



Bronchial Asthma in Children

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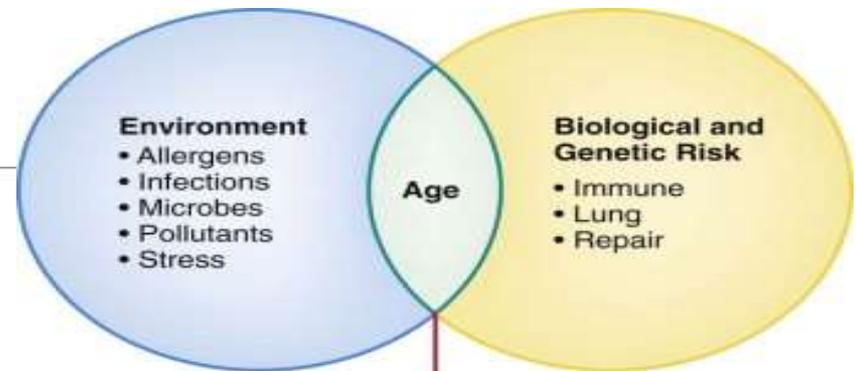
Definition of Asthma

- A chronic inflammatory disease of the airways with the following clinical features:
 - Episodic and/or chronic symptoms of airway obstruction
 - Bronchial hyperresponsiveness to triggers
 - Evidence of at least partial reversibility of the airway obstruction
 - Alternative diagnoses are excluded

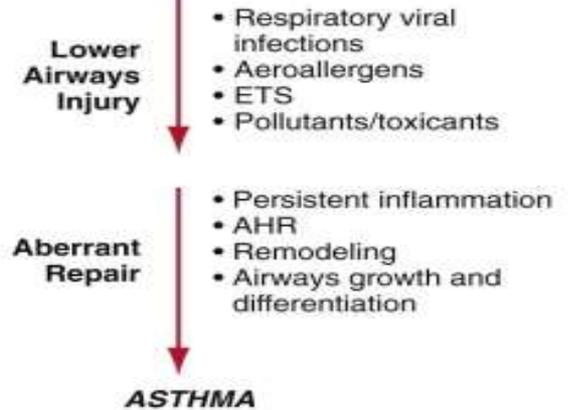


Etiology

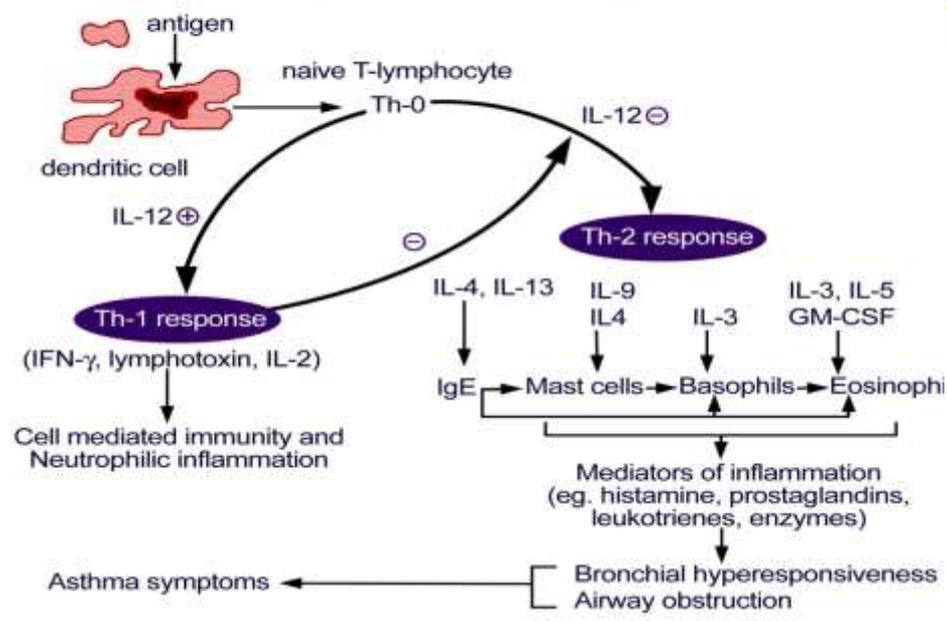
- Although the cause of childhood asthma has **not been determined**, contemporary research implicates a combination of
- **Environmental exposures and**
- **Inherent biologic and**
- **Genetic vulnerabilities .**



Innate and Adaptive Immune Development (Atopy)

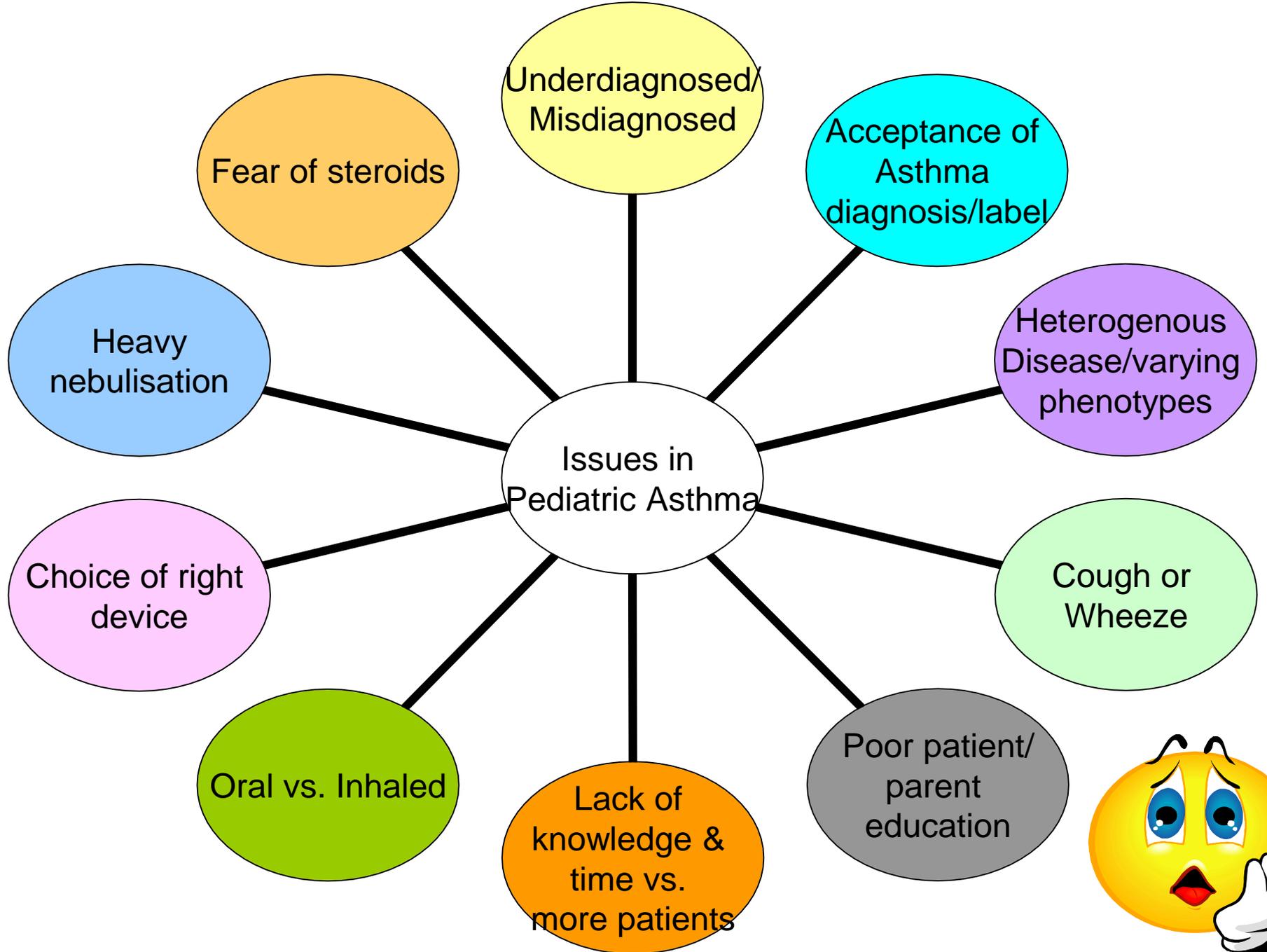


Pathogenesis of asthma



Epidemiology

- **Asthma** is a common chronic disease, causing considerable **morbidity**.
- In **2007**, 9.6 million children (13.1%) had been diagnosed with asthma in their lifetimes.
- **Boys** (14% vs 10% girls) and children in **poor** families (16% vs 10% not poor) are more likely to have asthma.
- Approximately **80%** of all asthmatic patients report disease onset prior to **6 yr of age**.



Types of Childhood Asthma

- There are 2 main types of childhood asthma:
- **(1) recurrent wheezing** in early childhood, primarily triggered by common viral infections of the respiratory tract, and
- **(2) chronic asthma** associated with allergy that persists into later childhood and often adulthood.
- A 3rd type of childhood asthma typically emerges in females who experience obesity and early-onset puberty (by 11 yr of age).

Pathogenesis

- **Airflow obstruction** in asthma is the result of numerous pathologic processes. bronchoconstriction of bronchiolar smooth muscular bands restricts or blocks airflow.
- A cellular **inflammatory** infiltrate and exudates distinguished by **eosinophils**,
- but also including other inflammatory cell types (neutrophils, monocytes, lymphocytes, mast cells, basophils),
- **Helper T** lymphocytes and
- other immune cells that produce proallergic, proinflammatory **cytokines** (IL-4, IL-5, IL-13),
- and **chemokines** (eotaxin) mediate this inflammatory process.

Clinical Manifestations and Diagnosis

- Intermittent dry **coughing**
- expiratory **wheezing**
- **shortness of breath and chest tightness**
- Intermittent, nonfocal chest pain.
- Respiratory symptoms can be worse at **night**
- **Daytime symptoms**, often linked with physical activities or play.
- limitation of physical activities, general fatigue.

Wheezing—Asthma?

- Wheezing with upper respiratory infections is very common in small children, but:
 - Many of these children will not develop asthma.
 - Asthma medications may benefit patients who wheeze whether or not they have asthma.

All that wheezes is not asthma.

Cough—Asthma?

- Consider asthma in children with:
 - Recurrent episodes of cough with or without wheezing
 - Nocturnal awakening because of cough
 - Cough that is associated with exercise/play

Cough may be the only symptom present in patients with asthma.

Typical features of Asthma

- Afebrile episodes
- Personal atopy (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, food allergies),
- Family history of atopy or asthma
- Nocturnal Exacerbations.
- Exercise /Activity induced symptoms
- Trigger Induced Symptoms
- Seasonal exacerbations
- Relief with bronchodilators.

Asthma Predictive Index

- Identify high risk children (2 and 3 years of age):
 - ≥ 4 wheezing episodes in the past year

PLUS

- One major criterion
 - Parent with asthma
 - Atopic dermatitis
 - Aero-allergen sensitivity

OR

- Two minor criteria
 - Food sensitivity
 - Peripheral eosinophilia ($\geq 4\%$)
 - Wheezing not related to infection

On examination

- expiratory wheezing
- prolonged expiratory phase
- Decreased breath sounds in some of the lung fields.
- **Crackles** (or rales) and rhonchi.
- The combination of segmental crackles and poor breath sounds can indicate **lung segmental atelectasis**.
- **In severe exacerbations**, features of respiratory distress, with inspiratory and expiratory wheezing, increased prolongation of exhalation, poor air entry.
- **In extremis**, airflow may be so limited that wheezing cannot be heard .

investigations

- **Lung function tests** can help to confirm the diagnosis of asthma and to determine disease severity.
- **Spirometry** is helpful as an objective measure of airflow limitation.usually feasible in **children > 6 yr of age.**

- **Peak expiratory flow (PEF) monitoring** devices provide simple and inexpensive home-use tools to measure airflow and can be helpful in a number of circumstances.
- **Radiology;** The findings of chest radiographs in children with asthma often appear to be normal, aside from subtle and nonspecific findings of hyperinflation (flattening of the diaphragms) and peribronchial thickening. Also complications and co morbidities can be looked.
- Other tests, such as allergy testing to assess sensitization to inhalant allergens, help with the management and prognosis of asthma.



Lung function tests in Asthma

Spirometry (in clinic):

Airflow limitation:

- Low FEV₁ (relative to percentage of predicted norms)
- FEV₁/FVC ratio <0.80

Bronchodilator response (to inhaled β-agonist):

- Improvement in FEV₁ ≥12% and ≥200 mL*

Exercise challenge:

- Worsening in FEV₁ ≥15%*

Daily peak flow or FEV1 monitoring: day to day and/or am-to-pm variation ≥20%*

FEV₁, forced expiratory volume in 1 sec; FVC, forced vital capacity.

* MAIN criteria consistent with asthma.

The Causes of Asthma exacerbations

- The causes or **inducers** of asthma is very different to what may **trigger** asthma.

Inducers

- **Inducers causes both of the airway to be inflamed and the airway hyper-responsive.**
- **The symptoms that cause induces often last longer.**
- A common form of inducers is allergens. Inhalant allergens are the most important inducer.
- Exposure to any allergen may cause inflammation after a **7-8 hours**.
- **Because inflammation occurs so slowly it is often impossible for the physician to identify the asthma attack.**

The common inhaled allergens are:

Pollen – from grass, tress and weeds

Animal – common household pets such as cats and dogs furs

Molds

Household dust and mites

Triggers

- Triggers is when the airway become irritated and tightening and as a result causes bronchoconstriction.
- **Triggers do not cause inflammation.**
- The symptoms and bronchoconstriction caused by triggers then are immediate and short lived.
- If inflammation is already present the airway will react more quickly to triggers.

| The common triggers of bronchoconstriction include everyday stimuli such as: | | |
|--|---|-------------------|
| Smoke – from cigarette or factory | Cold Air | Exercise |
| Strong Fumes – from cars, truck or factory | Dust | Inhaled irritants |
| Chemicals in the air or in food | Viral infections, such as the common cold | Emotional upsets |

Treatment

- **Management** of asthma should have the following components:
- (1) assessment and monitoring of disease activity;
- (2) education to enhance the patient's and family's knowledge and skills for self-management;
- (3) identification and management of precipitating factors and co-morbid conditions that may worsen asthma; and
- (4) appropriate selection of medications to address the patient's needs.
- **The long-term goal of asthma management is attainment of optimal asthma control.**

In general ???

❖ There are two main types of drugs used for treating asthma.

☐ Medications to reduce bronchoconstrictions:

- Beta 2 Agonist
- Anticholinergics
- Theophylline

☐ Medications to reduce inflammations:

- Steroids (oral, Parenteral & Inhalers)
- Not steroids:
 - **Leukotriene modifiers** (montelukast is available worldwide; zafirlukast is mentioned only in NAEPP and pranlukast only in Japanese Guideline for Childhood Asthma, 2008 (JGCA).
 - **Cromolyn & Nedocromil** (Reduction of mast cell degranulation)

Treatment

Farther more ???

□ Long-term control medications:

- **Corticosteroids (mainly ICS, occasionally OCS).**
- **Long Acting Beta Agonists (LABA's)** including salmeterol and formoterol,
- **Leukotriene Modifiers (LTM)**
- **Cromolyn & Nedocromil**
- **Methylxanthines: (Sustained-release theophylline)**

□ Quick- relief medications:

- **Short acting Beta Agonists (SABA's)**
- **Systemic corticosteroids**
- **Anticholinergics**

- **Classifying Asthma Severity** into **intermittent, mild, moderate, or severe persistent** asthma depending on symptoms of impairment and risk
- Once classified, use the **6 steps** depending on the severity to obtain asthma control with the lowest amount of medication
- **Controller medications** should be considered if:
 - **>4 exacerbations/year,**
 - **2 episodes of oral steroids in 6 months, or**
 - **use of SABA's (salbutamol) more than twice a week**

FDA Approved Therapies

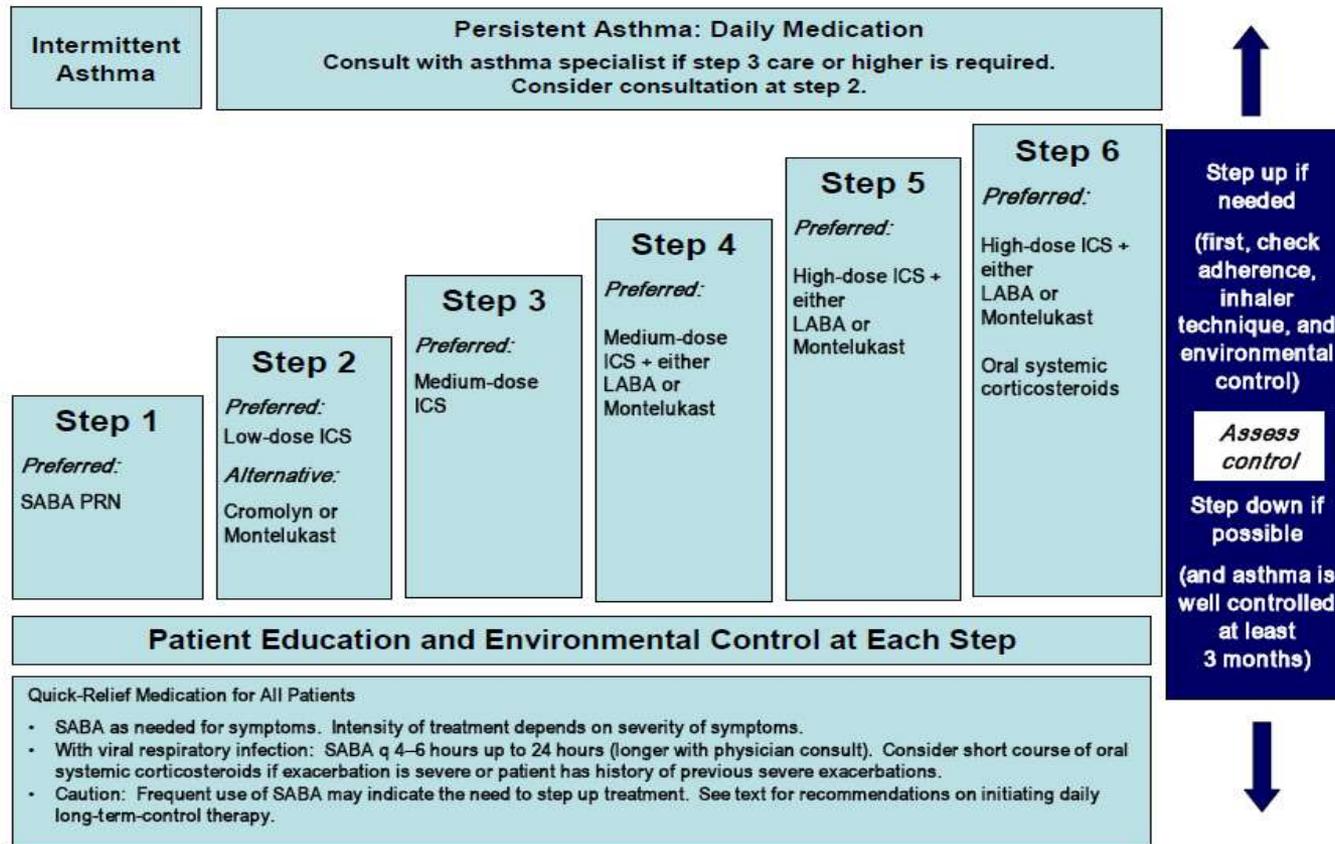
- ICS budesonide nebulizer solution (**1-8 years**)
- ICS fluticasone DPI (**4 years of age and older**)
- LABA and LABA/ICS combination DPI and MDI (**4 years of age and older**)
- Montelukast chewables (**2-4 years**), granules (**down to 1 year of age**)
- Cromolyn sodium nebulizer (**2 years and older**)

Classifying Asthma Severity and Initiating Treatment in Children 0 to 4 Years of Age

| Components of Severity | | Classification of Asthma Severity (0–4 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 | 0 | 1–2x/month | 3–4x/month | >1x/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 |
| Risk | Exacerbations requiring oral systemic corticosteroids | 0–1/year | ≥2 exacerbations in 6 months requiring oral systemic corticosteroids, or ≥4 wheezing episodes/1 year lasting >1 day AND risk factors for persistent asthma | | |
| | | <p style="text-align: center;">← Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time. →</p> <p style="text-align: center;">Exacerbations of any severity may occur in patients in any severity category.</p> | | | |
| Recommended Step for Initiating Therapy | | Step 1 | Step 2 | Step 3 and consider short course of oral systemic corticosteroids | |
| (See figure 4–1a for treatment steps.) | | In 2–6 weeks, depending on severity, evaluate level of asthma control that is achieved. If no clear benefit is observed in 4–6 weeks, consider adjusting therapy or alternative diagnoses. | | | |

Adapted from: National Asthma Education and Prevention Program. *Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma*. US Department of Health and Human Services. Available at: <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf>. Accessed July 5, 2012

Stepwise Approach for Managing Asthma in Children 0 to 4 Years of Age

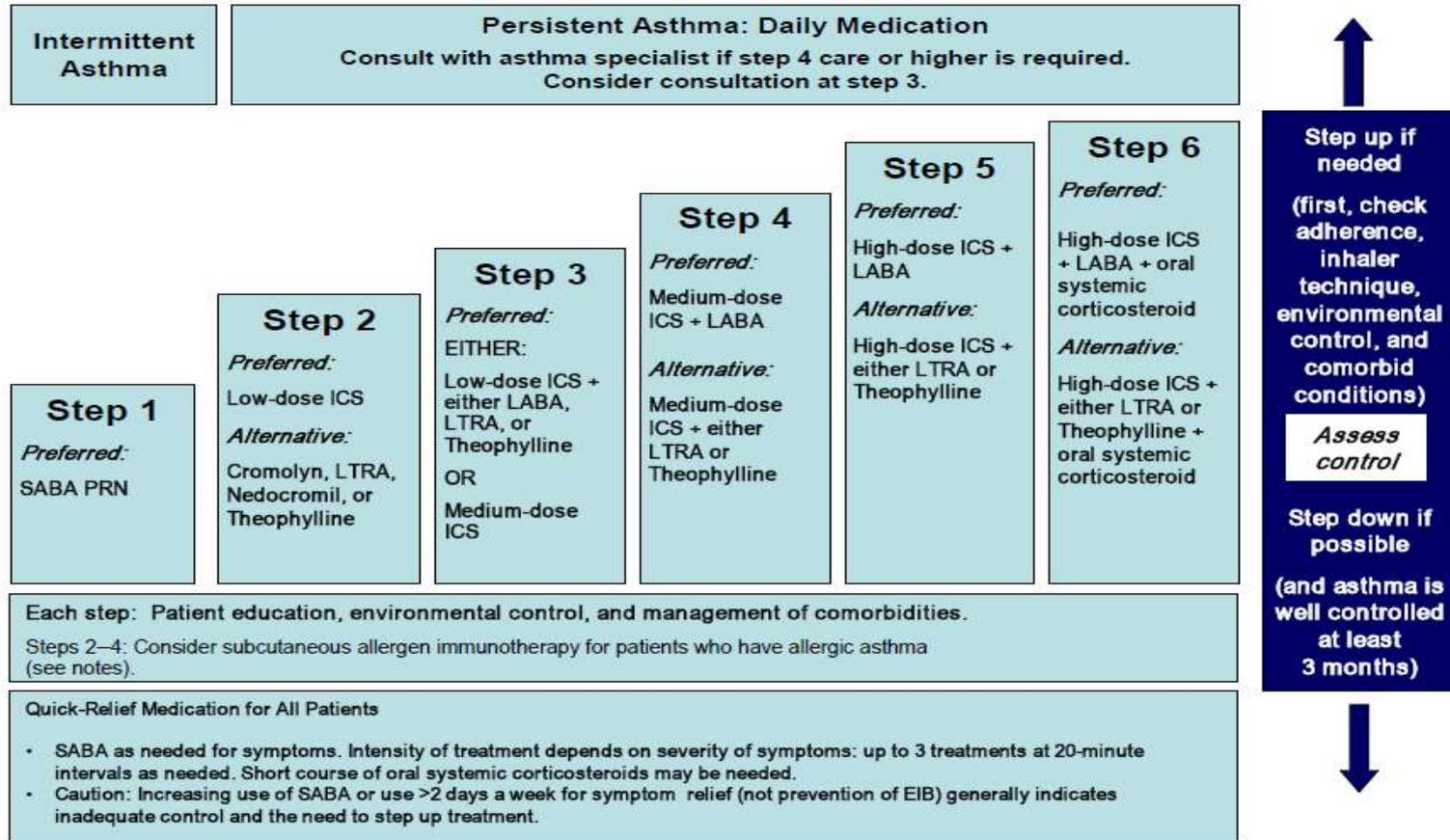


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Classifying Asthma Severity and Initiating Treatment in Children 5 to 11 Years of Age

| Components of Severity | | Classification of Asthma Severity (5–11 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 | ≤2x/month | 3–4x/month | >1x/week but not nightly | Often 7x/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 = 60–80% predicted • FEV₁/FVC = 75–80% | <ul style="list-style-type: none"> • FEV₁ <60% predicted • FEV₁/FVC <75% |
| Risk | Exacerbations requiring oral systemic corticosteroids | 0–1/year (see note) | ≥2/year (see note)  | | |
| | | ← 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 FEV ₁ . | | | |
| Recommended Step for Initiating Therapy | | Step 1 | Step 2 | Step 3, medium-dose ICS option | Step 3, medium-dose ICS option, or step 4 |
| (See figure 4–1b for treatment steps.) | | In 2–6 weeks, evaluate level of asthma control that is achieved, and adjust therapy accordingly. | | | |

Stepwise Approach for Managing Asthma in Children 5 to 11 Years of Age

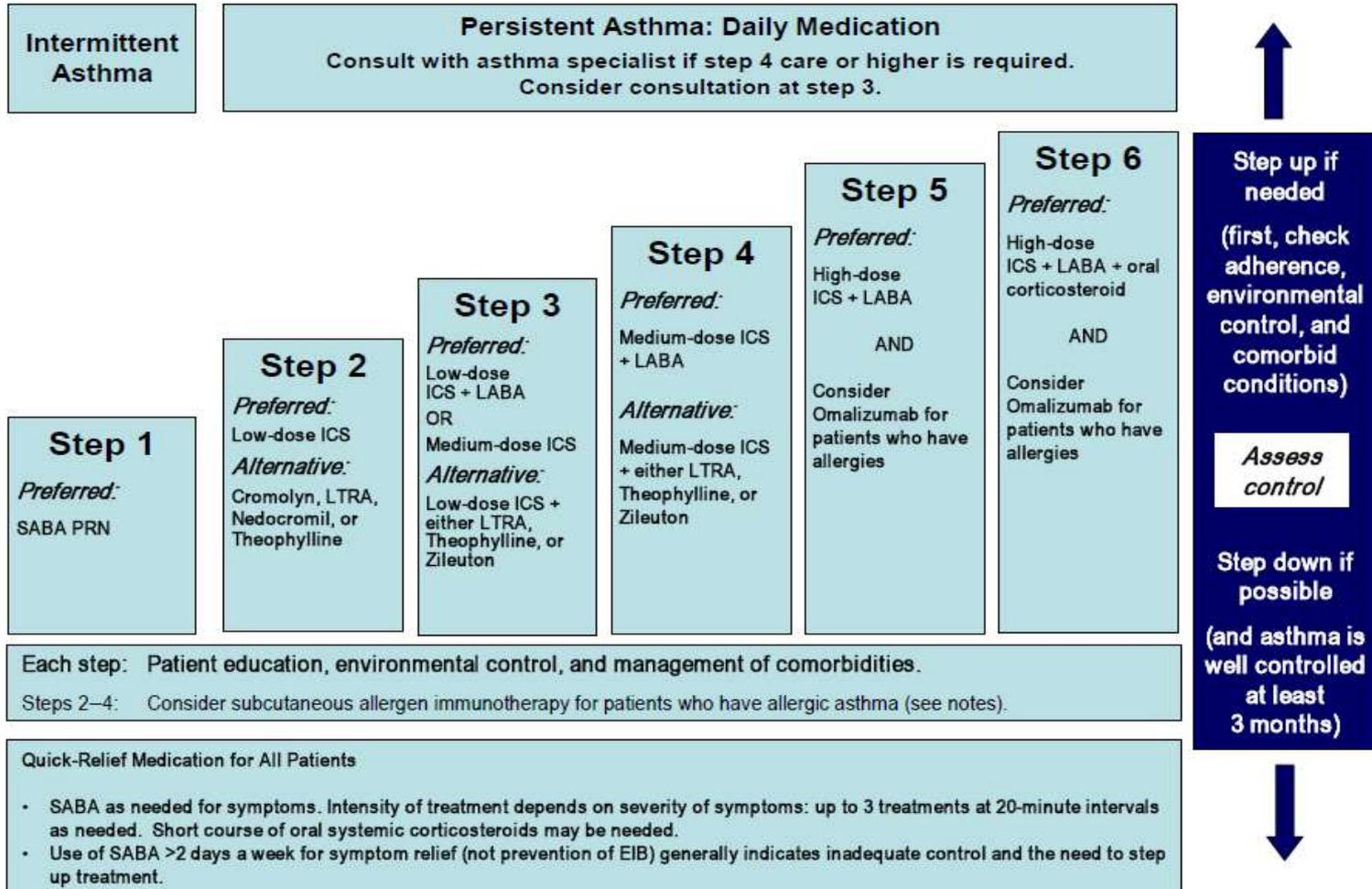


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Classifying Asthma Severity and Initiating Treatment in Youth ≥ 12 Years of Age and Adults

| Components of Severity | | Classification of Asthma Severity ≥ 12 years of age | | | |
|---|---|--|--|---|---|
| | | Intermittent | Persistent | | |
| | | | Mild | Moderate | Severe |
| Impairment Normal FEV ₁ /FVC: 8–19 yr 85% 20–39 yr 80% 40–59 yr 75% 60–80 yr 70% | Symptoms | ≤ 2 days/week | > 2 days/week but not daily | Daily | Throughout the day |
| | Nighttime awakenings | ≤ 2 x/month | 3–4x/month | > 1 x/week but not nightly | Often 7x/week |
| | Short-acting beta ₂ -agonist use for symptom control (not prevention of EIB) | ≤ 2 days/week | > 2 days/week but not daily, and not more than 1x on any day | 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 normal | <ul style="list-style-type: none"> FEV₁ $> 80\%$ predicted FEV₁/FVC normal | <ul style="list-style-type: none"> FEV₁ $> 60\%$ but $< 80\%$ predicted FEV₁/FVC reduced 5% | <ul style="list-style-type: none"> FEV₁ $< 60\%$ predicted FEV₁/FVC reduced $> 5\%$ |
| Risk | Exacerbations requiring oral systemic corticosteroids | 0–1/year (see note) | ≥ 2 /year (see note) | | |
| Recommended Step for Initiating Treatment | | Step 1 | Step 2 | Step 3 | Step 4 or 5 |
| (See figure 4–5 for treatment steps.) | | and consider short course of oral systemic corticosteroids | | | |
| | | In 2–6 weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly. | | | |

Stepwise Approach for Managing Asthma in Children 12 Years of Age and Adults



Low, medium and high dose inhaled corticosteroids

| Inhaled corticosteroid | Total daily dose (mcg) | | |
|----------------------------------|------------------------|-----------|-------|
| | Low | Medium | High |
| Beclometasone dipropionate (CFC) | 100–200 | >200–400 | >400 |
| Beclometasone dipropionate (HFA) | 50–100 | >100–200 | >200 |
| Budesonide (DPI) | 100–200 | >200–400 | >400 |
| Budesonide (nebules) | 250–500 | >500–1000 | >1000 |
| Ciclesonide (HFA) | 80 | >80–160 | >160 |
| Fluticasone propionate (DPI) | 100–200 | >200–400 | >400 |
| Fluticasone propionate (HFA) | 100–200 | >200–500 | >500 |
| Mometasone furoate | 110 | ≥220–<440 | ≥440 |
| Triamcinolone acetonide | 400–800 | >800–1200 | >1200 |

Reviewing response and adjusting treatment

- **How often should asthma be reviewed?**
 - 1-3 months after treatment started, then every 3-12 months
 - After an exacerbation, within 1 week
- **Stepping up asthma treatment**
 - *Sustained step-up*, for at least 2-3 months if asthma poorly controlled
 - Important: first check for common causes (symptoms not due to asthma, incorrect inhaler technique, poor adherence)
 - *Short-term step-up*, for 1-2 weeks, e.g. with viral infection or allergen
 - May be initiated by patient with written asthma action plan
- **Stepping down asthma treatment**
 - Consider step-down after good control maintained for 3 months
 - try to reduce therapy (usually by **25-50%**)
 - Find each patient's minimum effective dose, that controls both symptoms and exacerbations.

Inhaled Medication deliveries

Inhaled medication delivery devices

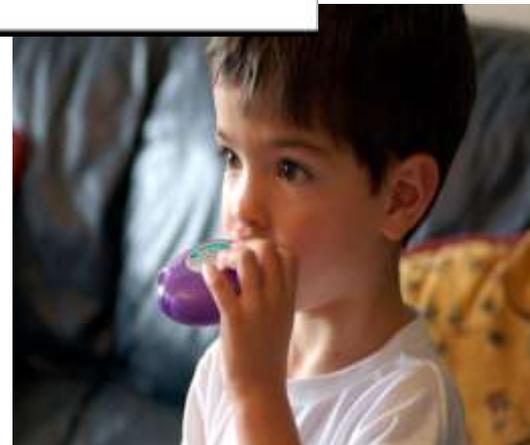
0 to ~5 years

pMDI with static-treated spacer and mask (or mouthpiece as soon as the child is capable of using)

>~5 years

Choice of: pMDI with static-treated spacer and mouthpiece, DPI (rinse or gargle after inhaling ICS), breath-actuated pMDI (depending on patient ability to use, preference)

Nebulizer: second choice at any age



Age specific recommendations for drug delivery devices

Table 1 Age specific recommendations for drug delivery devices

| Age (years) | First choice | Second choice | Comments |
|-------------------------|---|---|--|
| 0-2 | MDI + spacer and facemask | Nebuliser | Ensure optimum spacer use Avoid "open vent" nebulisers |
| 3-6 | MDI + spacer | Nebuliser | Very few children at this age can use dry powder inhalers adequately |
| 6-12 (bronchodilators) | MDI + spacer, breath actuated or dry powder inhaler | - | If using breath actuated or dry powder inhaler, also prescribe MDI + spacer for acute exacerbations |
| 6-12 (steroids) | MDI + spacer | Dry powder inhaler | May need to adjust dose if switching between inhalers Advise mouth rinsing or gargling |
| 12+ (bronchodilators) | Dry powder inhaler or breath actuated MDI | - | |
| 12+ (steroids) | MDI + spacer | Dry powder inhaler or breath actuated MDI | May need to adjust dose if switching between inhalers Advise mouth rinsing or gargling |
| Acute asthma (all ages) | MDI + spacer | Nebuliser | Ensure optimum spacer use and appropriate dosing Nebulise for a set period of time Written instructions for what to do in acute asthma |

MDI, pressurised metered dose inhaler.

Assessment of exacerbation severity

| | Mild | Moderate | Severe | Very severe |
|---------------------------------------|--------------------|-------------------------|--|-----------------|
| Wheeze | Variable | Moderate to loud | Loud – on both inhalation and exhalation | Often quiet |
| Breathlessness | Walking | At rest | At rest/sits upright | |
| Speaks in | Sentences | Phrases | Words | Unable to speak |
| Accessory muscle use | No | Common | Marked | Paradoxical |
| Consciousness | Not affected | Not affected | Agitated, confused | |
| Respiratory rate | Slightly increased | Increased | Highly increased | Undetermined |
| Pulse | <100 | <140 (depending on age) | >140 | Bradycardia |
| PEF (% of predicted or personal best) | >60–70 | 40–70 | <40 | <25 |
| SaO ₂ (% on air) | >94–95 | 90–95 | <90 | |
| PCO ₂ (mmHg) | <42 | <42 | ≥ 42 | |

ASSESS ASTHMA SEVERITY

Always treat according to the most severe feature

MODERATE ASTHMA

- SpO₂ ≥ 92%
- Able to talk
- PEFR ≥ 50% best or predicted

Age < 5 years

- Heart rate ≤ 140/min
- Resp rate ≤ 40/min

Age > 5 years

- Heart rate ≤ 125/min
- Resp rate ≤ 30/min

SEVERE ASTHMA

- SpO₂ < 92%
- Too breathless to talk
- Obvious accessory neck muscle use
- PEFR 33–50% best or predicted

Age < 5 years

- Heart rate > 140/min
- Resp rate > 40/min

Age > 5 years

- Heart rate > 125/min
- Resp rate > 30/min

LIFE-THREATENING ASTHMA

SpO₂ < 92% plus any of:

- Poor respiratory effort
- Exhaustion
- Agitation
- Altered consciousness
- Cyanosis
- Silent chest
- PEFR < 33% best or predicted

MANAGEMENT

MANAGEMENT

- Salbutamol 6 puffs via spacer

Age > 5 years

- Prednisolone 1–2 mg/kg (max 40 mg)

Age < 5 years

- Consider prednisolone 1–2 mg/kg (max 40 mg)

- Oxygen via face mask 8 L/min
- Salbutamol 6 puffs via spacer or nebulised salbutamol 2.5–5 mg

All ages

- Prednisolone 1–2 mg/kg (max 40 mg)

- **Call ambulance**

- Oxygen via face mask 8 L/min
- Nebulised salbutamol 5 mg plus ipratropium 0.25 mg
- Prednisolone 1–2 mg/kg (max 40 mg) or IV hydrocortisone 4 mg/kg (max 100 mg)
- In extreme cases consider IM adrenaline at anaphylaxis dose

ASSESS RESPONSE AFTER 15 MINUTES

Good Response (now mild)

- Continue salbutamol via spacer as needed but not exceeding 4-hourly
- If symptoms are not controlled on 4 hourly salbutamol switch to poor response pathway and refer to hospital
- Continue prednisolone for up to three days
- Arrange follow-up clinic visit

Poor Response (remains moderate or severe)

- Repeat salbutamol one to two times then review

If still poor response

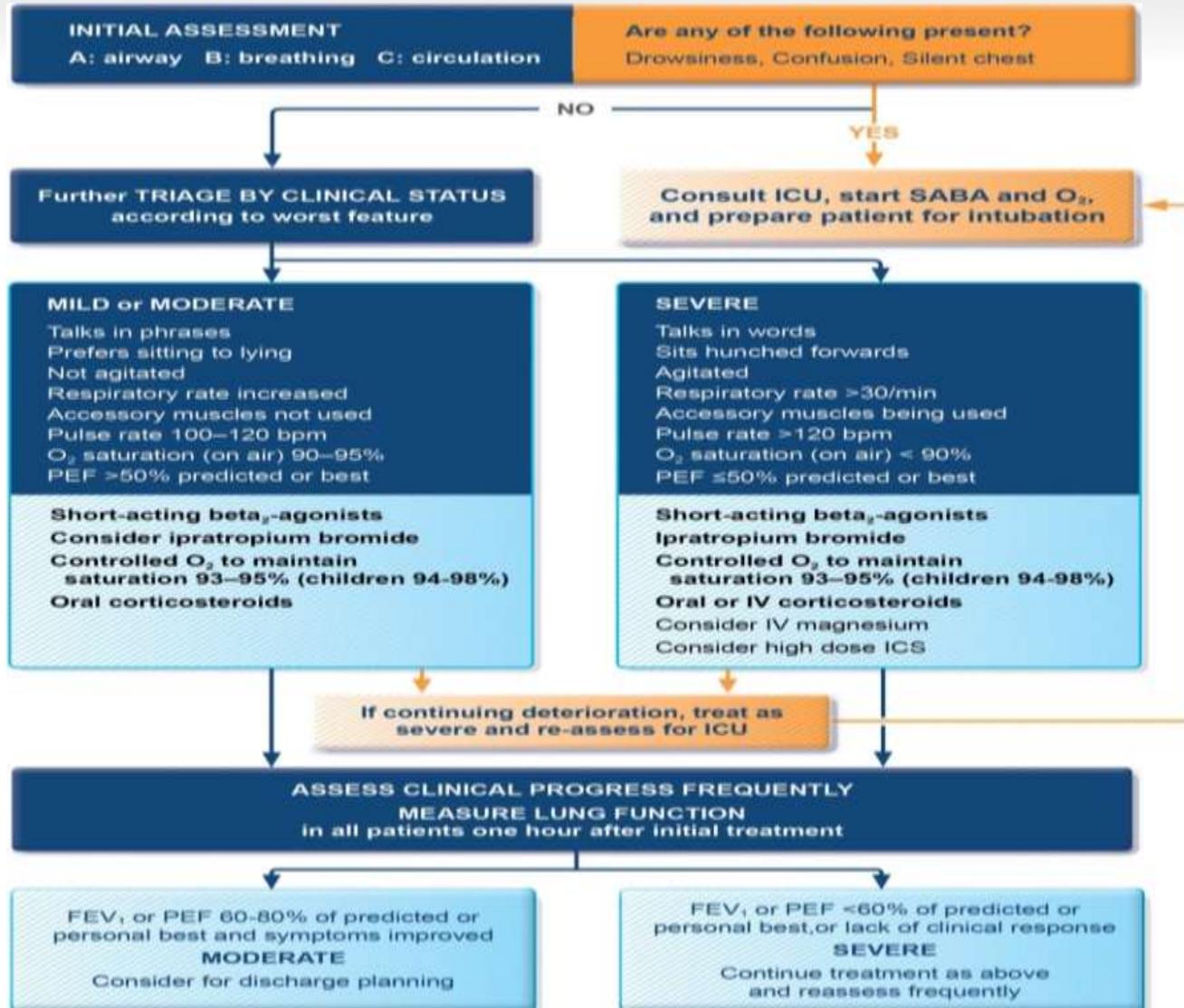
- Refer to hospital – send written documentation
- Repeat salbutamol hourly until improving
- Ambulance if severe and stay with patient until ambulance arrives
- Anytime life-threatening switch to continuous salbutamol nebulisers and call ambulance

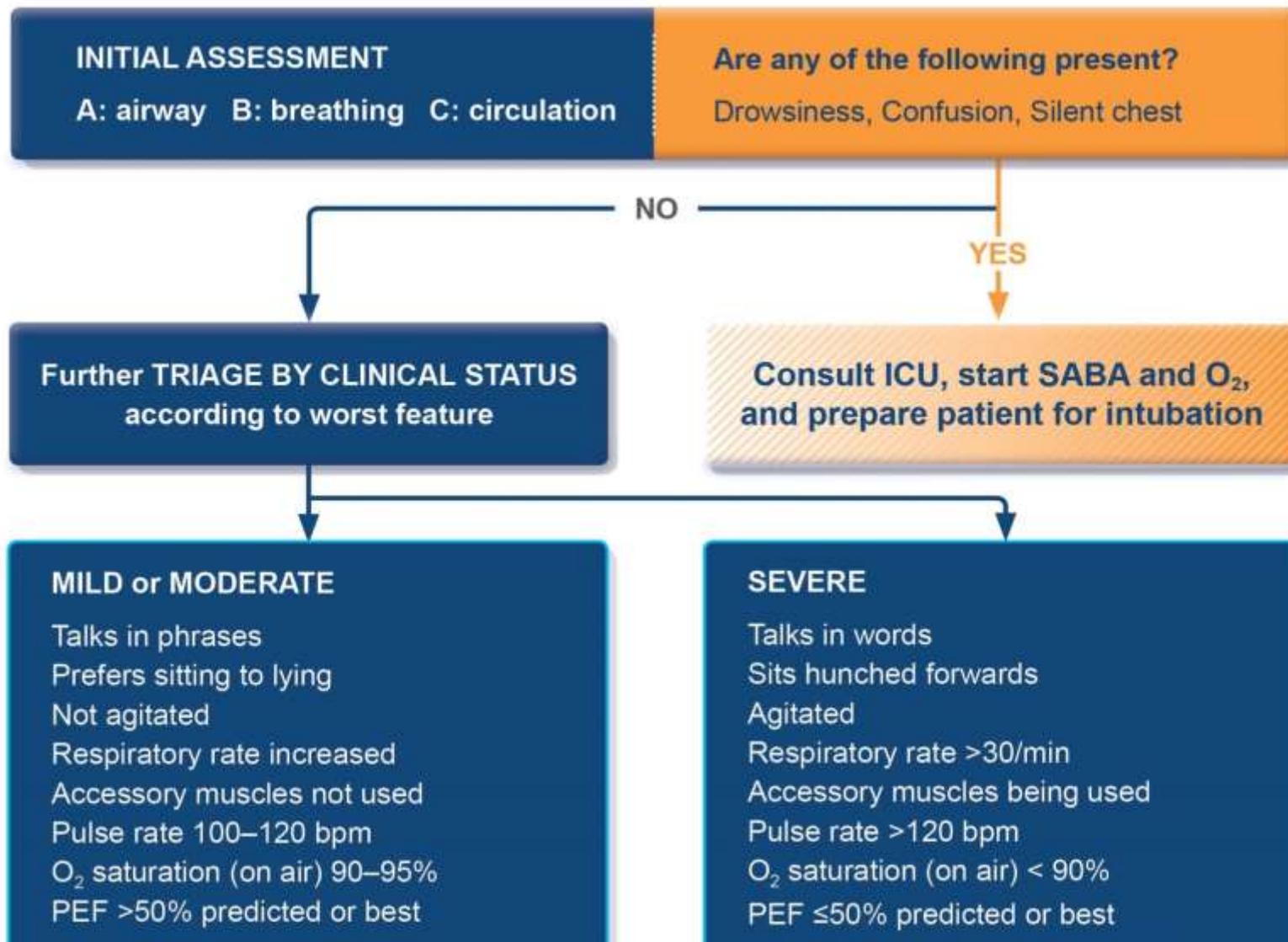
Continuous salbutamol nebulisers awaiting ambulance

Lower threshold for referral to hospital if:

- Attack in late afternoon or at night
- Recent hospital admission or previous severe attack
- Concern over social circumstances or ability to cope at home

Managing exacerbations in acute care settings





MILD or MODERATE

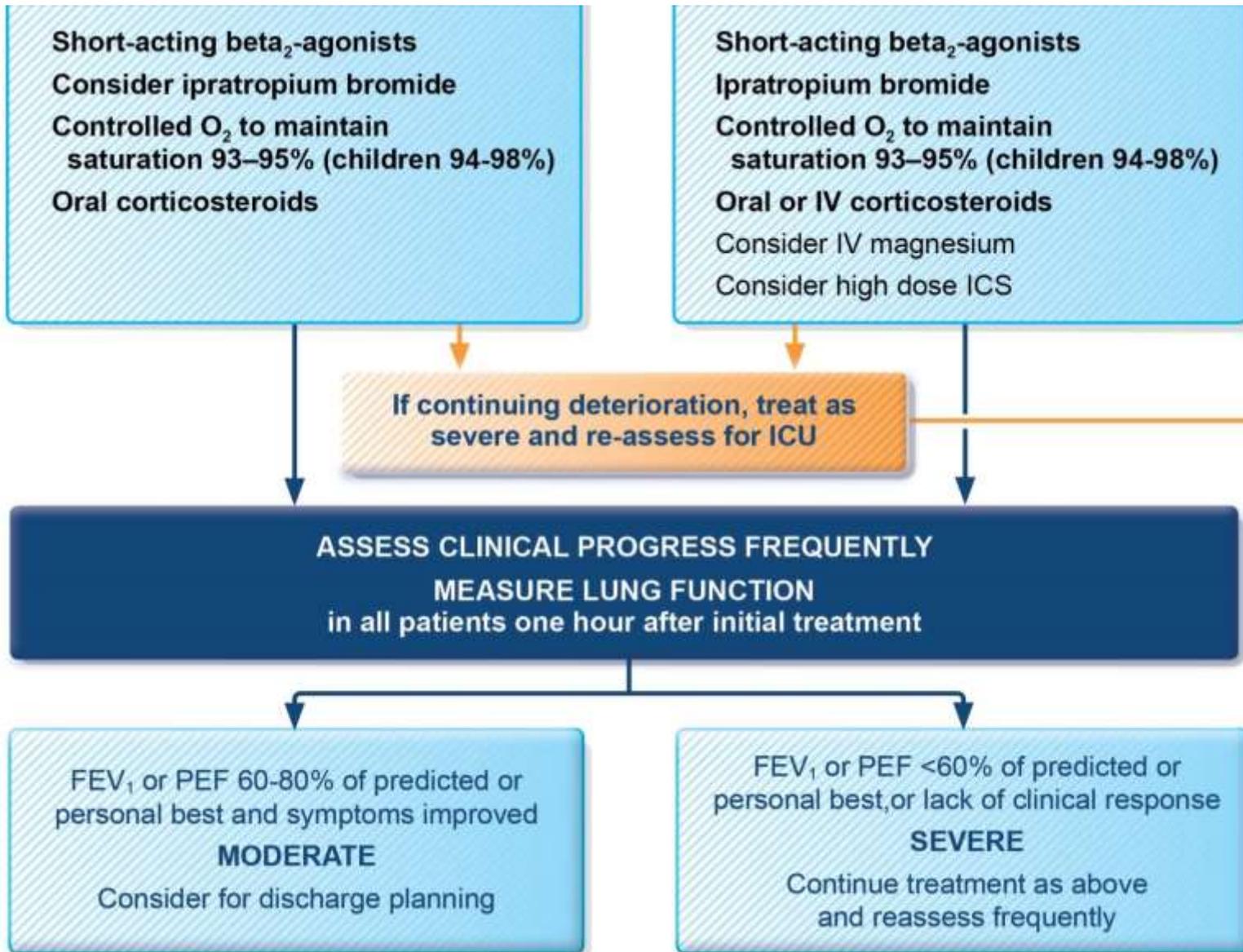
Talks in phrases
Prefers sitting to lying
Not agitated
Respiratory rate increased
Accessory muscles not used
Pulse rate 100–120 bpm
O₂ saturation (on air) 90–95%
PEF >50% predicted or best

Short-acting beta₂-agonists
Consider ipratropium bromide
Controlled O₂ to maintain saturation 93–95% (children 94–98%)
Oral corticosteroids

SEVERE

Talks in words
Sits hunched forwards
Agitated
Respiratory rate >30/min
Accessory muscles being used
Pulse rate >120 bpm
O₂ saturation (on air) < 90%
PEF ≤50% predicted or best

Short-acting beta₂-agonists
Ipratropium bromide
Controlled O₂ to maintain saturation 93–95% (children 94–98%)
Oral or IV corticosteroids
Consider IV magnesium
Consider high dose ICS



Prognosis

- Recurrent coughing and wheezing occurs in **35% of preschool-aged children**.
- Of these, approximately **one third** continue to have persistent asthma into later childhood, and approximately **two thirds** improve on their own through their teen years.

Prognosis

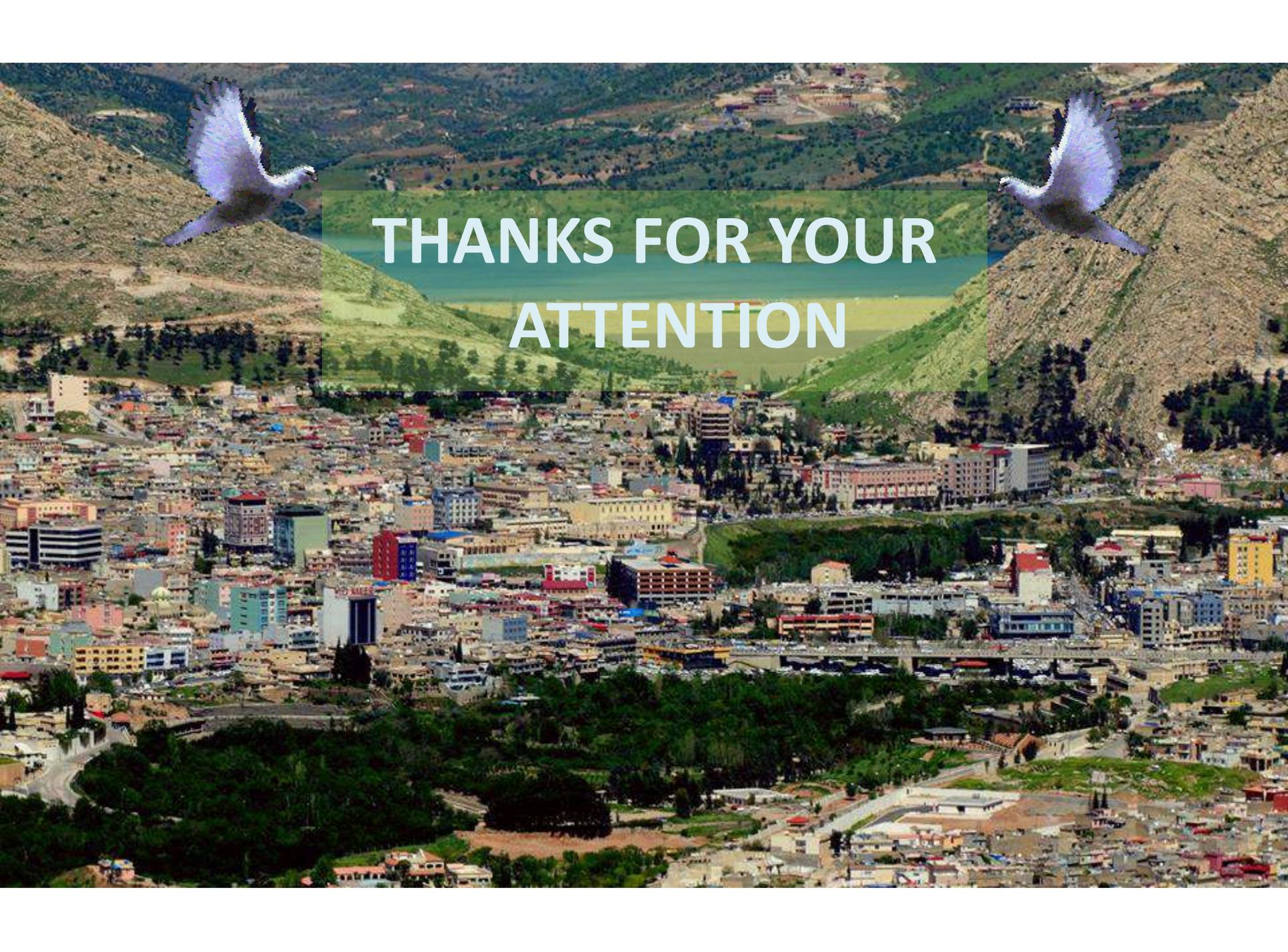
- Asthma severity by the **ages of 7-10 yr** of age is predictive of asthma persistence in adulthood.
- Children with **moderate to severe asthma** and with **lower lung function measures** are likely to have persistent asthma as adults.
- Children with **milder asthma and normal lung function** are likely to improve over time, with some becoming periodically asthmatic (disease-free for months to years);
- **however, complete remission for 5 yr in childhood is uncommon.**

Prevention

- Investigations into the environmental and lifestyle factors responsible for the lower prevalence of childhood asthma suggest that early immunomodulatory intervention might prevent asthma development.
- A “**hygiene hypothesis**” purports that naturally occurring microbial exposures in early life might drive early immune development **away** from allergic sensitization, persistent airways inflammation, and remodeling.

Prevention

- **Several nonpharmacotherapeutic measures with numerous positive health attributes—**
 - ✓ avoidance of environmental tobacco smoke (beginning prenatally),
 - ✓ prolonged breastfeeding (>4 mo),
 - ✓ an active lifestyle, and a healthy diet—might reduce the likelihood of asthma development.
 - ✓ Immunizations are currently not considered to increase the likelihood of development of asthma; therefore, all standard childhood immunizations are recommended for children with asthma, including varicella and annual influenza vaccines.

An aerial photograph of a densely populated city nestled in a valley. The city features a mix of colorful buildings, including red, blue, and yellow structures. In the background, a large green reservoir is visible, surrounded by steep, rocky hills. Two white doves are flying in the sky, one on the left and one on the right, framing the central text. The overall scene is bright and clear, suggesting a sunny day.

**THANKS FOR YOUR
ATTENTION**