 Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
<b>Preferred</b>	PRN SABA and At the start of RTI: Add short course daily ICS▲ 	Daily low-dose ICS and PRN SABA	Daily medium-dose ICS and PRN SABA	Daily medium-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA + oral systemic corticosteroid and PRN SABA
<b>Alternative</b>		Daily montelukast* or Cromolyn,* and PRN SABA		Daily medium-dose ICS + montelukast* and PRN SABA	Daily high-dose ICS + montelukast* and PRN SABA	Daily high-dose ICS + montelukast* + oral systemic corticosteroid and PRN SABA
			For children age 4 years only, see Step 3 and Step 4 on Management of Persistent Asthma in Individuals Ages 5-11 Years diagram. 			



# Intermittent ICS

- Recommended: 7–10 day course of daily ICS with PRN SABA starting at the onset of a respiratory tract infection symptoms
  - Budesonide inhalation 1 mg twice daily for 7 days at the first sign of respiratory tract infection-associated symptoms<sup>1,2</sup>
  - Need High Dose ICS for this to work





# Background leading to major GINA changes

- Concern about use of SABA alone in mildest
  - Does not address underlying inflammation
  - Increased risk of death and/or severe exacerbations
- SABA use alone reinforces perception that SABA "works" and controller therapy does not



	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 5-11 Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6
Preferred	PRN SABA	Daily low-dose ICS and PRN SABA	Daily and PRN combination low-dose ICS-formoterol <sup>▲</sup> ★	Daily and PRN combination medium-dose ICS-formoterol <sup>▲</sup> ★	Daily high-dose ICS-LABA and PRN SABA	Daily high-dose ICS-LABA + oral systemic corticosteroid and PRN SABA
Alternative		Daily LTRA,* or Cromolyn,* or Nedocromil,* or Theophylline,* and PRN SABA	Daily medium-dose ICS and PRN SABA or Daily low-dose ICS-LABA, or daily low-dose ICS + LTRA,* or daily low-dose ICS + Theophylline,* and PRN SABA	Daily medium-dose ICS-LABA and PRN SABA or Daily medium-dose ICS + LTRA* or daily medium-dose ICS + Theophylline,* and PRN SABA	Daily high-dose ICS + LTRA* or daily high-dose ICS + Theophylline,* and PRN SABA	Daily high-dose ICS + LTRA* + oral systemic corticosteroid or daily high-dose ICS + Theophylline* + oral systemic corticosteroid and PRN SABA
		Steps 2-4: Conditionally recommend the use of subcutaneous immunotherapy as an adjunct treatment to standard pharmacotherapy in individuals ≥ 5 years of age whose asthma is controlled at the initiation, build up, and maintenance phases of immunotherapy <sup>▲</sup>			Consider Omalizumab	



# Single Maintenance and Reliever Therapy (SMART)

- Only with ICS- Fomoterol: BID as maintenance and 1-2 puffs prn
- Max dose:
  - Ages 4-11 years: 8 puffs (36mcg) per day
  - Age 12 and up: 12 puffs (54mcg) per day
- Brands: Symbicort or Dulera



# SABA (short-acting) and LABA (Long-acting) beta-agonists

- SABA: Albuterol Rapid onset, lasts a few hours

- LABA:

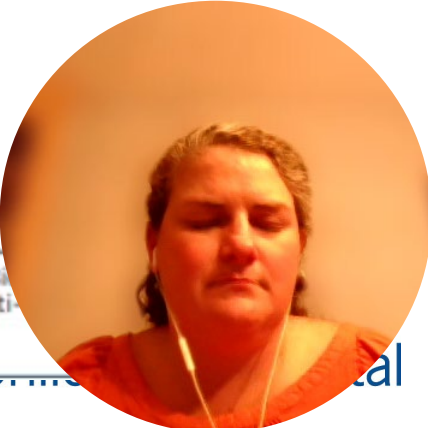
- Salmeterol Gradual onset, lasts about 8 hours

- Formoterol Rapid onset, lasts about 12 hours

- Onset of action?
- Duration of action?



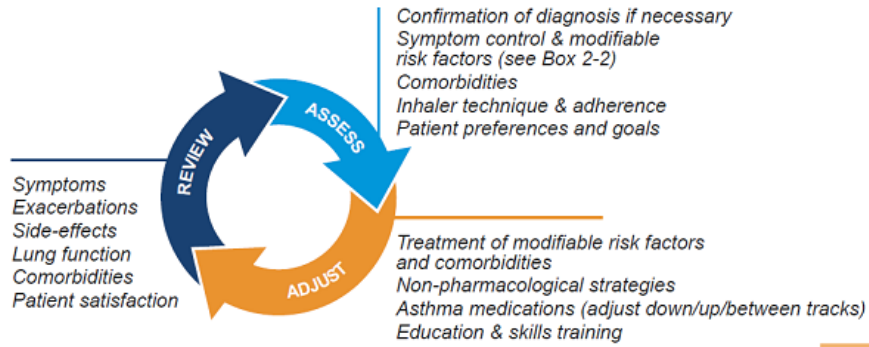
	Intermittent Asthma	Management of Persistent Asthma in Individuals Ages 12+ Years				
Treatment	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6 <sup>■</sup>
Preferred	PRN SABA	Daily low-dose ICS and PRN SABA or PRN concomitant ICS and SABA <sup>▲</sup> ★	Daily and PRN combination low-dose ICS-formoterol <sup>▲</sup> ★	Daily and PRN combination medium-dose ICS-formoterol <sup>▲</sup> ★	Daily medium-high dose ICS-LABA + LAMA <sup>▲</sup> and PRN SABA <sup>▲</sup>	Daily high-dose ICS-LABA + oral systemic corticosteroids + PRN SABA
Alternative		Daily LTRA* and PRN SABA or Cromolyn,* or Nedocromil,* or Zileuton,* or Theophylline,* and PRN SABA	Daily medium-dose ICS and PRN SABA or Daily low-dose ICS-LABA, or daily low-dose ICS + LAMA,★ or daily low-dose ICS + LTRA,* and PRN SABA or Daily low-dose ICS + Theophylline* or Zileuton,* and PRN SABA	Daily medium-dose ICS-LABA or daily medium-dose ICS + LAMA,★ and PRN SABA <sup>▲</sup> ★ or Daily medium-dose ICS + LTRA,* or daily medium-dose ICS + Theophylline,* or daily medium-dose ICS + Zileuton,* and PRN SABA	Daily medium-high dose ICS-LABA or daily high-dose ICS + LTRA,* and PRN SABA	
		Steps 2-4: Conditionally recommend the use of subcutaneous immunotherapy as an adjunct treatment to standard pharmacotherapy in individuals ≥ 5 years of age whose asthma is controlled at the initiation, build up, and maintenance phases of immunotherapy <sup>▲</sup>			Consider adding Asthma Biologics (e.g., anti-IgE, anti-IL5, anti-IL4/IL13)**	



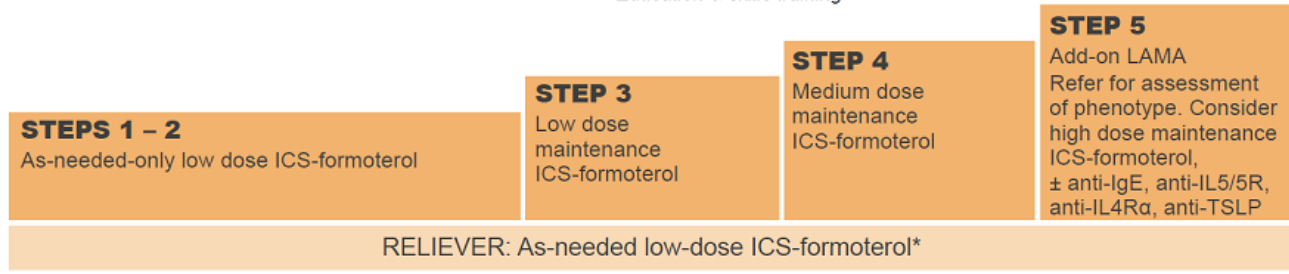
# GINA example: For 12+ years old

## GINA 2023 – Adults & adolescents 12+ years

**Personalized asthma management**  
Assess, Adjust, Review  
for individual patient needs

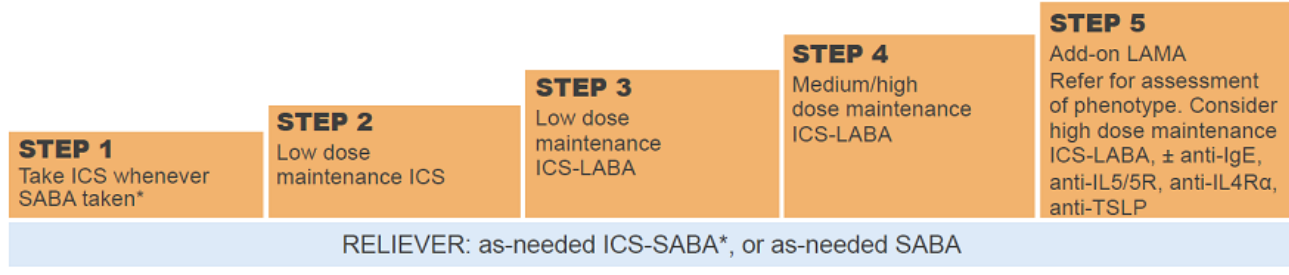


**TRACK 1: PREFERRED CONTROLLER and RELIEVER**  
Using ICS-formoterol as the reliever\* reduces the risk of exacerbations compared with using a SABA reliever, and is a simpler regimen



See GINA severe asthma guide

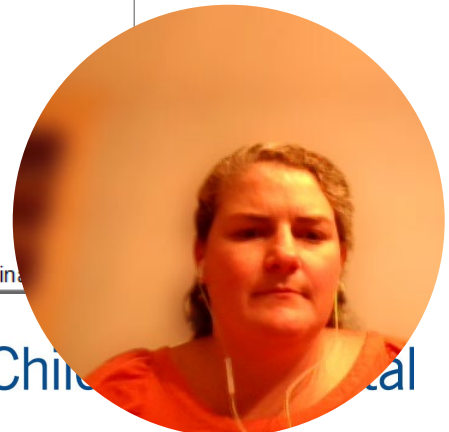
**TRACK 2: Alternative CONTROLLER and RELIEVER**  
Before considering a regimen with SABA reliever, check if the patient is likely to adhere to daily controller treatment



*Other controller options (limited indications, or less evidence for efficacy or safety – see text)*

	Low dose ICS whenever SABA taken*, or daily LTRA, or add HDM SLIT	Medium dose ICS, or add LTRA, or add HDM SLIT	Add LAMA or LTRA or HDM SLIT, or switch to high dose ICS	Add azithromycin (adults) or LTRA. As last resort consider adding low dose OCS but consider side-effects
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\*Anti-inflammatory reliever (AIR)





## How to prescribe low-dose ICS-formoterol in GINA Track 1

Example: budesonide-formoterol 200/6 mcg [160/4.5 delivered dose]

- **Steps 1–2:** take 1 inhalation whenever needed for symptoms
- **Step 3:** take 1 inhalation twice a day (or once a day) PLUS 1 inhalation whenever needed for symptoms
- **Steps 4–5:** take 2 inhalations twice a day PLUS 1 inhalation whenever needed for symptoms
- As-needed doses of ICS-formoterol can also be taken before exercise (*Lazarinis et al, Thorax 2014*) or before allergen exposure (*Duong et al, JACI 2007*)



# Singularair

**FDA requires Boxed Warning about serious mental health side effects for asthma and allergy drug montelukast (Singularair); advises restricting use for allergic rhinitis**

*Risks may include suicidal thoughts or actions*



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## ESTIMATED COMPARATIVE DAILY DOSAGES: INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL

Daily Dose	0-4 years of age			5-11 years of age			≥12 years of age		
	Low	Medium*	High*	Low	Medium*	High*	Low	Medium*	High*
<b>MEDICATION</b>									
<b>Beclomethasone MDI<sup>†</sup></b>	N/A	N/A	N/A	80-160 mcg	>160-320 mcg	>320 mcg	80-240 mcg	>240-480 mcg	>480 mcg
40 mcg/puff				1-2 puffs 2x/day	3-4 puffs 2x/day		1-3 puffs 2x/day	4-6 puffs 2x/day	
80 mcg/puff				1 puff 2x/day	2 puffs 2x/day	≥3 puffs 2x/day	1 puff am, 2 puffs pm	2-3 puffs 2x/day	≥4 puffs 2x/day
<b>Budesonide DPI<sup>†</sup></b>	N/A	N/A	N/A	180-360 mcg	>360-720 mcg	>720 mcg	180-540 mcg	>540-1,080 mcg	>1,080 mcg
90 mcg/inhalation				1-2 inh <sup>†</sup> 2x/day	3-4 inh <sup>†</sup> 2x/day		1-3 inh <sup>†</sup> 2x/day		
180 mcg/ inhalation					2 inh <sup>†</sup> 2x/day	≥3 inh <sup>†</sup> 2x/day	1 inh <sup>†</sup> am, 2 inh <sup>†</sup> pm	2-3 inh <sup>†</sup> 2x/day	≥4 inh <sup>†</sup> 2x/day
<b>Budesonide Nebules</b>	0.25-0.5 mg	>0.5-1.0 mg	>1.0 mg	0.5 mg	1.0 mg	2.0 mg	N/A	N/A	N/A
0.25 mg	1-2 nebs <sup>†</sup> /day			1 neb <sup>†</sup> 2x/day					
0.5 mg	1 neb <sup>†</sup> /day	2 nebs <sup>†</sup> /day	3 nebs <sup>†</sup> /day	1 neb <sup>†</sup> /day	1 neb <sup>†</sup> 2x/day				
1.0 mg		1 neb <sup>†</sup> /day	2 nebs <sup>†</sup> /day		1 neb <sup>†</sup> /day	1 neb <sup>†</sup> 2x/day			
<b>Ciclesonide MDI<sup>†</sup></b>	N/A	N/A	N/A	80-160 mcg	>160-320 mcg	>320 mcg	160-320 mcg	>320-640 mcg	>640 mcg
80 mcg/puff				1-2 puffs/day	1 puff am, 2 puffs pm- 2 puffs 2x/day	≥3 puffs 2x/day	1-2 puffs 2x/day	3-4 puffs 2x/day	
160 mcg/puff				1 puff/day	1 puff 2x/day	≥2 puffs 2x/day		2 puffs 2x/day	≥3 puffs 2x/day
<b>Flunisolide MDI<sup>†</sup></b>	N/A	N/A	N/A	160 mcg	320-480 mcg	≥480 mcg	320 mcg	>320-640 mcg	>640 mcg
80 mcg/puff				1 puff 2x/day	2-3 puffs 2x/day	≥4 puffs 2x/day	2 puffs 2x/day	3-4 puffs 2x/day	≥5 puffs 2x/day

\* It is preferable to use a higher mcg/puff or mcg/inhalation formulation to achieve as low a number of puffs or inhalations as possible

<sup>†</sup> Abbreviations: DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); neb, nebulizer



## ESTIMATED COMPARATIVE DAILY DOSAGES: INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL *(continued)*

Daily Dose	0-4 years of age			5-11 years of age			≥12 years of age		
	Low	Medium*	High*	Low	Medium*	High*	Low	Medium*	High*
<b>MEDICATION</b>									
<b>Fluticasone MDI<sup>†</sup></b>	176 mcg	>176-352 mcg	>352 mcg	88-176 mcg	>176-352 mcg	>352 mcg	88-264 mcg	>264-440 mcg	>440 mcg
44 mcg/puff	2 puffs 2x/day	3-4 puffs 2x/day		1-2 puffs 2x/day	3-4 puffs 2x/day		1-3 puffs 2x/day		
110 mcg/puff		1 puff 2x/day	≥2 puffs 2x/day		1 puff 2x/day	≥2 puffs 2x/day		2 puffs 2x/day	3 puffs 2x/day
220 mcg/puff								1 puffs 2x/day	≥2 puffs 2x/day
<b>Fluticasone DPI<sup>†</sup></b>	N/A	N/A	N/A	100-200 mcg	>200-400 mcg	>400 mcg	100-300 mcg	>300-500 mcg	>500 mcg
50 mcg/inhalation				1-2 inh <sup>†</sup> 2x/day	3-4 inh <sup>†</sup> 2x/day		1-3 inh <sup>†</sup> 2x/day		
100 mcg/inhalation				1 inh <sup>†</sup> 2x/day	2 inh <sup>†</sup> 2x/day	>2 inh <sup>†</sup> 2x/day		2 inh <sup>†</sup> 2x/day	≥3 inh <sup>†</sup> 2x/day
250 mcg/inhalation						1 inh <sup>†</sup> 2x/day		1 inh <sup>†</sup> 2x/day	
<b>Mometasone DPI<sup>†</sup></b>	N/A	N/A	N/A	110 mcg	220-440 mcg	>440 mcg	110-220 mcg	>220-440	
110 mcg/inhalation				1 inh <sup>†</sup> /day	1-2 inh <sup>†</sup> 2x/day	≥3 inh <sup>†</sup> 2x/day	1-2 inh <sup>†</sup> pm	3-4 inh <sup>†</sup> 2 inh <sup>†</sup>	
220 mcg/inhalation					1-2 inh <sup>†</sup> /day	≥3 inh <sup>†</sup> divided in 2 doses	1 inh <sup>†</sup> pm	1 inh <sup>†</sup> 2x 2 inh <sup>†</sup>	

\* It is preferable to use a higher mcg/puff or mcg/inhalation formulation to achieve as low a number of puffs or inhalations as possible

† Abbreviations: DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); reb, nebulizer



**Box 11-3. Low daily doses of inhaled corticosteroids for children 5 years and younger**

**This is not a table of equivalence**, but instead, suggestions for 'low' total daily doses for the ICS treatment recommendations for children aged 5 years and younger in Box 11-2 (p.190), based on available studies and product information. Data on comparative potency are not readily available, particularly for children.

**This table does NOT imply potency equivalence.** For example, if you switch a child's treatment from a 'low' dose of one ICS to a 'low' dose of another ICS, this may represent a decrease (or increase) in potency. The child's asthma may become unstable (or they may be at increased risk of adverse effects).

Children should be monitored to ensure stability after any change of treatment. Doses and potency may also differ by country, depending on local products, inhaler devices, regulatory labelling and clinical guidelines. The doses listed here are the lowest approved doses for which safety and effectiveness have been adequately studied in this age group.

**Low-dose ICS** provides most of the clinical benefit for most children with asthma. Higher doses are associated with an increased risk of local and systemic side-effects, which must be balanced against potential benefits.

Inhaled corticosteroid	Low total daily dose in mcg (age-group with adequate safety and effectiveness data)
BDP (pMDI, standard particle, HFA)	100 (ages 5 years and older)
BDP (pMDI, extrafine particle, HFA)	50 (ages 5 years and older)
Budesonide nebulized	500 (ages 1 year and older)
Fluticasone propionate (pMDI, standard particle, HFA)	50 (ages 4 years and older)
Fluticasone furoate (DPI)	Not sufficiently studied in children 5 years and younger
Mometasone furoate (pMDI, standard particle, HFA)	100 (ages 5 years and older)
Ciclesonide (pMDI, extrafine particle, HFA)	Not sufficiently studied in children 5 years and younger

BDP : beclometasone dipropionate. For other abbreviations see p.11. In children, pMDI should always be used with a spacer

**Box 11-4. Choosing an inhaler device for children 5 years and younger**

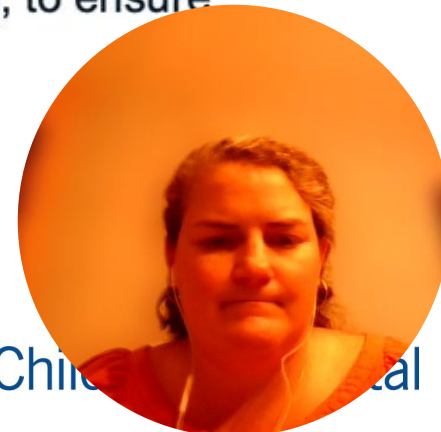
Age	Preferred device	Alternate device
0–3 years	Pressurized metered-dose inhaler plus dedicated spacer with face mask	Nebulizer with face mask
4–5 years	Pressurized metered-dose inhaler plus dedicated spacer with mouthpiece	Pressurized metered-dose inhaler plus dedicated spacer with face mask or nebulizer with mouthpiece or face mask



# Low, medium and high doses of ICS

Inhaled corticosteroid (alone or in combination with LABA)	Total daily ICS dose (mcg) – see notes above		
	Low	Medium	High
<b>Adults and adolescents (12 years and older)</b>			
Beclometasone dipropionate (pMDI, standard particle, HFA)	200–500	>500–1000	>1000
Beclometasone dipropionate (DPI or pMDI, extrafine particle, HFA)	100–200	>200–400	>400
Budesonide (DPI, or pMDI, standard particle, HFA)	200–400	>400–800	>800
Ciclesonide (pMDI, extrafine particle, HFA)	80–160	>160–320	>320
Fluticasone furoate (DPI)		100	200
Fluticasone propionate (DPI)	100–250	>250–500	>500
Fluticasone propionate (pMDI, standard particle, HFA)	100–250	>250–500	>500
Mometasone furoate (DPI)	Depends on DPI device – see product information		
Mometasone furoate (pMDI, standard particle, HFA)	200–400		>400
<b>Children 6–11 years – see notes above (for children 5 years and younger, see Box 11-3, p.191)</b>			
Beclometasone dipropionate (pMDI, standard particle, HFA)	100–200	>200–400	>400
Beclometasone dipropionate (pMDI, extrafine particle, HFA)	50–100	>100–200	>200
Budesonide (DPI, or pMDI, standard particle, HFA)	100–200	>200–400	>400
Budesonide (nebulizer)	250–500	>500–1000	>1000
Ciclesonide (pMDI, extrafine particle*, HFA)	80	>80–160	>160
Fluticasone furoate (DPI)		50	n.a.
Fluticasone propionate (DPI)	50–100	>100–200	>200
Fluticasone propionate (pMDI, standard particle, HFA)	50–100	>100–200	>200
Mometasone furoate (pMDI, standard particle, HFA)	100		200

- This is a table of low, medium and high doses of various ICS
- **It does NOT imply equivalent potency**
- For example, if you switch a patient from a 'medium' dose of one ICS to a 'medium' dose of another ICS, this may represent a *decrease* in potency, so their asthma may worsen, or it might represent an *increase* in potency and the patient may experience more adverse effects
- Always monitor patients after any change in medication, dose or device, to ensure they are stable



## SHORT-ACTING BETA<sub>2</sub>-AGONIST BRONCHODILATORS

relax tight muscles in airways and offer quick relief of symptoms such as coughing, wheezing and shortness of breath for 3-4 hours

<b>Albuterol Sulfate Inhalation Solution</b> 0.43, 1.5, 2.5 mg; 3 mL (A)(N)	<b>ProAir<sup>®</sup> Digihaler<sup>™</sup></b> 90 mcg albuterol sulfate inhalation powder (DM) (A)	<b>ProAir<sup>®</sup> RespiClick<sup>™</sup></b> 90 mcg albuterol sulfate inhalation powder (DM) (A)	<b>Proventil<sup>®</sup> HFA</b> 90 mcg albuterol sulfate (DM) (A)(C)	<b>Ventolin<sup>®</sup> HFA</b> 90 mcg albuterol sulfate (DM) (A)(C)	<b>Xopenex<sup>®</sup></b> 0.51, 0.43, 1.25 mg; 3 mL levalbuterol hydrochloride inhalation solution (A)(C)(N)	<b>Xopenex<sup>®</sup> HFA<sup>™</sup></b> 45 mcg levalbuterol tartrate (A)(C)
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## LONG-ACTING BETA<sub>2</sub>-AGONIST BRONCHODILATORS

relax tight muscles in airways and offer lasting relief of symptoms such as coughing, wheezing and shortness of breath for at least 12 hours

<b>Brevo<sup>®</sup></b> 15 mg; 2 mL arformoterol tartrate inhalation solution (C)(N)	<b>Perforomist<sup>®</sup></b> 20 mcg; 2 mL formoterol fumarate inhalation solution (C)(N)	<b>Serevent<sup>®</sup> Diskus<sup>™</sup></b> 50 mcg salmeterol xinafole inhalation powder (DM) (A)(C)	<b>Striverdi<sup>®</sup> Respimat<sup>™</sup></b> 2.5 mcg vilanterol hydrochloride (DM) (C)
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## INHALED CORTICOSTEROIDS

reduce and prevent swelling of airway tissues; they do not relieve sudden symptoms of coughing, wheezing or shortness of breath

<b>Alvesco<sup>®</sup> HFA</b> 100, 160 mcg budesonide (DM) (A)	<b>ArmonAir<sup>®</sup> Digihaler<sup>™</sup></b> 55, 113, 232 mcg fluticasone propionate inhalation powder (DM) (A)	<b>Arneity<sup>®</sup> Ellipta<sup>™</sup></b> 50, 100, 200 mcg budesonide fumarate inhalation powder (DM) (A)	<b>Asmanex<sup>®</sup> HFA</b> 50, 100, 200 mcg mometasone furoate (DM) (A)	<b>Asmanex<sup>®</sup> Twisthaler<sup>™</sup></b> 110, 220 mcg mometasone furoate inhalation powder (DM) (A)	<b>Fluticasone Propionate Disks Inhalation Powder</b> 50, 100, 250 mcg Approved generic of Flonase Diskus (DM) (A)	<b>Fluticasone Propionate Diskus Inhalation Powder</b> 44, 110, 220 mcg Approved generic of Flonase Diskus (DM) (A)	<b>Pulmicort Flexhaler<sup>™</sup></b> 90, 180 mcg budesonide inhalation powder (DM) (A)	<b>Pulmicort Respules<sup>™</sup></b> 0.25, 0.50, 1.0 mg; 2 mL budesonide inhaler suspension (A)(C)(N)	<b>QVAR<sup>®</sup> Redihaler<sup>™</sup></b> 43, 86 mcg beclomethasone dipropionate (DM) (A)
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## MUSCARINIC ANTAGONISTS (ANTICHOLINERGIC)

relieve cough, sputum production, wheeze and chest tightness associated with chronic lung diseases

<b>Atrovent<sup>®</sup> HFA</b> 17 mcg ipratropium bromide (DM) (C)	<b>Increase<sup>®</sup> Ellipta<sup>™</sup></b> 62.5 mcg aclidinium inhalation powder (DM) (C)	<b>Ipratropium Bromide Inhalation Solution</b> 0.5, 2.5 mg; 2.5 mL (C)(N)	<b>Spiriva<sup>®</sup> HandiHaler<sup>™</sup></b> 18 mcg tiotropium bromide inhalation powder (C)	<b>Spiriva<sup>®</sup> Respimat<sup>™</sup></b> 1.25, 2.5 mcg tiotropium bromide (DM) (A)(C)	<b>Todalza<sup>®</sup> Pressair<sup>™</sup></b> 400 mcg aclidinium bromide inhalation powder (DM) (C)	<b>Yupelri<sup>®</sup></b> 175 mcg, 3 mL tiotropium bromide inhalation solution (C)(N)
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## PDE4 INHIBITORS

target long-acting beta<sub>2</sub>-agonists and reduce exacerbations

<b>Daliresp<sup>®</sup></b> 250, 500 mcg roflumilast (C)
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## COMBINATION MEDICATIONS

contain both inhaled corticosteroid and long-acting beta<sub>2</sub>-agonist (LABA)

<b>Advair Diskus<sup>™</sup></b> 100/50, 250/50, 500/50 mcg fluticasone propionate and salmeterol inhalation powder (DM) (A)(C)	<b>Advair<sup>®</sup> HFA</b> 45/14, 113/14, 232/14 mcg fluticasone propionate and salmeterol xinafole (DM) (A)(C)	<b>AirDuo<sup>®</sup> Digihaler<sup>™</sup></b> 55/14, 113/14, 232/14 mcg fluticasone propionate and salmeterol inhalation powder (DM) (A)	<b>AirDuo<sup>®</sup> RespiClick<sup>™</sup></b> 55/14, 113/14, 232/14 mcg fluticasone propionate and salmeterol inhalation powder (DM) (A)(C)	<b>Breo<sup>®</sup> Ellipta<sup>™</sup></b> 50/25, 100/25, 200/25 mcg fluticasone fumarate and vilanterol inhalation powder (DM) (A)(C)	<b>Breyna<sup>®</sup></b> 80/4.5, 160/4.5 mcg budesonide and formoterol fumarate dihydrate (Approved generic of Symbicort) (DM) (A)(C)	<b>Dulera<sup>®</sup></b> 50/5, 100/5, 200/5 mcg mometasone furoate and formoterol fumarate dihydrate (DM) (A)	<b>Symbicort<sup>®</sup></b> 80/4.5, 160/4.5 mcg budesonide and formoterol fumarate dihydrate (DM) (A)(C)	<b>Wixela<sup>®</sup> Inhub<sup>™</sup></b> 100/50, 250/50, 500/50 mcg fluticasone propionate and salmeterol inhalable approved generic of Advair Diskus/ (DM) (A)(C)
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contains both long-acting beta<sub>2</sub>-agonist (LABA) and long-acting muscarinic antagonist (LAMA)

contains inhaled corticosteroid, long-acting beta<sub>2</sub>-agonist (LABA) and long-acting muscarinic antagonist (LAMA)

contains both short-acting beta<sub>2</sub>-agonist and short-acting muscarinic antagonist

contains inhaled corticosteroid and short-acting beta<sub>2</sub>-agonist (SABA)

<b>Anoro<sup>®</sup> Ellipta<sup>™</sup></b> 62.5/2.5 mcg aclidinium and vilanterol inhalation powder (DM) (C)	<b>Besvespi Aerosphere<sup>™</sup></b> 5/4, 8 mcg glycopyrronium and formoterol fumarate (DM) (C)	<b>Duakir<sup>®</sup> Pressair<sup>™</sup></b> 600, 12 mcg aclidinium bromide and formoterol fumarate (DM) (C)	<b>Stiolto<sup>®</sup> Respimat<sup>™</sup></b> 2.5/2.5 mcg tiotropium bromide and olodaterol (DM) (C)	<b>Trelegy<sup>®</sup> Ellipta<sup>™</sup></b> 200/12.5/2.5 mcg 100/62.5/2.5 mcg fluticasone fumarate, aclidinium and vilanterol inhalation powder (DM) (A)(C)	<b>Breztri Aerosphere<sup>™</sup></b> 160/9/4.8 mcg budesonide, glycopyrronium and formoterol fumarate (DM) (C)	<b>Combivent<sup>®</sup> Respimat<sup>™</sup></b> 20/100 mcg ipratropium bromide and albuterol (DM) (C)	<b>Ipratropium Bromide and Albuterol Sulfate Inhalation Solution</b> 2.5 mg; 3 mL (C)(C)	<b>AirSupra<sup>®</sup></b> 60, 90 mcg budesonide and vilanterol (DM) (A)
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## BIOLOGICS

target cells and pathways that cause airway inflammation; delivered by injection or IV

<b>Cinqair<sup>®</sup></b> 62.5/25 mL reslizumab (A)	<b>Dupixent<sup>®</sup></b> 100, 200, 300 mg dupilumab (A)	<b>Fasenra<sup>®</sup></b> 30 mg benralizumab (A)	<b>Necala<sup>®</sup></b> 210 mg mepolizumab (A)	<b>Tezspire<sup>®</sup></b> 210 mg tezepelumab-ekko (A)	<b>Xolair<sup>®</sup></b> 75 to 375 mg omalizumab (A)
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## LEUKOTRIENE MODIFIERS

block chemicals called leukotrienes that cause inflammation; available as tablet or granules

<b>Singulair<sup>®</sup></b> 4, 5, 10 mg montelukast (A)	<b>Zafirlukast<sup>®</sup></b> 10, 20 mg zafirlukast (A)	<b>Zyflo CR<sup>®</sup></b> 600 mg zileuton (A)
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- Can't talk about asthma without stressing the importance of using with a spacer!



**Akron Children's Hospital**  
www.akronchildrens.org

**Asthma Treatment Plan for** Test Patient ACHP  
Last Updated/Reviewed on: 5/22/2018 5:33 AM  
Whom to call for questions about your Asthma: ACHP - HUDSON  
(330-342-5555)

Asthma Triggers may include: cigarette smoke, mold, other, dust  
A flu shot is recommended, in the fall, for all children with asthma and their families.

**Every Day Treatment and Physical Activity**

- Breathing is easy
- No cough or wheeze
- Can work and play

Take all of these medicines every day.  
- QVAR 40 Redihaler (beclomethasone) - 1 puff - Inhalation - daily

- Physical Activity Plan: with exercise/recess/sports or other physical activity: 15 minutes before the activity take ALBUTEROL Inhaler - 2 puffs - Inhalation

**Asthma Is Getting Worse**

- Increased cough or wheeze
- Tight chest
- Shortness of breath
- Wake up at night
- First sign of getting a cold

If Patient is getting worse, have Patient take all the every day medications and also take this rescue medicine  
- ALBUTEROL Inhaler - 2 puffs - Inhalation - Right away

- Wait 15 minutes and see if the treatment(s) helped
- If no improvement, repeat rescue medicine and continue every 4 hours as needed for 1-2 days, call the healthcare provider if not getting better
- If BETTER, continue rescue medicine every 4-6 hours as needed

**Emergency**

- Rescue medicine does not help
- Breathing is hard and fast
- Ribs or neck muscles show when breathing in
- Can't walk or talk well
- Feeling very scared

If Patient continues to worsen, have Patient take this rescue medicine:  
- XOPENEX Inhaler (Levalbuterol) - 4 puffs - Inhalation - Right away and repeat every 15mins for 2 more doses

- Wait 15 minutes and see if the treatment(s) helped
- If GETTING WORSE or NOT IMPROVING, go to the hospital or call 9-1-1 as this could be a life threatening emergency!
- If BETTER, continue rescue medicine every 4-6 hours as needed and call your healthcare provider for advice

RE: ACHP, Test Patient - MR# 12345678 - DOB 01/01/2000 Page 1 of 1

# Asthma Treatment Plan

- Should be provided at during all visits
- Directions for reliever medications and rescue actions
- Directions for preventive medications
- Triggers to avoid
- **Plans for follow-up** including provider/office name and time frame/date
- Also give school version for all kids in school/daycare: **typically use the first option for combined letter and school ATP**
- **SMART, intermittent ICS, step-up therapies now available as Alternate Therapies**



# Asthma Education: Why does it matter?

- **Know which medication to use when and appropriate technique**
- 42% of inpatient pediatric asthmatics missed a critical step in inhaler use –Samady et al 2019
- More than 1/3 of patients missed appropriate breathing
- More than 10% did not remove cap
- Those with prior inpatient education or  $\geq 2$  prior admissions did better, but  $\frac{1}{4}$  still missed a critical step





# Follow up



Akron Children's Hospital



## FOLLOW-UP VISITS: ASSESSING ASTHMA CONTROL AND ADJUSTING THERAPY

Level of control (Columns 2–4) is based on the most severe component of impairment (symptoms and functional limitations) or risk (exacerbations). Assess impairment by patient's or caregiver's recall of events listed in Column 1 during the previous 2–4 weeks and by spirometry and/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. Assess risk by recall of exacerbations during the previous year and since the last visit. Recommendations for adjusting therapy based on level of control are presented in the last row.

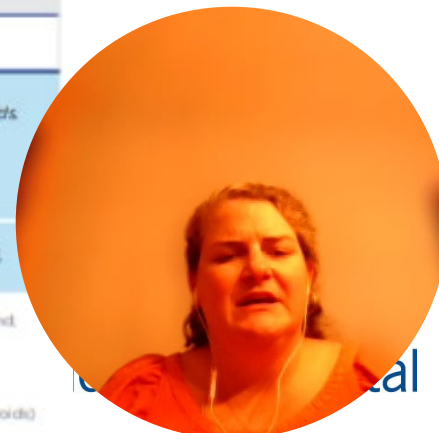
Components of Control		Well Controlled			Not Well Controlled			Very Poorly Controlled		
		Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years	Ages 0–4 years	Ages 5–11 years	Ages ≥12 years
Impairment	Symptoms	≤2 days/week	≤2 days/week but not more than once on each day	≤2 days/week	>2 days/week	>2 days/week or multiple times on ≤2 days/week	>2 days/week	Throughout the day		
	Nighttime awakenings	≤1x/month		≤2x/month	>1x/month	≥2x/month	1–3x/week	>1x/week	≥2x/week	≥4x/week
	Interference with normal activity	None			Some limitation			Extremely limited		
	SABA* use for symptom control (not to prevent EIB*)	≤2 days/week			>2 days/week			Several times per day		
	Lung function → FEV <sub>1</sub> * (% predicted) or peak flow (% personal best) → FEV <sub>1</sub> /FVC*	Not applicable	>80%	>80%	Not applicable	60–80%	60–80%	Not applicable	<60%	<60%
	Validated questionnaires <sup>†</sup> → ATAQ* → ACQ* → ACT*	Not applicable	Not applicable	0 ≤0.75 <sup>‡</sup> ≥20	Not applicable	Not applicable	1–2 ≥1.5 16–19	Not applicable	Not applicable	3–4 Not applicable ≤15
	Asthma exacerbations requiring oral systemic corticosteroids <sup>§</sup>	0–1/year			2–3/year	≥2/year		>3/year	≥2/year	
Risk	<i>Consider severity and interval since last asthma exacerbation.</i>									
	Reduction in lung growth/Progressive loss of lung function	Not applicable	Evaluation requires long-term follow-up care.		Not applicable	Evaluation requires long-term follow-up care.		Not applicable	Evaluation requires long-term follow-up care.	
	Treatment-related adverse effects	<i>Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.</i>								
<b>Recommended Action for Treatment</b> (See "Stepwise Approach for Managing Asthma-Long Term," page 7) The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual/patient needs.		Maintain current step. Regular follow-up every 1–6 months. Consider step down if well controlled for at least 3 months.			Step up 1 step	Step up at least 1 step	Step up 1 step	Consider short course of oral systemic corticosteroids. Step up 1–2 steps. Reevaluate in 2 weeks to achieve control.		
					Reevaluate in 2–6 weeks to achieve control. For children 0–4 years, if no clear benefit observed in 4–6 weeks, consider adjusting therapy or alternative diagnoses.					
					Before step up in treatment: Review adherence to medication, inhaler technique, and environmental control. If alternative treatment was used, discontinue and use preferred treatment for that step. For side effects, consider alternative treatment options.					

\* Abbreviations: ACQ, Asthma Control Questionnaire; ACT, Asthma Control Test; ATAQ, Asthma Therapy Assessment Questionnaire; EIB, exercise-induced bronchospasm; FVC, forced vital capacity; FEV<sub>1</sub>, forced expiratory volume in 1 second; SABA, short-acting beta<sub>2</sub>-agonist.

<sup>†</sup> Minimal important difference: 1.0 for the ATAQ, 0.5 for the ACQ; not determined for the ACT.

<sup>‡</sup> ACQ values of 0.75–1.4 are indeterminate regarding well-controlled asthma.

<sup>§</sup> Data are insufficient to link frequencies of exacerbations with different levels of asthma control. Generally, more frequent and intense exacerbations (e.g., requiring urgent care, hospital or intensive care admission, and/or oral corticosteroids) indicate poorer asthma control.



# First – Establish Adherence

- Are they taking their medications?
- Are they taking it with a Spacer?
- Are they taking it correctly?



# Are You Still Sure It's Asthma?

TABLE 6 Diseases which can masquerade as severe asthma

## Children

- Dysfunctional breathing/vocal cord dysfunction
- Bronchiolitis
- Recurrent (micro)aspiration, reflux, swallowing dysfunction
- Prematurity and related lung disease
- Cystic fibrosis
- Congenital or acquired immune deficiency
- Primary ciliary dyskinesia
- Central airways obstruction/compression
- Foreign body
- Congenital malformations including vascular ring
- Tracheobronchomalacia
- Carcinoid or other tumour
- Mediastinal mass/enlarged lymph node
- Congenital heart disease
- Interstitial lung disease
- Connective tissue disease

## Adults

- Dysfunctional breathlessness/vocal cord dysfunction
- Chronic obstructive pulmonary disease
- Hyperventilation with panic attacks
- Bronchiolitis obliterans
- Congestive heart failure
- Adverse drug reaction (e.g. angiotensin-converting enzyme inhibitors)
- Bronchiectasis/cystic fibrosis
- Hypersensitivity pneumonitis
- Hypereosinophilic syndromes
- Pulmonary embolus
- Herpetic tracheobronchitis
- Endobronchial lesion/foreign body (e.g. amyloid, carcinoid)
- Allergic bronchopulmonary aspergillosis
- Acquired tracheobronchomalacia
- Churg-Strauss syndrome



# Asthma Exacerbation

As much as we try, some kiddo's still get hospitalized for their asthma...



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# Treatment of Asthma Exacerbation

- It's easy! Albuterol and steroids (and sometimes oxygen)
- NHLBI Guidelines Goals:
  - Correct significant hypoxemia
  - Rapid reversal of airflow obstruction
  - Intensify therapy to reduce relapse and return of airflow obstruction
  - Teach signs/symptoms for recognition and give home asthma action plan



# Asthma Treatment with Systemic Steroids: Prednisone

- Systemic corticosteroid to decrease airway inflammation:
  - Prednisone (oral pill)
  - Prednisolone (Orapred or Prelone oral liquid)
  - Methylprednisolone (Solumedrol IV)
- **No benefit** to IV over oral if tolerating oral intake
- **2mg/kg/DAY divided BID** is recommendation for inpatients to max of **60mg total per day** (PICU will dose higher)
  - Once-daily dosing is also fine – no difference in outcomes
- Usual: 5 day burst for those needing inpatient therapy
  - Occasionally 3 day burst for those with milder exacerbations
- Prolonged course needed for more severe
- Taper needed when multiple recent courses or prolonged course



# Asthma Treatment with Systemic Steroids: Dexamethasone

- Dexamethasone compared to Prednisone
- Studies suggest **equally effective** with benefit of fewer doses and improved compliance (not yet studied for critically ill patients)
- **0.6mg/kg to max of 16mg once daily for 1-2 days**
- Can use IV form orally
- Can dispense second dose from our ED to use as crushed tablet
- Typically used inpatient if started in ED, giving second dose prior to discharge
- **Difficult to find liquid in outpatient pharmacies except for very oral formulation**





# Oral Corticosteroids

- Of note, GINA 2024 guidelines have new updates on oral Corticosteroid max based on age...

## *Oral corticosteroids*

For children with severe exacerbations, a dose of OCS equivalent to prednisolone 1–2 mg/kg/day, with a maximum of 20 mg/day for children under 2 years of age and 30 mg/day for children aged 2–5 years, is currently recommended (Evidence A),<sup>862</sup> although several studies have failed to show any benefits when given earlier (e.g., by parents or caregivers) during periods of worsening wheeze managed in an outpatient setting (Evidence D).<sup>846-849,863,864</sup> A meta-analysis demonstrated a reduced risk of hospitalization when oral corticosteroids were administered in the emergency department, but no clear benefit in risk of hospitalization when given in the outpatient setting.<sup>865</sup> A course of 3–5 days is sufficient in most children of this age, and can be stopped without tapering (Evidence D), but the child must be reviewed after discharge (as below) to confirm they are recovering.

In children discharged from the emergency department, an intramuscular corticosteroid may be an alternative to a course of OCS for preventing relapse,<sup>760</sup> but the risk of long-term adverse effects must be considered. There is insufficient evidence to recommend intramuscular over oral corticosteroids.<sup>760</sup>

Regardless of treatment, the severity of the child's symptoms must be carefully monitored. The sooner therapy is started in relation to the onset of symptoms, the more likely it is that the impending exacerbation may be clinically attenuated or prevented.



# Asthma Treatment: SABA [short acting beta agonist] Albuterol

- Decrease airway smooth muscle constriction
  - Bronchodilators (albuterol)
    - MDI **preferred** method over nebulized on floor due to efficiency and reinforcement of technique with family
    - Option for either MDI or nebulized as part of pathway
    - Nebulizer typically preferred in ED due to those with severe symptoms
    - Less frequent doses as patient improves
- Supportive care
  - Oxygen for persistent hypoxemia (typically below 90%)
- Frequent assessments
  - Patients may rapidly change



# Initial Status Asthmaticus: Emergency Treatment

- 3 back-to-back albuterol/ipratropium treatments or continuous albuterol with ipratropium added in
- Duonebs used here (2.5mg albuterol/0.5mg ipratropium)
- Continuous albuterol dose 0.5-1mg/kg/hr rounding to the nearest 5mg/hr (5-20mg/hr)
- Steroids given early
- Oxygen as needed



# Adjunctive Therapies for Severe

- IV Magnesium
- High flow nasal canula
- IM Epinephrine
- IV Terbutaline
- Heliox
- Respiratory Support-Intubation



# Assessing overall asthma control

- **Classifying the severity** of asthma should happen at every admission per NHLBI guidelines (mild intermittent, mild persistent, moderate persistent, severe persistent)
- **Controller medications** (typically inhaled corticosteroids) should be started during admission for **ALL persistent asthmatics**
- Adjusting dose up should be done for those in poor control already on a controller
- Referral to asthma specialist per NHLBI guidelines (listed in order)



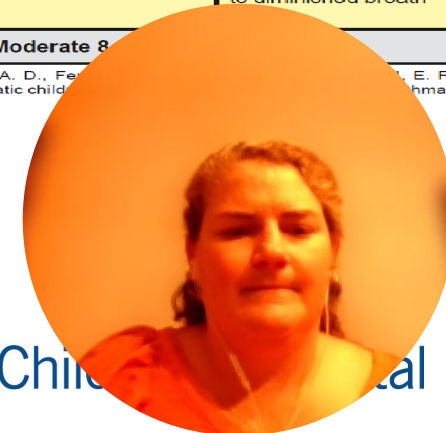
# Pathway and PAS

- Standardizes care using the evidence to reduce unnecessary variation with a series of timed **assessments** using a standardized pediatric asthma score (PAS) to base decisions about treatments
- The Pediatric Asthma Score (PAS) is.....
- One of several standardized asthma scales which was developed by Kelly et al., (2000) and adapted for use to assess the pediatric patient.
- Score between 5-15 based on RR, oxygen requirement, retractions, dyspnea, auscultation
- Used in the asthma pathway and order sets to help drive and determine therapy and interventions at Akron Children's using a common language
  - ED, Acute Care, PICU, Transport (and even some EMS)
- Some criteria are subjective so may not have best inter-rater reliability
- Does not assess underlying control of asthma at baseline

Pediatric Asthma Scale (PAS)

	1	2	3
Respiratory Rate 1-3 years 4-5 years 6-12 years >12 years	≤34 ≤30 ≤26 ≤23	35-39 31-35 27-30 24-27	≥40 ≥36 ≥31 ≥28
Oxygen Requirement	>95% on room air	90-95% on room air	<90% on room air or requiring any amount of O <sub>2</sub>
Retractions	None or intercostal	Intercostal and substernal OR nasal flaring (infants)	Intercostal, substernal, and supraclavicular OR nasal flaring and head bobbing (infants)
Dyspnea 1-4 years	Normal feeding, vocalization, and play	Decreased appetite, coughing after play, hyperactivity	Stops eating or drinking, stops playing, OR drowsy and confused and/or grunting
Dyspnea ≥5 years	Counts to ≥10 in one breath OR speaks in complete sentences	Counts to 4-6 in one breath OR speaks in partial sentences	Counts to ≤3 in one breath OR speaks in single words OR grunts
Auscultation	Normal breath sounds, end expiratory wheezes	Expiratory wheezing	Inspiratory and expiratory wheezing to diminished breath
<b>Total PAS</b>	<b>Mild 5-7</b>	<b>Moderate 8-11</b>	<b>Severe 12-15</b>

Adapted from: Kelly, C. S., Anderson, C. L., Wenger, A. D., Fein, R. E., & Finkelstein, E. F. (2000). Improved outcomes for hospitalized asthmatic children. *Pediatrics*, 106, 103-108. *Journal of Allergy, and Immunology*, 84, 509-516.

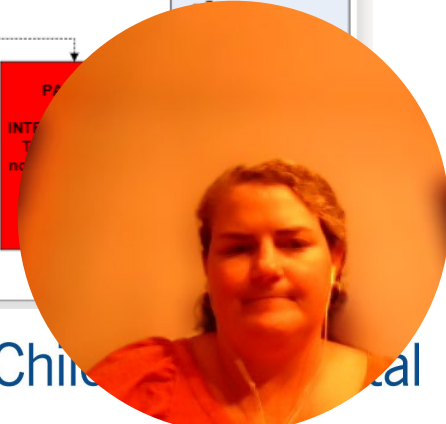
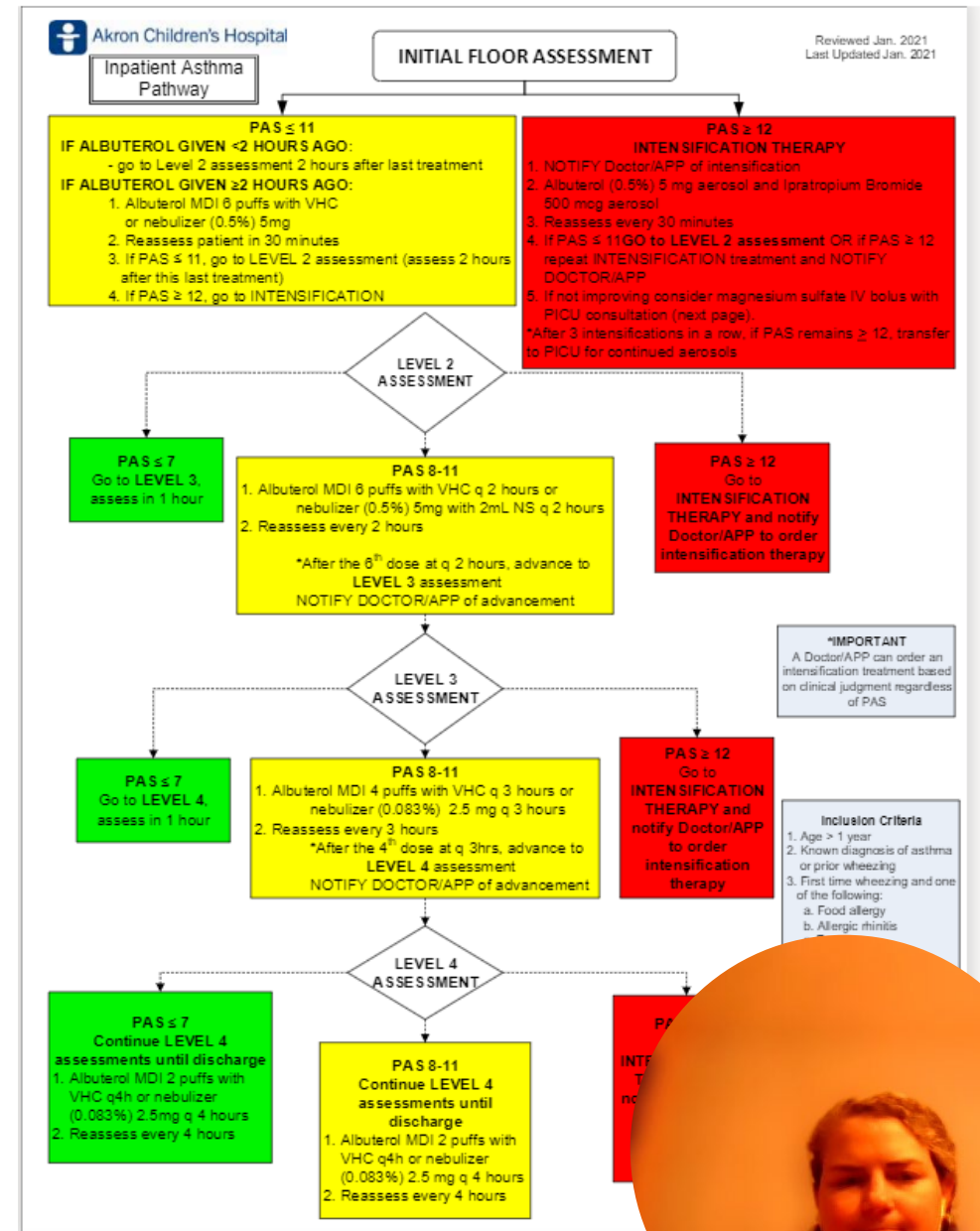


# Inpatient Asthma Pathway

- ▶ **Timed series of standardized assessments**
  - Assessment by PAS (Pediatric Asthma Score)
- ▶ **Treatments and assessments are based on PAS**

Depending on the PAS score:

  - No treatment may be needed
  - Treatment may be needed or
  - More aggressive treatment needed
- ▶ **Medication must be administered properly**
- ▶ **Family education**



# Follow up after Hospitalization

- Should happen within a week of discharge with close follow up to monitor response to adjustment in asthma therapy





Questions?



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