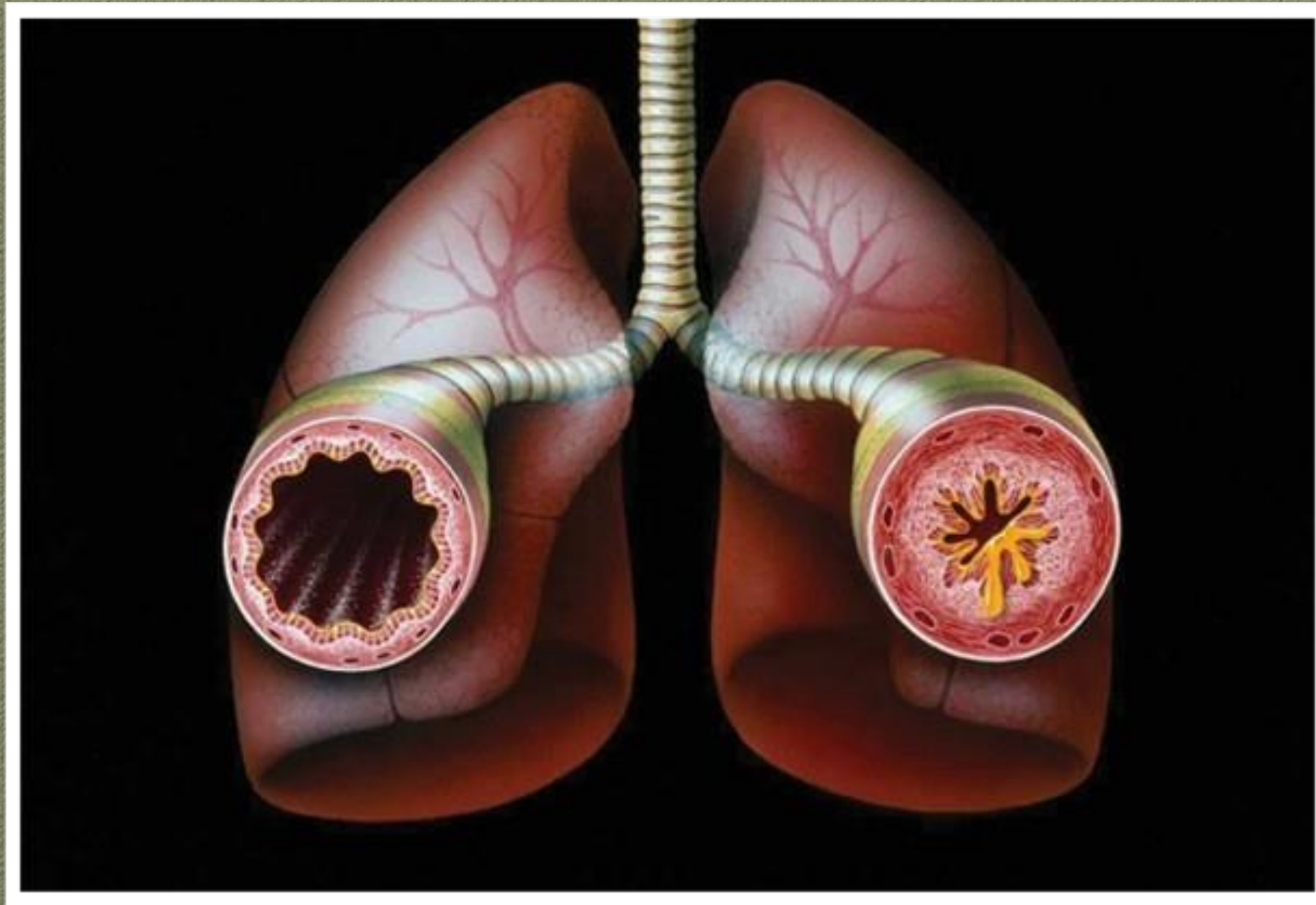




# Bronchial asthma

Dr. C.D. Kulkarni

MD Pulmonology



# Objectives

- To know the definition of asthma
- To understand the risk factors and triggers of asthma
- To know the pathophysiology of bronchial asthma
- To know how to diagnose asthma
- To understand the management of chronic stable asthma
- To understand the management of acute asthmatic attack

# Burden of Asthma

- Asthma is one of the most common chronic diseases worldwide with an estimated 300 million affected individuals
- Asthma is a clinical syndrome that affects 20 million Americans and accounts for 12.7million medical visits yearly. One third of those afflicted with asthma are children under the age of 18 years.
- The estimated annual direct and indirect cost of asthma care is rising dramatically and totaled approximately \$16 billion in 2001 in the United States



# Celebrities with asthma





A 32 year old female patient presented to the ER with acute dyspnea, dry cough and wheezes, she gave a history of recurrent similar attacks in the past, she admitted increasing symptoms with exercise and dust exposure, how would you approach this case?

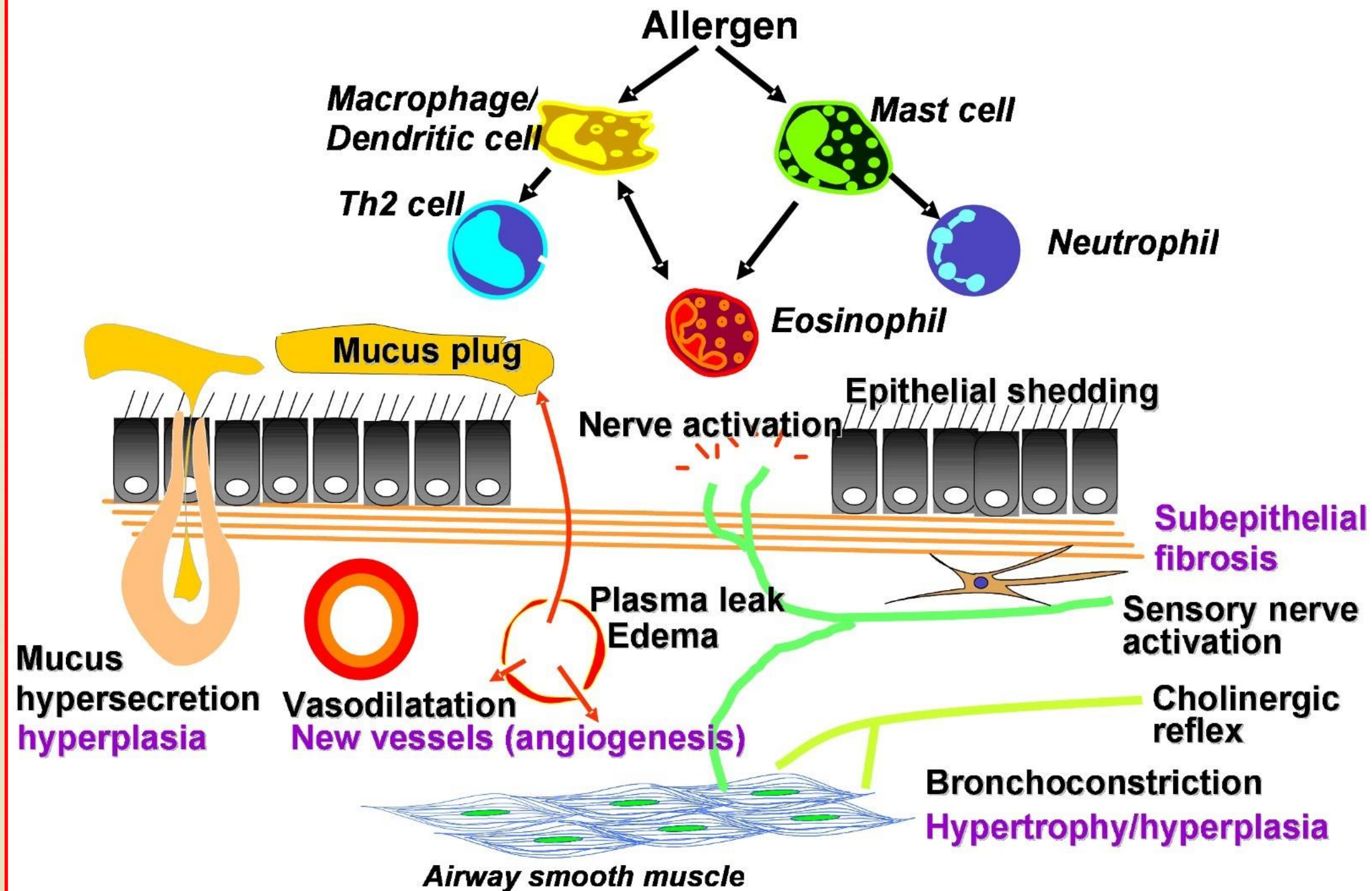




# Definition of Asthma

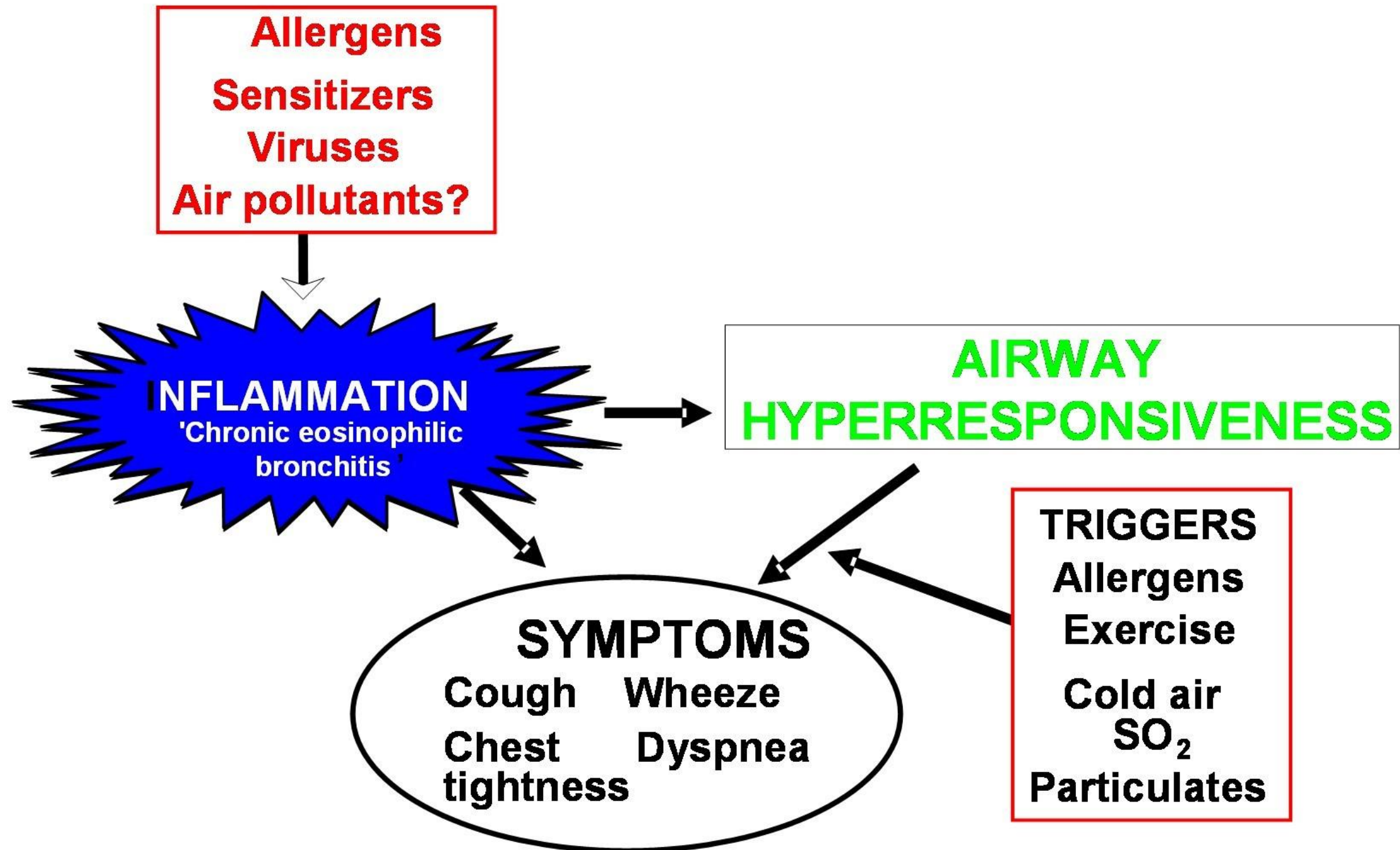
- Achronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation causes recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night and in the early morning. These episodes are usually associated with widespread but variable airflow obstruction that is often reversible either spontaneously or with treatment.

# Asthma Inflammation: Cells and Mediators





# Mechanisms: Asthma Inflammation





# Asthma Inflammation: Cells and Mediators

## Inflammatory cells

Mast cells  
Eosinophils  
Th2 cells  
Basophils  
Neutrophils  
Platelets

## Structural cells

Epithelial cells  
Sm muscle cells  
Endothelial cells  
Fibroblast  
Nerves



## Mediators

Histamine  
Leukotrienes  
Prostanoids  
PAF  
Kinins  
Adenosine  
Endothelins  
Nitric oxide  
Cytokines  
Chemokines  
Growth factors



## Effects

Bronchospasm  
Plasma exudation  
Mucus secretion  
AHR  
Structural changes



# Risk Factors for Asthma

- Host factors: predispose individuals to, or protect them from, developing asthma
- Environmental factors: influence susceptibility to development of asthma in predisposed individuals, precipitate asthma exacerbations, and/or cause symptoms to persist



# Factors that Exacerbate Asthma

- Allergens
- Respiratory infections
- Exercise and hyperventilation
- Weather changes
- Sulfur dioxide
- Food, additives, drugs



# Factors that Influence Asthma Development and Expression

## Host Factors

- Genetic

- Atopy

- Airway

hyperresponsiveness

- Gender

- Obesity

- Environmental Factors
  - Indoor allergens
  - Outdoor allergens
  - Occupational sensitizers
  - Tobacco smoke
  - Air Pollution
  - Respiratory Infections
  - Diet



# TRIGGERS

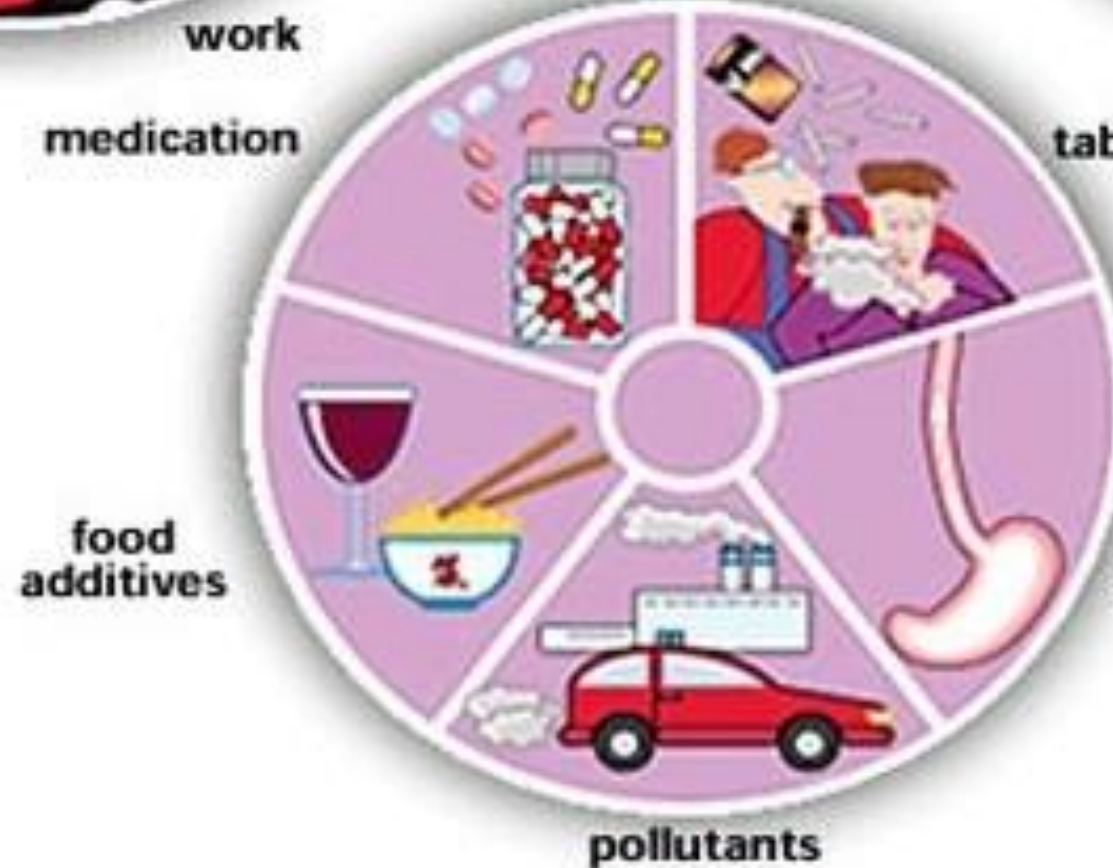
## inflammatory factors



temperature change

strong odors

## others



## irritants



tabacco





#### POLLUTION

Several air pollutants have been recognized as asthma triggers: ozone, sulfur and nitrogen dioxides, cigarette smoke, wood combustion products, aerosols, irritant substances, and strong odors.



#### METEOROLOGICAL CONDITIONS

Sudden changes of temperature or high ambient humidity may trigger asthma attacks.



#### PHYSICAL EFFORT

A sustained or moderate physical effort may cause an asthma attack, especially when the weather is cold.



#### EMOTIONS

Strong emotions, annoyances, and stress are psychological triggering factors.



#### INFECTIONS

Infections of the airways (e.g. from a cold) represent 80% of the triggering factors of asthma in children. Asthma does not, however, increase the risk of respiratory infection.



#### ALLERGENS

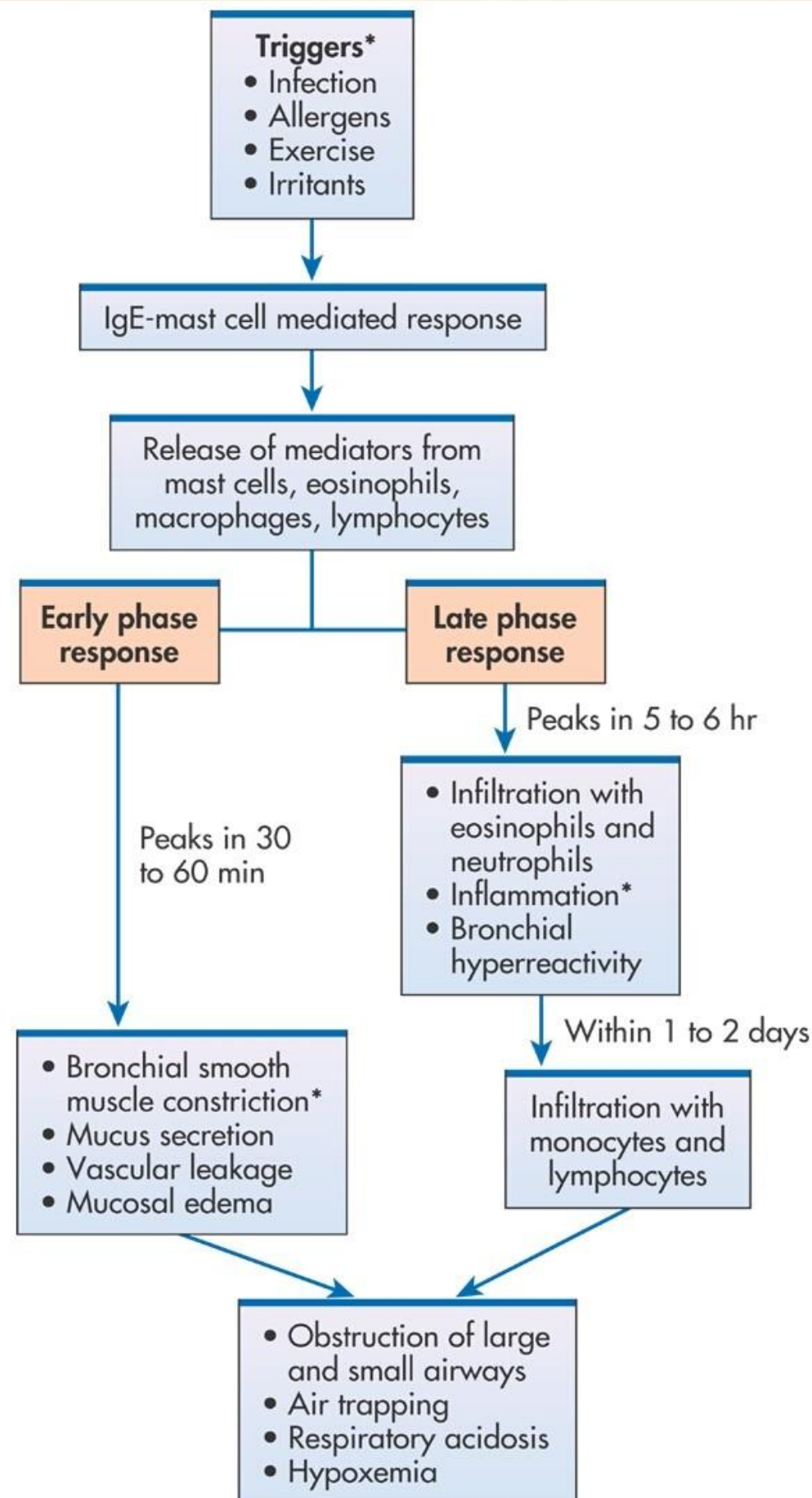
Contact with allergens (dust, dust mites, pollens, animal hair, and saliva) is a frequent cause of asthma.



#### DRUGS

Some drugs are known for causing asthma attacks, specifically aspirin, beta blockers, and nonsteroidal anti-inflammatories.

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*“One of the first duties of the physician is to educate the masses not to take medicines”*

***sir william osler***



# Asthma

## Pathophysiology

### Early-Phase Response

- Peaks 30-60 minutes post exposure, subsides 30-90 minutes later
- Characterized primarily by bronchospasm
- Increased mucous secretion, edema formation, and increased amounts of tenacious sputum
- Patient experiences wheezing, cough, chest tightness, and dyspnea



## Late-Phase Response

- Characterized primarily by inflammation
- Histamine and other mediators set up a self-sustaining cycle increasing airway reactivity causing hyperresponsiveness to allergens and other stimuli
- Increased airway resistance leads to air trapping in alveoli and hyperinflation of the lungs
- If airway inflammation is not treated or does not resolve, may lead to irreversible lung damage

# Is it Asthma?

- Recurrent episodes of wheezing
- Troublesome cough at night
- Cough or wheeze after exercise
- Cough, wheeze or chest tightness after exposure to airborne allergens or pollutants
- Colds “go to the chest” or take more than 10 days to clear



# Asthma Diagnosis

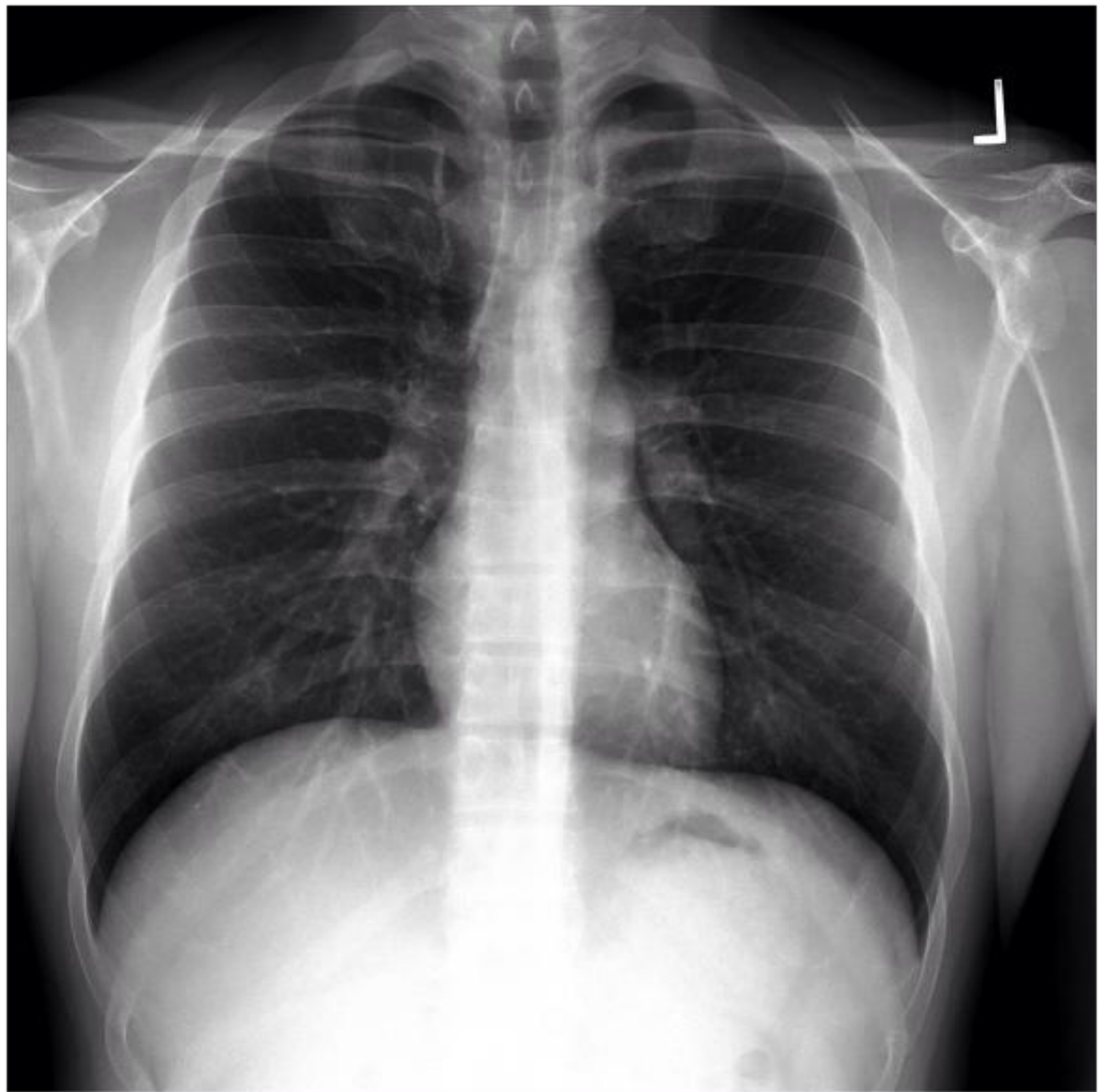
- History and patterns of symptoms
- Measurements of lung function
  - Spirometry
  - Peak expiratory flow
- Measurement of airway responsiveness
- Measurements of allergic status to identify risk factors
- Extra measures may be required to diagnose asthma in children 5 years and younger and the elderly



**Table 2 – Ancillary tests useful in asthma diagnosis**

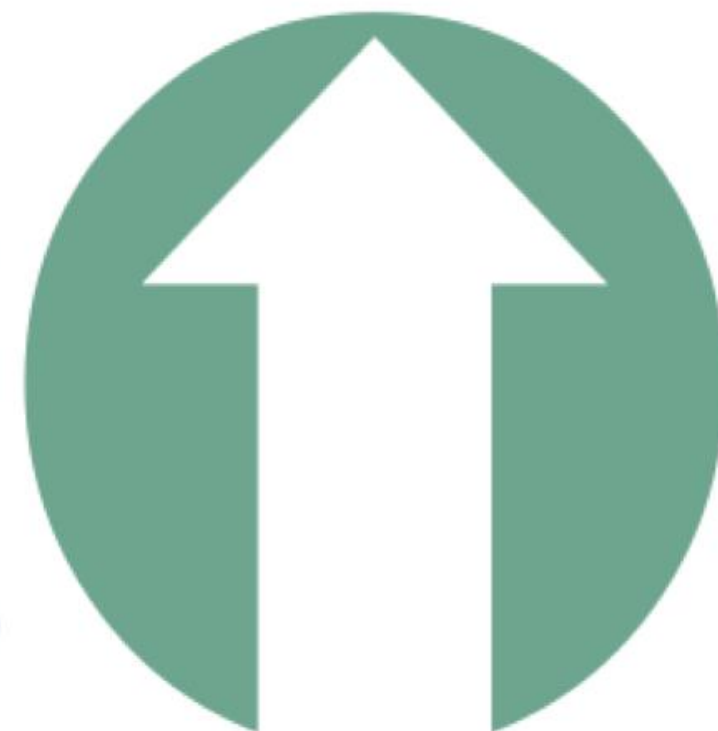
| Test                                                                                                                                                                                                       | Information                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pulmonary function tests                                                                                                                                                                                   | PEF and FEV <sub>1</sub> measure severity of asthma/COPD. Variability $\geq 15\%$ in FEV <sub>1</sub> or $\geq 20\%$ in PEF is hallmark of asthma. A low DLCO in a patient with a smoking history suggests COPD. Post-bronchodilator obstruction suggests the need for a course of corticosteroids to demonstrate that the patient does not have COPD.                                 |
| Chest radiography                                                                                                                                                                                          | To exclude complications of asthma, such as pneumothorax, and to assist in differential diagnoses, such as heart failure, pneumonia, and cancer.                                                                                                                                                                                                                                       |
| High-resolution CT                                                                                                                                                                                         | Helps exclude causes of cough and dyspnea not detectable on routine chest radiograph, including bronchiectasis and interstitial lung disease. Appropriate windows can be used for detection of pulmonary embolism.                                                                                                                                                                     |
| Arterial blood gas analysis                                                                                                                                                                                | Needed if oxygen saturation is $< 92\%$ or PEF is $< 33\%$ of best/predicted, or patient has silent chest, cyanosis, or other features of severe asthma.                                                                                                                                                                                                                               |
| Blood tests                                                                                                                                                                                                | Eosinophilia in blood and sputum is common in asthma. IgE level is elevated in allergic bronchopulmonary aspergillosis. Antineutrophil cytoplasmic antibody is present in Churg-Strauss syndrome. Neutrophilia may indicate infection. BNP has a high negative predictive value for heart failure.                                                                                     |
| Fractional expiratory nitric oxide                                                                                                                                                                         | Proxy for airway inflammation that may be helpful in diagnosing asthma, monitoring disease activity, predicting exacerbations, monitoring response to treatment, and assessing adherence to therapy. Exhaled nitric oxide is increased when eosinophilic airway inflammation is present in younger patients with allergic asthma. Its role in elderly patients is not yet established. |
| Electrocardiography                                                                                                                                                                                        | Normal ECG findings have a high negative predictive value for heart failure. Signs of right ventricular strain may suggest the possibility of pulmonary embolism in patients with unexplained breathlessness.                                                                                                                                                                          |
| Allergy skin tests or allergen-specific IgE levels in the blood                                                                                                                                            | These are used to identify or confirm allergic triggers.                                                                                                                                                                                                                                                                                                                               |
| Bronchial inhalation and methacholine tests                                                                                                                                                                | Confirm presence of nonspecific bronchial hyperreactivity and have a high negative predictive value for asthma.                                                                                                                                                                                                                                                                        |
| Forced oscillation/whole-body plethysmography/slow vital capacity or FEV <sub>1</sub> alone                                                                                                                | These are alternative tests of pulmonary function that require little patient participation, which may be available in some hospital-based pulmonary function testing laboratories.                                                                                                                                                                                                    |
| Bronchoalveolar lavage and bronchial biopsy                                                                                                                                                                | These are research tools to demonstrate airway inflammation and remodeling.                                                                                                                                                                                                                                                                                                            |
| PEF, peak expiratory flow; FEV <sub>1</sub> , forced expiratory volume in 1 second; COPD, chronic obstructive pulmonary disease; DLCO, carbon monoxide-diffusing capacity; BNP, brain natriuretic peptide. |                                                                                                                                                                                                                                                                                                                                                                                        |





## CLINICAL FEATURES THAT INCREASE THE PROBABILITY OF ASTHMA

- More than one of the following symptoms: wheeze, breathlessness, chest tightness and cough, particularly if:
  - ~ symptoms worse at night and in the early morning
  - ~ symptoms in response to exercise, allergen exposure and cold air
  - ~ symptoms after taking aspirin or beta blockers
- History of atopic disorder
- Family history of asthma and/or atopic disorder
- Widespread wheeze heard on auscultation of the chest
- Otherwise unexplained low FEV<sub>1</sub> or PEF (historical or serial readings)
- Otherwise unexplained peripheral blood eosinophilia



## CLINICAL FEATURES THAT LOWER THE PROBABILITY OF ASTHMA

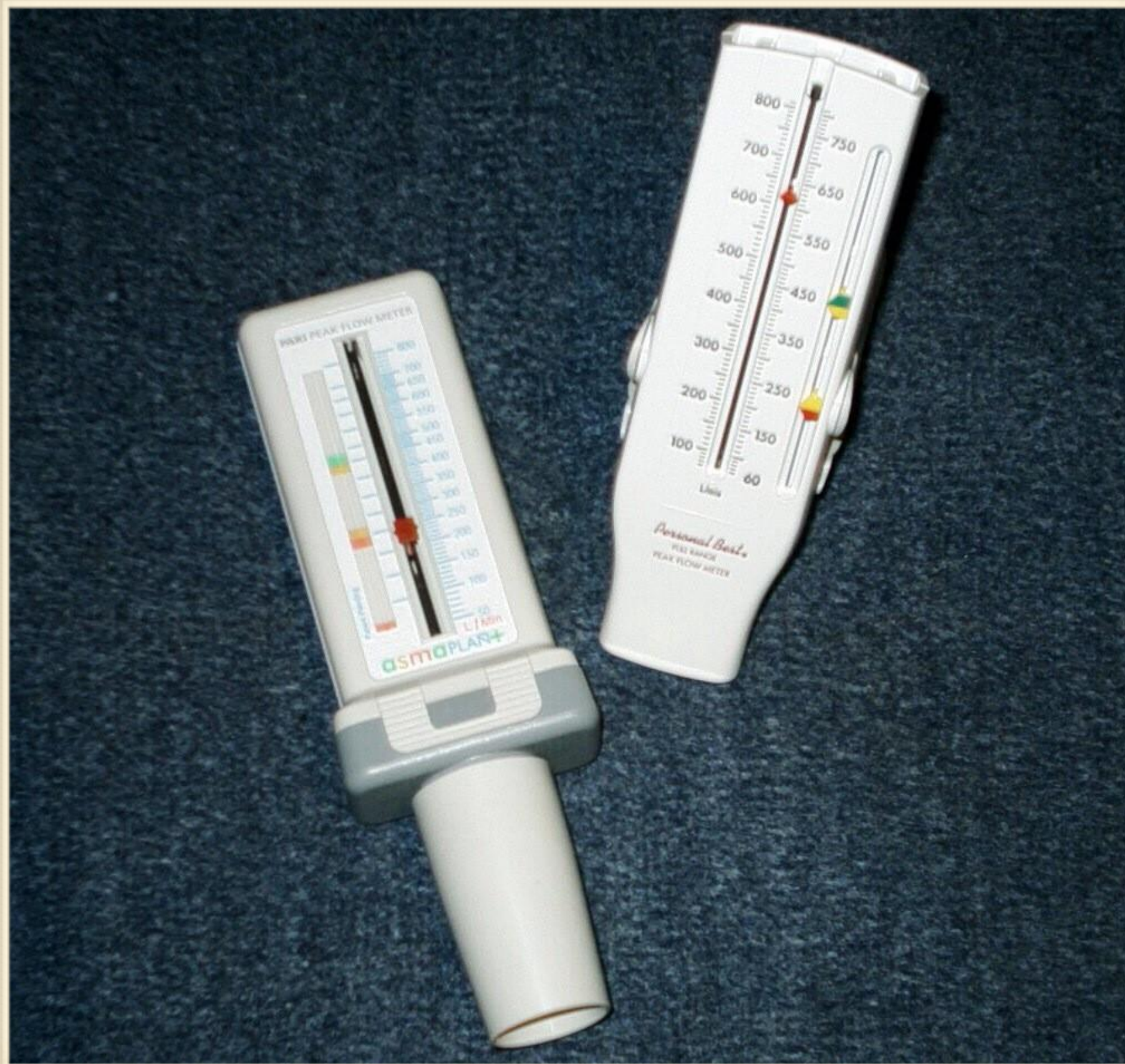
- Prominent dizziness, light-headedness, peripheral tingling
- Chronic productive cough in the absence of wheeze or breathlessness
- Repeatedly normal physical examination of chest when symptomatic
- Voice disturbance
- Symptoms with colds only
- Significant smoking history (ie > 20 pack-years)
- Cardiac disease
- Normal PEF or spirometry when symptomatic\*





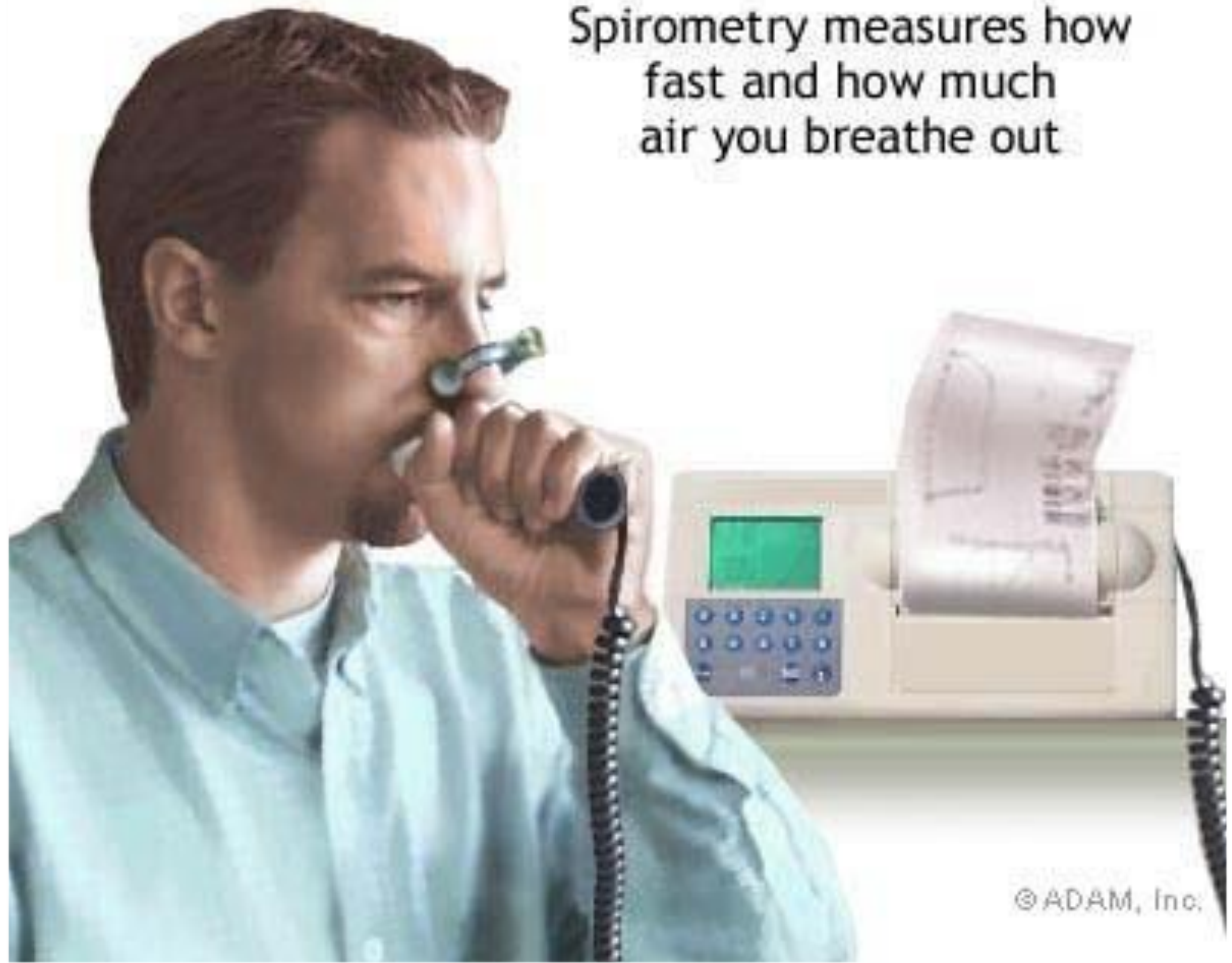








Spirometry measures how  
fast and how much  
air you breathe out



© ADAM, Inc.





## Table 2. Examples of How Spirometry Is Used in Assessing Impairment and Risk in Patients With Asthma<sup>a</sup>

### Impairment

Based on:

- Frequency of symptoms
- Intensity of symptoms
- Functional limitations

Assessment of impairment is accomplished by spirometry—mainly forced expiratory volume in 1 sec (FEV<sub>1</sub>), and the ratio of FEV<sub>1</sub> to forced vital capacity (FVC), as well as clinical features such as:

- How often symptoms are experienced
- How often the patient awakens at night
- How often the patient uses a short-acting  $\beta$ 2-agonist for symptom relief
- How often asthma interferes with normal activity

### Risk

Based on:

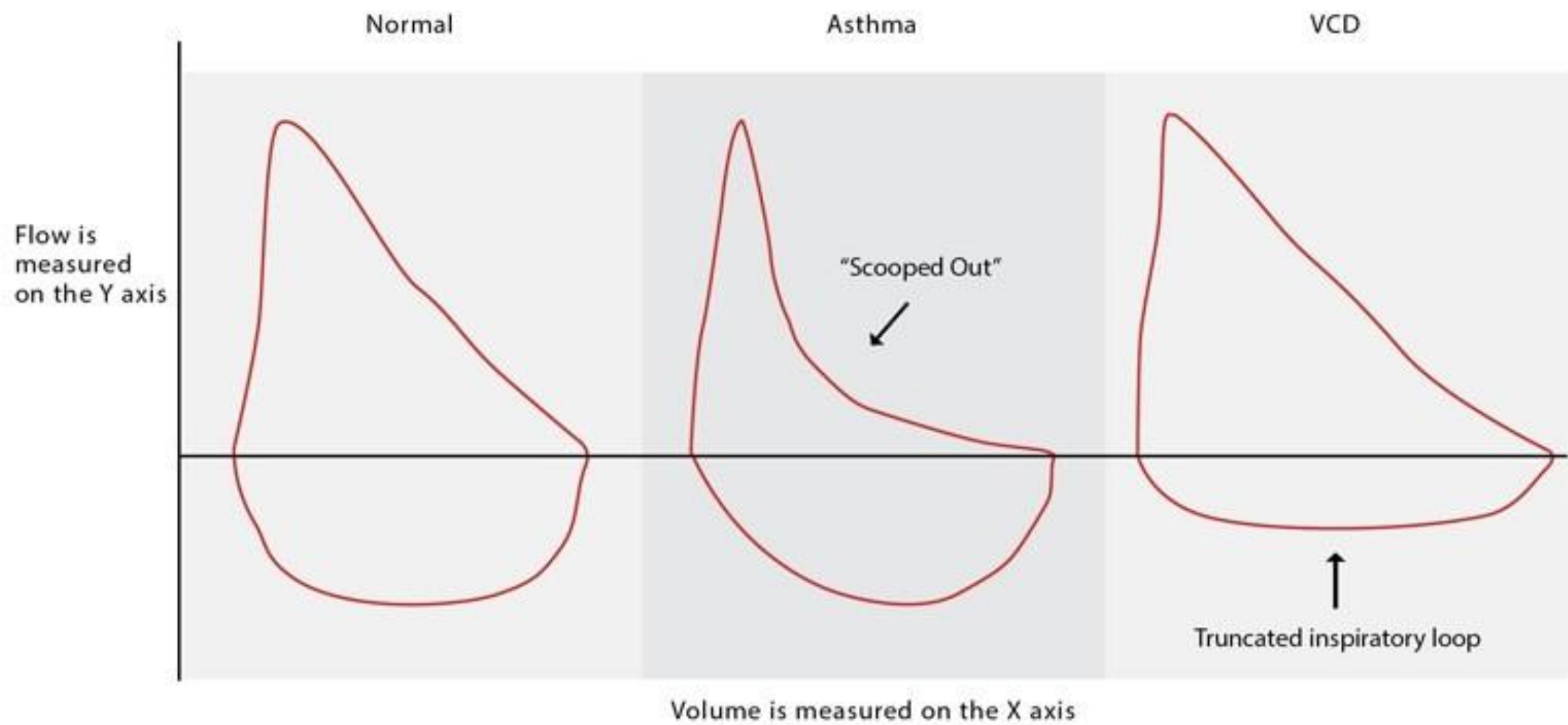
- Likelihood of future exacerbations or decline in lung function
- Risk of adverse medication effects

Assessment of risk is determined by long-term trends in spirometry and clinical features such as the frequency of/need for:

- Oral corticosteroids
- Hospitalization
- ICU admission
- Intubation

<sup>a</sup> For specific classifications of asthma control, and corresponding recommended action, refer to Reference 7.

Source: Adapted from Reference 7.





## Spirometry criteria for diagnosis of Asthma

| Spirometry<br>(showing reversible airway obstruction)                                                                                          | Criteria for children<br>(ages $\geq 6$ years)                                                                                  | Adult criteria                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Reduced FEV<sub>1</sub>/FVC</p> <p><b>AND</b></p> <p>Increase in FEV<sub>1</sub> after a bronchodilator or course of controller therapy</p> | <p>Less than lower limit of normal based on age, sex, height, and ethnicity</p> <p><b>AND</b></p> <p><math>\geq 12\%</math></p> | <p>Less than lower limit of normal based on age, sex, height and ethnicity</p> <p><b>AND</b></p> <p><math>\geq 12\%</math> (and minimum <math>\geq 200</math> mL)</p> |

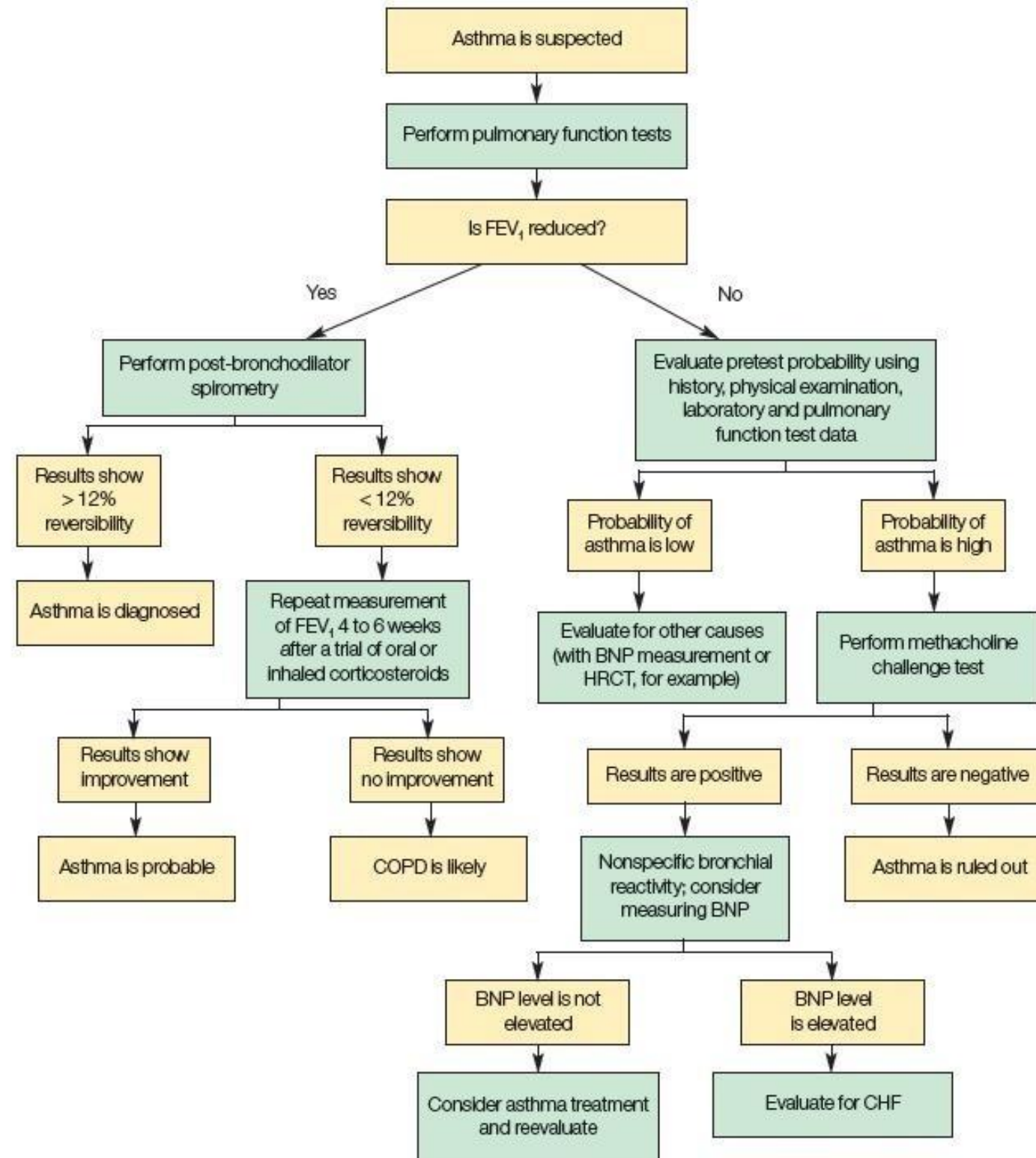
Ref: Lougheed MD et al. Can Respir J 2012;19:127-164.

| Characteristic                                  | Asthma                          | COPD                                        |
|-------------------------------------------------|---------------------------------|---------------------------------------------|
| Age at onset                                    | Usually < 40 yr                 | Usually > 40 yr                             |
| Smoking history                                 | Not causal, but worsens control | Usually >10 pack-years                      |
| Sputum production                               | Infrequent                      | Common                                      |
| Allergies                                       | Common                          | Infrequent                                  |
| Clinical symptoms                               | Intermittent and variable       | Persistent and progressive                  |
| Course of disease                               | Stable (with exacerbations)     | Progressive worsening (with exacerbations)  |
| Importance of nonrespiratory comorbid illnesses | Not usually important           | Often important                             |
| Spirometry results                              | Often normalize over time       | May improve, but do not normalize over time |
| Airway inflammation                             | Eosinophilic                    | Neutrophilic                                |

\*Adapted with permission from the *Canadian Pharmacists Journal*: 140[Suppl 3], 2007.<sup>22</sup>



**Figure – Algorithm for the diagnosis of asthma in the elderly**



FEV<sub>1</sub>, forced expiratory volume in 1 second; COPD, chronic obstructive pulmonary disease; BNP, brain natriuretic peptide; HRCT, high-resolution CT; CHF, congestive heart failure.

**Table 1.** Levels of asthma control.

| Characteristics                                  | Controlled <sup>*</sup>                                        | Partially controlled <sup>†</sup>                 | Uncontrolled <sup>‡</sup>                         |
|--------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------|
| Daytime symptoms                                 | None or $\leq 2$ episodes/week                                 | $> 2$ episodes/week                               | $> 2$ episodes/week                               |
| Limitations of activities                        | None                                                           | Yes                                               | Yes                                               |
| Night-time symptoms or awakening                 | None                                                           | Yes                                               | Yes                                               |
| Need for reliever/rescue medications             | None or $\leq 2$ times/week                                    | $> 2$ times/week                                  | $> 2$ times/week                                  |
| Pulmonary function<br>(PEF or FEV <sub>1</sub> ) | Normal or $\geq 80\%$ predicted<br>or personal best (if known) | $< 80\%$ predicted<br>or personal best (if known) | $< 80\%$ predicted<br>or personal best (if known) |
| Acute exacerbations                              | None                                                           | $\geq$ One/year                                   | One in any week                                   |

<sup>\*</sup>, so rated when all items below are met; <sup>†</sup>, so rated when 1 or 2 of the items below are met in any week; <sup>‡</sup>, so rated when at least 3 of the items below are met in any week.



## IS YOUR ASTHMA CONTROLLED?

|            | ELEMENTS                                     | AGE           | WELL CONTROLLED*                                                         |
|------------|----------------------------------------------|---------------|--------------------------------------------------------------------------|
| IMPAIRMENT | Symptoms                                     | Age 0–11:     | 2 or less days per week, but less than once on each day                  |
|            |                                              | Age 12–Adult: | 2 or less days per week                                                  |
|            | Waking Up At Night                           | Age 0–4:      | 1 time or less per month                                                 |
|            |                                              | Age 5–11:     | 1 time or less per month                                                 |
|            |                                              | Age 12–Adult: | 2 or less times per month                                                |
|            | Interference with Normal Activity            | All Ages      | None                                                                     |
|            | Quick Relief Medicine for Symptom Control    | All Ages      | 2 or less days per week (does not include pre-treatment before exercise) |
|            | FEV <sub>1</sub> or Peak Flow                | Age 5–Adult:  | More than 80% of predicted or personal best                              |
| RISK       | Episode Needing Oral Steroid Liquid or Pill: | All Ages      | 0 – 1 times per year                                                     |

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[www.pedipress.com](http://www.pedipress.com)

\*If your asthma is not well controlled, work with your doctor to improve your asthma action plan.



# Marijuana IS medicine.

"Every 19 minutes  
somebody dies of a  
prescription drug  
overdose.

It doesn't happen  
with marijuana."

**Sanjay Gupta, MD**

*Neurosurgeon & Chief Medical Correspondent, CNN*

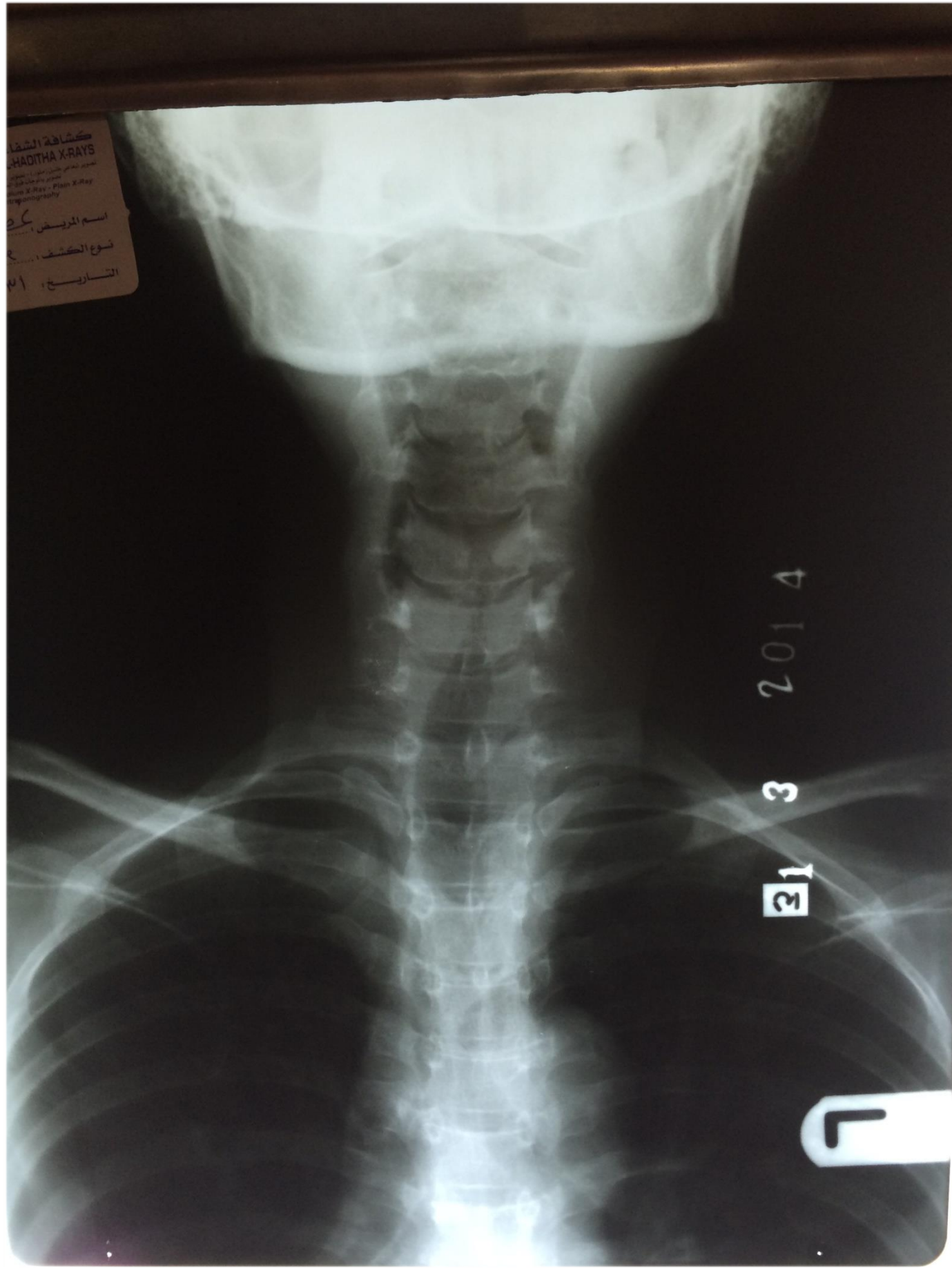




### **Box 1 : CAUSES OF NONRESPONSIVE ASTHMA<sup>1,4</sup>.**

---

- A) Wrong diagnosis :
    - Chronic obstructive pulmonary disease (COPD)
    - Left Ventricular failure (LVF)
    - Bronchiectasis, cystic fibrosis
    - Inhaled foreign body
    - Recurrent aspiration
    - Obliterative bronchiolitis (OB)
    - Tumours involving central airway
    - Tracheobronchomalacia
    - Vocal Cord Dysfunction (VCD)
  - B) Poor adherence to therapy.
  - C) Unidentified exacerbating factors :
    - Unidentified allergies
    - Occupational exposure
    - Gastro esophageal reflex
    - Systemic diseases (thyrotoxicosis, carcinoid, Churg- Strauss syndrome)
    - Drugs (beta blockers, ACE inhibitors)
    - Rhinitis / sinusitis / sleep apnoea
    - Psychological factors.
  - D) Unstable Asthma : Nocturnal asthma, Pre-menstrual, brittle asthma.
  - E) Corticosteroid resistant asthma.
  - F) Corticosteroid dependant asthma.
-



مكشافة الشفة  
HADITHA X-RAYS  
اسم المريض: .....  
نوع الكشف: .....  
التاريخ: ٢٠١٤

2014

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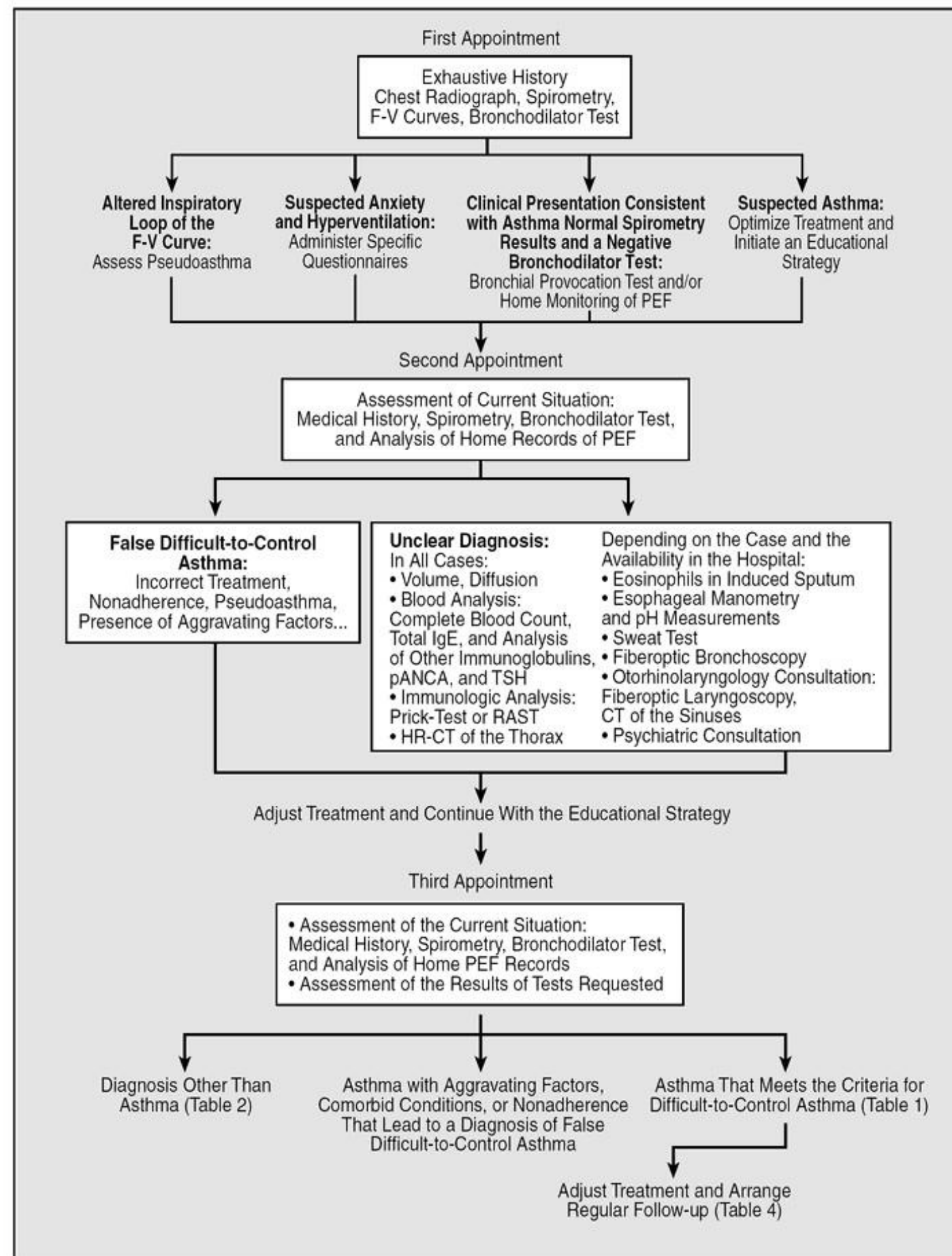


TABLE 2

**Situations Leading to False Difficult-to-Control Asthma**

Incorrect diagnosis of asthma

Comorbid conditions with similar symptoms

- Obstruction of the upper airway (vocal cord dysfunction, tracheal stenosis, etc)
- Hyperventilation syndrome
- Hyperthyroidism
- Rhinosinusitis
- Gastroesophageal reflux
- Bronchiectasis

Uncontrolled aggravating factors

- Exposure to allergens (pets)
- Occupational asthma
- Drugs ( $\beta$ -blockers, nonsteroidal antiinflammatory drugs, etc)

Treatment nonadherence



# Asthma Management and Prevention Program

## Goals of Long-term Management

- Achieve and maintain control of symptoms
- Maintain normal activity levels, including exercise
- Maintain pulmonary function as close to normal levels as possible
- Prevent asthma exacerbations
- Avoid adverse effects from asthma medications
- Prevent asthma mortality

# Asthma Management and Prevention Program

## Component 1: Develop Patient/Doctor Partnership

- Educate continually
- Include the family
- Provide information about asthma
- Provide training on self-management skills
- Emphasize a partnership among health care providers, the patient, and the patient's family



# Asthma Management and Prevention Program

## Component 2: Identify and Reduce Exposure to Risk Factors

- Measures to prevent the development of asthma, and asthma exacerbations by avoiding or reducing exposure to risk factors should be implemented wherever possible.
- Asthma exacerbations may be caused by a variety of risk factors—allergens, viral infections, pollutants and drugs.
- Reducing exposure to some categories of risk factors improves the control of asthma and reduces medications needs.

# Asthma Management and Prevention Program

## Component 2: Identify and Reduce Exposure to Risk Factors

- Reduce exposure to indoor allergens
- Avoid tobacco smoke
- Avoid vehicle emission
- Identify irritants in the workplace
- Explore role of infections on asthma development, especially in children and young infants



# Asthma Management and Prevention Program

## Influenza Vaccination

- Influenza vaccination should be provided to patients with asthma when vaccination of the general population is advised
- However, routine influenza vaccination of children and adults with asthma does not appear to protect them from asthma exacerbations or improve asthma control

# Global Strategy for Asthma Management and Prevention

## Clinical Control of Asthma

- Determine the initial level of control to implement treatment (assess patient impairment)
- Maintain control once treatment has been implemented (assess patient risk)



# Levels of Asthma Control

(Assess patient impairment)

| Characteristic                         | Controlled<br>(All of the following) | Partly controlled<br>(Any present in any week) | Uncontrolled                                                       |
|----------------------------------------|--------------------------------------|------------------------------------------------|--------------------------------------------------------------------|
| Daytime symptoms                       | Twice or less per week               | More than twice per week                       | 3 or more features of partly controlled asthma present in any week |
| Limitations of activities              | None                                 | Any                                            |                                                                    |
| Nocturnal symptoms / awakening         | None                                 | Any                                            |                                                                    |
| Need for rescue / "reliever" treatment | Twice or less per week               | More than twice per week                       |                                                                    |
| Lung function                          | Normal                               | < 80% predicted or personal best (if           |                                                                    |

Assessment of Future Risk (risk of exacerbations, instability, rapid decline in lung function, side effects)

# Assess Patient Risk

Features that are associated with increased risk of adverse events in the future include:

- Poor clinical control
- Frequent **exacerbations** in past year
- Ever admission to critical care for asthma
- Low FEV<sub>1</sub>, exposure to cigarette smoke, high dose medications



## Component 3: Assess, Treat and Monitor Asthma

- Depending on level of asthma control, the patient is assigned to one of five treatment steps
- Treatment is adjusted in a continuous cycle driven by changes in asthma control status. The cycle involves:
  - Assessing Asthma Control
  - Treating to Achieve Control
  - Monitoring to Maintain Control

The choice of treatment should be guided by:

- Level of asthma control
- Current treatment
- Pharmacological properties and availability of the various forms of asthma treatment
- Economic considerations

Cultural preferences and differing health care systems need to be considered.



# Controller Medications

---

- Inhaled glucocorticosteroids
- Leukotriene modifiers
- Long-acting inhaled  $\beta_2$ -agonists in combination with inhaled glucocorticosteroids
- Systemic glucocorticosteroids
- Theophylline
- Cromone
- s Anti-IgE

# Estimate Comparative Daily Dosages for Inhaled Glucocorticosteroids by Age

| Drug | Low Daily Dose (µg) |           | Medium Daily Dose (µg) |           | High Daily Dose (µg) |           |
|------|---------------------|-----------|------------------------|-----------|----------------------|-----------|
|      | > 5 y               | Age < 5 y | > 5 y                  | Age < 5 y | > 5 y                | Age < 5 y |

|                                      |          |         |            |           |           |       |
|--------------------------------------|----------|---------|------------|-----------|-----------|-------|
| Beclomethasone                       | 200-500  | 100-200 | >500-1000  | >200-400  | >1000     | >400  |
| Budesonide                           | 200-600  | 100-200 | 600-1000   | >200-400  | >1000     | >400  |
| Budesonide-Neb Inhalation Suspension | 250-500  |         | 500-1000   |           | >1000     |       |
| Ciclesonide                          | 80–160   | 80-160  | >160-320   | >160-320  | >320-1280 | >320  |
| Flunisolide                          | 500-1000 | 500-750 | >1000-2000 | >750-1250 | >2000     | >1250 |
| Fluticasone                          | 100-250  | 100-200 | >250-500   | >200-500  | >500      | >500  |
| Mometasone furoate                   | 200-400  | 100-200 | > 400-800  | >200-400  | >800-1200 | >400  |
| Triamcinolone acetonide              | 400-1000 | 400-800 | >1000-2000 | >800-1200 | >2000     | >1200 |



# Reliever Medications

---

- Rapid-acting inhaled  $\beta_2$ -agonists
- Systemic glucocorticosteroids
- Anticholinergics
- Theophylline
- Short-acting oral  $\beta_2$ -agonists

## Allergen-specific Immunotherapy

- Greatest benefit of specific immunotherapy using allergen extracts has been obtained in the treatment of allergic rhinitis
- The role of specific immunotherapy in asthma is limited
- Specific immunotherapy should be considered only after strict environmental avoidance and pharmacologic intervention, including inhaled glucocorticosteroids, have failed to control asthma
- Perform only by trained physician



## LEVEL OF CONTROL

## TREATMENT OF ACTION

controlled

maintain and find lowest controlling step

partly controlled

consider stepping up to gain control

uncontrolled

step up until controlled

exacerbation

treat as exacerbation

REDUCE

INCREASE

REDUCE

INCREASE

## TREATMENT STEPS

STEP

1

STEP

2

STEP

3

STEP

4

STEP

5

**FIGURE 1: CLASSIFYING ASTHMA SEVERITY AND INITIATING TREATMENT  
IN PATIENTS  $\geq 12$  YEARS OF AGE**

| Components of Severity                                                                                                 |                                                                                         | Classification of Asthma Severity<br>≥12 years of age                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                          |                                                                                                                                          |                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                        |                                                                                         | Intermittent                                                                                                                                                                                                                                                                                                                                                                                                   | Persistent                                                                                                               |                                                                                                                                          |                                                                                                                                  |
|                                                                                                                        |                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                | Mild                                                                                                                     | Moderate                                                                                                                                 | Severe                                                                                                                           |
| <b>Impairment</b><br><br>Normal FEV <sub>1</sub> /FVC:<br>8–19 yr 85%<br>20–39 yr 80%<br>40–59 yr 75%<br>60–80 yr 70%  | 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 <sub>2</sub> -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"><li>• Normal FEV<sub>1</sub> between exacerbations</li><li>• FEV<sub>1</sub> &gt;80% predicted</li><li>• FEV<sub>1</sub>/FVC normal</li></ul>                                                                                                                                                                                                                                | <ul style="list-style-type: none"><li>• FEV<sub>1</sub> &gt;80% predicted</li><li>• FEV<sub>1</sub>/FVC normal</li></ul> | <ul style="list-style-type: none"><li>• FEV<sub>1</sub> &gt;60% but &lt;80% predicted</li><li>• FEV<sub>1</sub>/FVC reduced 5%</li></ul> | <ul style="list-style-type: none"><li>• FEV<sub>1</sub> &lt;60% predicted</li><li>• FEV<sub>1</sub>/FVC reduced &gt;5%</li></ul> |
| <b>Risk</b>                                                                                                            | Exacerbations requiring oral systemic corticosteroids                                   | 0–1/year (see note)                                                                                                                                                                                                                                                                                                                                                                                            | ≥2/year (see note)                  |                                                                                                                                          |                                                                                                                                  |
|                                                                                                                        |                                                                                         |  Consider severity and interval since last exacerbation. <br>Frequency and severity may fluctuate over time for patients in any severity category.<br><br>Relative annual risk of exacerbations may be related to FEV <sub>1</sub> . |                                                                                                                          |                                                                                                                                          |                                                                                                                                  |
| <b>Recommended Step for Initiating Treatment</b><br>(See “Stepwise Approach for Managing Asthma” for treatment steps.) |                                                                                         | Step 1                                                                                                                                                                                                                                                                                                                                                                                                         | Step 2                                                                                                                   | Step 3                                                                                                                                   | Step 4 or 5                                                                                                                      |
|                                                                                                                        |                                                                                         | and consider short course of oral systemic corticosteroids                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                          |                                                                                                                                          |                                                                                                                                  |
|                                                                                                                        |                                                                                         | In 2–6 weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly.                                                                                                                                                                                                                                                                                                                |                                                                                                                          |                                                                                                                                          |                                                                                                                                  |

Source: NIH, National Heart, Lung and Blood Institute. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3 2007). <http://www.nhlbi.nih.gov/guidelines/asthma/index.htm>.



REDUCE

INCREASE

## TREATMENT STEPS

STEP  
**1**STEP  
**2**STEP  
**3**STEP  
**4**STEP  
**5**

asthma education

environmental control

as needed rapid-  
acting  $\beta_2$ -agonistas needed rapid-acting  $\beta_2$ -agonist

SELECT ONE

SELECT ONE

TO STEP 3 TREATMENT,  
SELECT ONE OR MORE:TO STEP 4 TREATMENT, ADD  
EITHER

CONTROLLER OPTIONS

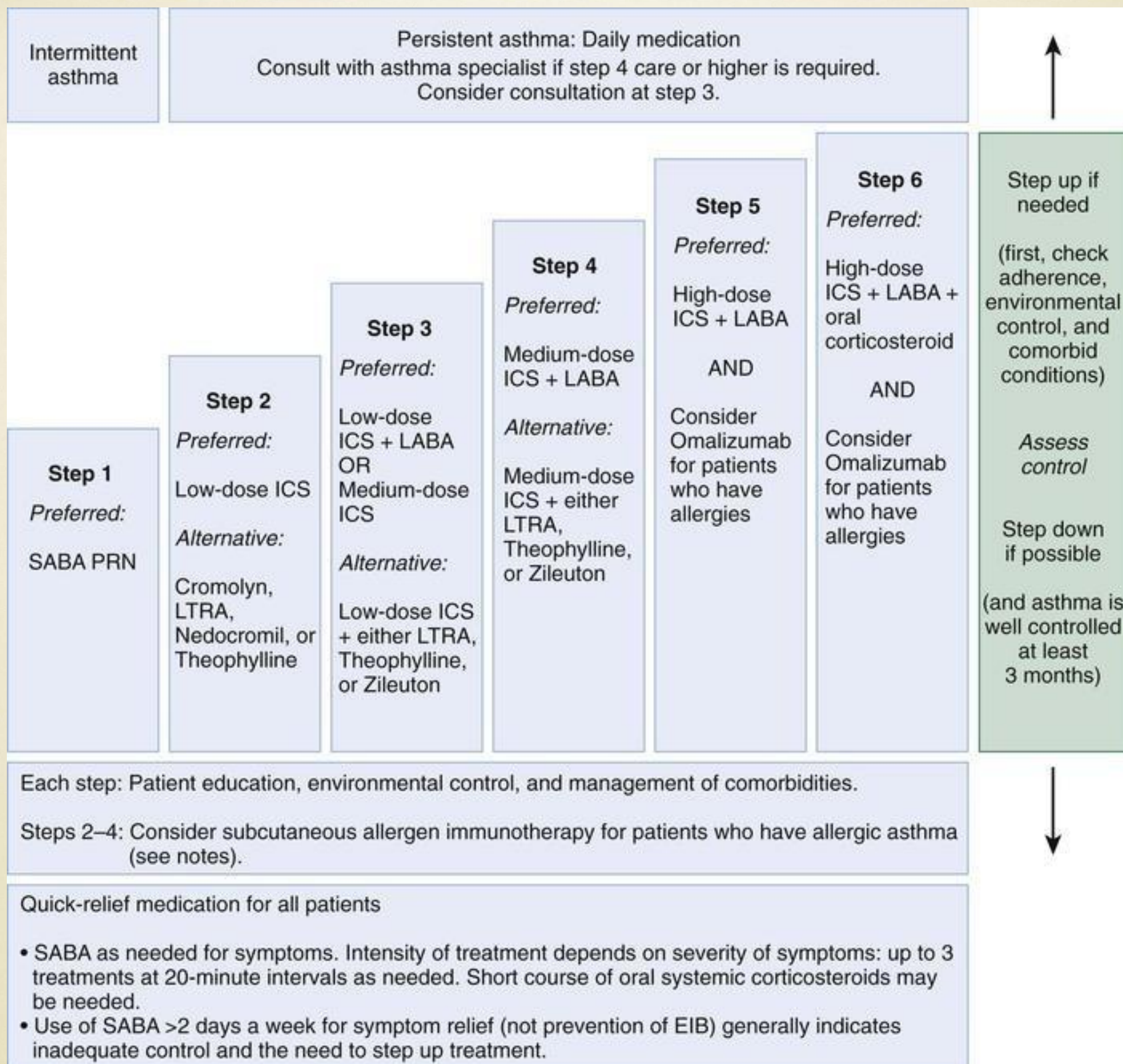
low-dose ICS\*

low-dose ICS  
*plus* long-acting  
 $\beta_2$ -agonistmedium- *or*  
high-dose ICS  
*plus* long-acting  
 $\beta_2$ -agonistoral  
glucocorticosteroid  
(lowest dose)leukotriene  
modifier\*\*medium- *or*  
high-dose ICSleukotriene  
modifieranti-IgE  
treatmentlow-dose ICS *plus*  
leukotriene modifiersustained-release  
theophyllinelow-dose ICS *plus*  
sustained-release  
theophylline

\*inhaled glucocorticosteroids

\*\* receptor antagonist or synthesis inhibitors

Shaded green - preferred controller options







**KEEP CALM,  
STUDY HARD  
AND  
BECOME A  
DOCTOR**

# Asthma Management and Prevention Program

## Component 4: Manage Asthma Exacerbations

---

- Exacerbations of asthma are episodes of progressive increase in shortness of breath, cough, wheezing, or chest tightness
- Exacerbations are characterized by decreases in expiratory airflow that can be quantified and monitored by measurement of lung function (FEV<sub>1</sub> or PEF)
- Severe exacerbations are potentially life-threatening and treatment requires close supervision



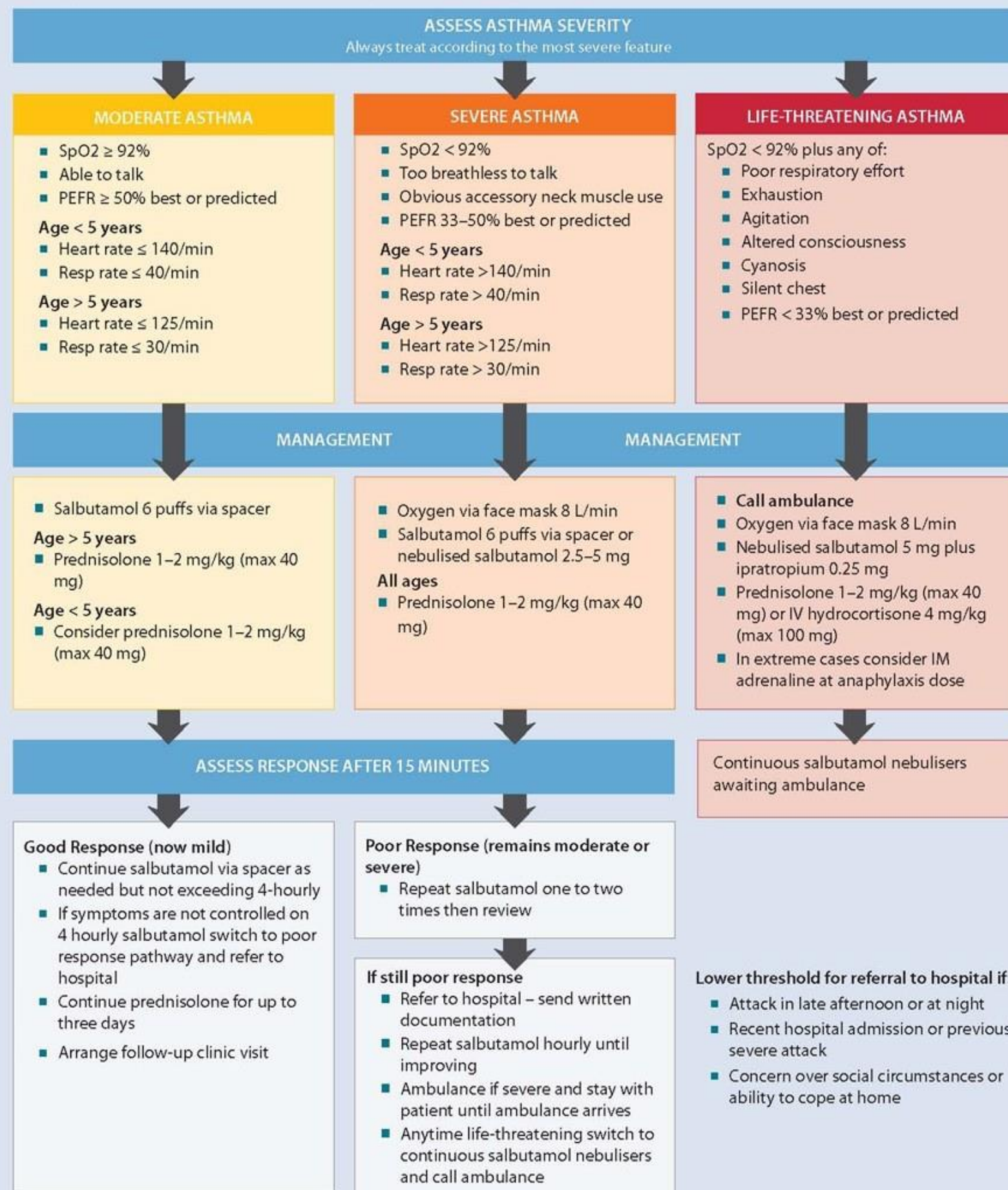
## Component 4: Manage Asthma Exacerbations

---

### Primary therapies for exacerbations:

- Repetitive administration of rapid-acting inhaled  $\beta_2$ -agonist
- Early introduction of systemic glucocorticosteroids
- Oxygen supplementation

Closely monitor response to treatment with serial measures of lung function





# Management of Life-Threatening Asthma in the Emergency Department

## Step One

- |                                                 |                                                                                                                                                                                 |                                                                                                                                                                     |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Continuous nebulized albuterol               | Use oxygen for nebulization <b>not</b> room air<br>8 liters per minute<br>Nebulizer will need to be refilled every 10-15 min<br>Dose is not important, <b>keep making smoke</b> | <b>Consider the differential</b><br>CHF<br>Pneumothorax<br>ACS<br>Arrhythmia<br>Pulmonary embolism<br>Airway obstruction /<br>Foreign body<br>Pericardial tamponade |
| 2. Nebulized ipratropium bromide                | 500 mcg, added to albuterol q20 min x 3, then q1h                                                                                                                               |                                                                                                                                                                     |
| 3. Methylprednisolone 125 mg (1.5 mg/kg) IV     | Alternative: Dexamethasone 20 mg IM or IV                                                                                                                                       |                                                                                                                                                                     |
| 4. Magnesium sulfate 2 g (50 mg/kg, max 2 g) IV | Give over 20 minutes                                                                                                                                                            |                                                                                                                                                                     |
| 5. Nebulized epinephrine                        | 0.5 mL of 2.25% racemic epi in 3 mL NS or 5 mL of standard 1:1000 L-epinephrine (1 mg in 1 mL)                                                                                  |                                                                                                                                                                     |

IF NO IMPROVEMENT

## Step Two

- |                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Epinephrine 0.5 mg (.01 mg/kg, max 0.5 mg) IM                                                                            | Proper concentration of epi for IM injection is 1:1000 (1 mg in 1 mL), so 0.5 mg = 0.5 mL<br>May repeat q10 min, or start IV drip at 5 mcg/min and titrate to effect<br>Instant epi drip: 1 amp crash cart epi (1 mg in 10 mL) in 1 liter NS, start at 2 drops/sec, titrate up<br>Alternative to epi: Terbutaline 10 mcg/kg IV bolus over 10 min, then titrate from 0.4 mcg/kg/minute |
| 2. Fluid bolus 20 cc/kg normal saline                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                       |
| 3. Diagnostics: Chest X-ray, CBC, chemistry, venous blood gas, HCG, ECG if concern for non-sinus rhythm or cardiac ischemia |                                                                                                                                                                                                                                                                                                                                                                                       |

### Agitated Patient

**Ketamine**  
1.5 mg/kg IV over 30 seconds,  
then 1 mg/kg/hour  
Titrate drip to effect  
If no IV: 5 mg/kg IM

IF WORSENING

**Non-Invasive Ventilation**  
Inspiratory support / IPAP / PS: 8 cm H<sub>2</sub>O  
Expiratory support / EPAP / PEEP: 3 cm H<sub>2</sub>O  
Continue nebulizer treatments through NIV

IF NO IMPROVEMENT

**Able to Tolerate NIV?**

NO

YES

## Step Three

**AVOID INTUBATION IF POSSIBLE**

### Cooperative Patient

**Non-Invasive Ventilation**  
Inspiratory support / IPAP / PS: 8 cm H<sub>2</sub>O  
Expiratory support / EPAP / PEEP: 3 cm H<sub>2</sub>O  
Continue nebulizer treatments through NIV

IF WORSENING

**Ketamine**  
1.5 mg/kg IV over 30 seconds,  
then 1 mg/kg/hour  
Titrate drip to effect  
If no IV: 5 mg/kg IM

IF WORSENING

IF WORSENING

## Intubation and Ventilation of the Asthmatic

### Indications

Progressive fatigue / respiratory failure  
Progressive deterioration of mental status  
Cardiac arrest

### Technique

Maximize preoxygenation  
Optimize for first pass success  
Induce while patient is upright  
Use largest ETT possible  
Be mindful of tendency to bag-mask ventilate too aggressively; this leads to breath stacking

### RSI Meds

Ketamine 2 mg/kg +  
Rocuronium 1.2 mg/kg or  
Succinylcholine 2 mg/kg

### Initial Vent Settings

Assist control / Volume control  
Respiratory rate 8 breaths/min  
Tidal volume 7 mL/kg IBW  
PEEP 2 cm H<sub>2</sub>O  
Inspiratory flow: 90 lpm (or I:E 1:5)  
FiO<sub>2</sub> 100%

**Plateau pressure** is measured by using the **inspiratory pause** function and noting airway pressure during the inspiratory hold

### Vent Management

Goal is plateau pressure < 30 cm H<sub>2</sub>O  
If Pplat too high, decrease rate, then tidal volume  
Continue nebulized albuterol  
Paralyze if needed, deep sedation/analgesia preferred  
External chest compression to assist exhalation  
Can accept saturation as low as mid 80s (goal ≥ 90%)  
Can accept high pCO<sub>2</sub> for several hours (goal pH > 7.15)  
Aggressive airway suctioning  
Frequent electrolyte checks, watch for hypokalemia  
Consider inhalational anesthetic, heliox

### If Patient Crashes on Vent

#### DISCONNECT VENTILATOR

External chest compression to assist exhalation  
Bag mask ventilation - do not overventilate  
Verify that ETT not displaced / clogged / kinked  
Bilateral thorocostomy  
Bolus fluid, epinephrine  
Consider ECMO/bypass



For each item below think about the statement that most closely reflects what you are currently experiencing.

| Step 1 | What to Look for                                                                          | CONTROLLED ASTHMA                                                                                                                                      | UNCONTROLLED ASTHMA                                                                                                                                                                                                                                                                                                                                         | DANGEROUSLY UNCONTROLLED ASTHMA                                                                                                                                                                                                                                                                                             |
|--------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | Physical activity →                                                                       | Normal <input type="checkbox"/>                                                                                                                        | Some interruption with activities <input type="checkbox"/>                                                                                                                                                                                                                                                                                                  | Difficulty talking <input type="checkbox"/>                                                                                                                                                                                                                                                                                 |
|        | *Reliever use →                                                                           | Less than 4 times / week <input type="checkbox"/>                                                                                                      | 4 or more times / week <input type="checkbox"/>                                                                                                                                                                                                                                                                                                             | Reliever inhaler doesn't work as usual<br>OR<br>Relief lasts less than 2 hours <input type="checkbox"/>                                                                                                                                                                                                                     |
|        | Day time symptoms:<br><small>may include: cough, difficulty breathing, wheeze</small> →   | Less than 4 days / week <input type="checkbox"/>                                                                                                       | 4 or more days / week <input type="checkbox"/>                                                                                                                                                                                                                                                                                                              | All the time <input type="checkbox"/>                                                                                                                                                                                                                                                                                       |
|        | Night time symptoms:<br><small>may include: cough, difficulty breathing, wheeze</small> → | Less than 1 night / week <input type="checkbox"/>                                                                                                      | 1 or more nights / week <input type="checkbox"/>                                                                                                                                                                                                                                                                                                            | Every night <input type="checkbox"/>                                                                                                                                                                                                                                                                                        |
|        | Peak Flow Rates<br><small>(optional)</small> →                                            | Greater than <input type="text"/>                                                                                                                      | Between <input type="text"/> and <input type="text"/>                                                                                                                                                                                                                                                                                                       | Less than <input type="text"/>                                                                                                                                                                                                                                                                                              |
| Step 2 | What is my level of asthma control? →                                                     | If all checks are in the green column, your asthma is under control (Green Zone).                                                                      | If you have any checks in the yellow column and zero checks in the red column, your asthma is uncontrolled and in the Yellow Zone.                                                                                                                                                                                                                          | If you have any checks in the red column, your asthma is dangerously uncontrolled (Red Alert Zone).                                                                                                                                                                                                                         |
| Step 3 | Steps to Take                                                                             | Follow your current plan.<br><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div> | Make an appointment to see your doctor <input type="checkbox"/><br>Follow the steps below:<br><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><br><div>• Continue this treatment for <input type="text"/> days.<br/>• If asthma is not improving within <input type="text"/> days see your doctor.</div> | Seek Immediate Medical Assistance<br><div>• Go to your nearest emergency room<br/>• Call 911<br/>• Take your reliever inhaler as necessary.<br/>May take every 10 - 20 minutes on way to the hospital or as recommended by your doctor.</div> <div><div></div><div></div><div></div><div></div><div></div><div></div></div> |



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