Asthma: Pediatric and Adult

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Disclosure Statement

Dr. King has nothing to disclose

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Learning Objectives

1. Identify a treatment rationale for the patient who presents with acute status asthmaticus.
2. Describe pharmacologic therapy in the treatment of asthma.
3. State the current NIH guidelines for the treatment of chronic asthma.
4. Discuss the approach to the pregnant patient with asthma.
Asthma

- National Heart, Lung, and Blood Institute (NHLBI) practice guidelines
- National Asthma Education and Prevention Program (NAEPP) Third Expert Panel Report (EPR-3)
  - Initial report in 1991
  - Second report in 1997
    - Updated in 2002
  - Third report in 2007
    - Most comprehensive EB guidance for Dx and Rx to date
EPR-3: What Changed in 2007?

• Recommend assessing asthma severity before starting Rx and assessing asthma control to guide adjustments in Rx (SOR B, C)
• Address both severity and control in terms of impairment and risk (SOR A)
• Feature 3 age breakdowns (0-4 yrs, 5-11 yrs, ≥ 12 yrs) and a 6-step approach to management (SOR C)
• Make it easier to individualize and adjust Rx (SOR B)
1. & 2. A 33-year-old female with no chronic illnesses arrives in your office relating a history of several episodes of shortness of breath associated with a hacky cough and chest tightness. She recently developed nasal congestion, sinus pressure, and muscle aches and thinks she has a cold. She has occasionally before been short of breath, does not smoke, and has no family history of respiratory disease. She has taken over-the-counter decongestants and cough suppressants with little relief of the coughing. She takes no prescription drugs.

VS: BP 108/65, HR 80, RR 14, T 37.2 degrees C, O2 sats 95% on RA.

PE: is remarkable for clear rhinorrhea, mild scattered expiratory wheezes, a normal cardiac exam, and non-tender maxillary and frontal sinuses.
1. What is the most likely trigger for her current symptoms?

A. Viral upper respiratory tract infection
B. Allergic rhinitis
C. Acute bacterial bronchitis
D. Gastroesophageal reflux
1. What is the most likely trigger for her current symptoms?

A. Viral upper respiratory tract infection (86%)
B. Allergic rhinitis (14%)
C. Acute bacterial bronchitis (0%)
D. Gastroesophageal reflux (1%)
2. What initial treatment would you prescribe for her at this time?

A. Montelukast
B. A steroid nasal spray
C. Corticosteroid inhaler
D. Albuterol inhaler
2. What initial treatment would you prescribe for her at this time?

A. Montelukast
B. A steroid nasal spray
C. Corticosteroid inhaler
D. Albuterol inhaler

90% D. Albuterol inhaler
What Is Asthma?

Clinical symptoms (recurrent)
- Intermittent Sxs
  - Cough
  - Wheeze
  - SOB/breathlessness
  - Chest pain
  - Rescue med use
  - Diurnal variation
  - Varying triggers
- Exacerbations
  - Perennial/seasonal
  - Episodic/continual
  - Diurnal
What Is Asthma?

Biological indicators, pathophysiology

• Chronic airway inflammation
• Bronchial hyperresponsiveness (BHR)
• Airflow limitation
  – Airway smooth muscle bronchoconstriction
  – Airway edema
  – Mucus plug formation
  – Bronchiolar obstruction
  – Airway remodeling
Asthma Differential Dx

- Viral pneumonitis/bronchitis
- COPD
- GERD
- Pneumothorax
- Pulmonary embolism
- Vocal cord dysfunction syndrome
- Pulmonary edema
- Endobronchial obstruction (tumor or FB)
- Acute hypersensitivity pneumonitis
- Epiglottitis
# COPD vs Asthma

<table>
<thead>
<tr>
<th>Symptom</th>
<th>COPD</th>
<th>Asthma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic cough &amp; sputum</td>
<td>Common</td>
<td>Variable</td>
</tr>
<tr>
<td>Breathlessness on exertion or poor lung function</td>
<td>Persistent; slowly progressive</td>
<td>Variable, intermittent, largely reversible</td>
</tr>
<tr>
<td>Onset prior to 40 yrs</td>
<td>Less common</td>
<td>Common</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>Almost always</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Airway hyperresponsiveness</td>
<td>Common</td>
<td>Always</td>
</tr>
<tr>
<td>Progression of Sxs</td>
<td>Slowly; little variability</td>
<td>Episodic and variable</td>
</tr>
<tr>
<td>Identifiable triggers</td>
<td>Uncommon</td>
<td>Common</td>
</tr>
<tr>
<td>Bronchodilator response</td>
<td>Modest</td>
<td>Often marked</td>
</tr>
</tbody>
</table>
3. Which of the following tests would you use to better categorize a wheezing patient’s condition?

A. Spirometry
B. CXR
C. ABG
D. Methacholine challenge
3. Which of the following tests would you use to better categorize a wheezing patient’s condition?

A. Spirometry  
B. CXR  
C. ABG  
D. Methacholine challenge

- A. Spirometry: 83%  
- B. CXR: 1%  
- C. ABG: 0%  
- D. Methacholine challenge: 17%
Establishing a Diagnosis

- Based on a patient’s
  - Medical history
  - Physical exam
  - Pulmonary function tests (PFTs)
  - Laboratory tests
- Spirometry (PFTs) is recommended in order to make the Dx
- Level of severity based on
  - Impairment
  - Risk
Clinical Testing

• Spirometry
  – Recommended for every pt ≥ 5 yrs of age
  • If pt < 5 yrs of age, a therapeutic trial of medication is recommended

• Studies specific to individual patients
  – Allergy testing
  – CXR
  – Bronchial provocation testing
  – Sinus x-rays or CT scan
  – GERD evaluation
  – CBC with eosinophils, total IgE, sputum exam
4. Which one of the following PFT results is most likely to be below the normal predicted range in a patient with asthma?

A. FVC (forced vital capacity)  
B. FEV1 (forced expiratory volume in 1 second)  
C. TLC (total lung capacity)  
D. FRC (functional residual capacity)
4. Which one of the following PFT results is most likely to be below the normal predicted range in a patient with asthma?

A. FVC (forced vital capacity)
B. FEV1 (forced expiratory volume in 1 second)
C. TLC (total lung capacity)
D. FRC (functional residual capacity)

B. FEV1 (forced expiratory volume in 1 second)
5. What percentage of airway reversibility and change in FEV1 do you need in order to confirm the diagnosis of asthma?

A. 12% and 500 mL  
B. 25% and 200 mL  
C. 12% and 200 mL  
D. 18% and 100 mL
5. What percentage of airway reversibility and change in FEV1 do you need in order to confirm the diagnosis of asthma?

A. 12% and 500 mL
B. 25% and 200 mL
C. 12% and 200 mL
D. 18% and 100 mL

C. 12% and 200 mL
Spirometry

- Measurements pre and post a short-acting beta$_2$-agonist (SABA)
  - FEV1
  - FVC
  - FEV1/FVC
- Airflow obstruction
  - Reduced FEV1 and FEV1/FVC values relative to predicted values (FEV1 < 80% predicted)
- Significant reversibility after inhaling a SABA
  - Increase by ≥ 12% and
  - 200 mL in FEV1
Pulmonary Function Tests

Asthmatic patient

- FEV1 is decreased to < 80% predicted
- FVC may fall, but FEV1 is much more commonly below predicted
- TLC is normal to elevated
- FRC is usually elevated
# Asthma Triggers

<table>
<thead>
<tr>
<th>URI</th>
<th>Environmental</th>
<th>Occupational or Recreational</th>
<th>Drug</th>
<th>CHF</th>
<th>GERD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viral</td>
<td>Allergens</td>
<td>Allergens</td>
<td>ASA</td>
<td>Cardiac asthma</td>
<td>Trigger for bronchospasm</td>
</tr>
<tr>
<td></td>
<td>Irritants</td>
<td>Irritants</td>
<td>NSAIDs</td>
<td></td>
<td>Consider in both pediatric and adult patients</td>
</tr>
<tr>
<td></td>
<td>-Perfume</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Tobacco smoke</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Wood burning stoves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td></td>
<td>Beta blockers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td></td>
<td>Sulfites (food)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. In considering the atopic patient and asthma. Which of the following is true?

A. Atopy is a strong predisposing factor for the patient with asthma
B. A peripheral eosinophil count is always elevated in patients with atopy and asthma
C. The CXR is usually abnormal in asthma
D. Skin allergy tests are always positive in the atopic patient
6. In considering the atopic patient and asthma. Which of the following is true?

A. Atopy is a strong predisposing factor for the patient with asthma

B. A peripheral eosinophil count is always elevated in patients with atopy and asthma

C. The CXR is usually abnormal in asthma

D. Skin allergy tests are always positive in the atopic patient
The Atopic Patient

• Atopy is one of the strongest predisposing factors for the patient with asthma
  – Genetic predisposition for the development of an IgE mediated response

• Investigation into the role of allergy
  – Complete history in every patient is indicated
    • There is a high prevalence of positive skin tests among individuals with asthma
    • Benefits of limiting exposure to known allergens

• History may help to distinguish seasonal allergies but may be inadequate for perennial allergies
The Atopic Patient

- Eosinophil count and IgE may be elevated in asthma
  - Neither test has sufficient specificity or sensitivity to be used alone in a diagnosis
- The chest x-ray and electrocardiogram are usually normal in asthma
  - May be useful to exclude other pulmonary or cardiac conditions
- Sputum examination may be helpful if sputum eosinophilia or infection are suspected
Allergy Treatment Can Improve Asthma Sxs

- **Key to control**
  - Avoidance of allergens or environmental control

- **Intranasal corticosteroids**
  - Reduce both allergic rhinitis and asthma sx in pts with mild asthma

- **Antihistamines alone or combined with a decongestant**
  - May reduce asthma and rhinitis sx

- **Leukotriene modulators**
  - Treat sx of asthma and allergic rhinitis at the same time

- **Immunotherapy**
  - May reduce development of asthma in pts with seasonal rhinoconjunctivitis
Control of House Dust Mites

Recommended actions (controversial and expensive)

• Encase the mattress in an allergen impermeable cover
• Encase the pillow in an allergen impermeable cover or wash it weekly
• Wash the sheets and blankets on the patient's bed weekly in hot water
  – A temperature of 130°F is necessary for killing house-dust mites

Cochrane Review 2011

• Sums up the results of 55 randomized trials of mite control.
• There was no difference in peak flow (a measure of lung function), asthma symptoms and medication scores, or the number of patients reporting an improvement in their asthma symptoms.
Severity and Control

Severity

• A measure of the intrinsic intensity of the disease process established ideally before initiating treatment

Control

• Monitored over time to guide adjustments to therapy
Assess Severity and Control Within Two Domains

**Impairment:**
- Symptoms (pt or caregiver recall of the past 2-4 wks)
  - Day sxds
  - Nighttime awakenings
  - Rescue SABA use
- Low lung function
  - Quality of life
  - Functional limitations

**Risk:**
- Exacerbations
- Progressive decline in pulmonary function (or reduced lung growth in children)
- Adverse events
- Adverse effects of medication
Assess Severity and Control

• Predictors of increased risk for exacerbations or death:
  – Persistent and/or severe airflow obstruction
  – At least 2 visits to the ED or hospitalizations for asthma within the past year
  – And a history of intubation or admission to the ICU, especially within the past 5 years
## Classification of Asthma Severity (0–4 years of age)

<table>
<thead>
<tr>
<th>Components of Severity</th>
<th>Classification of Asthma Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermittent</td>
</tr>
<tr>
<td>Impairment</td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>0</td>
</tr>
<tr>
<td>Short-acting beta_2-agonist use for symptom control (not prevention of EIB)</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
</tr>
<tr>
<td>Exacerbations requiring oral systemic corticosteroids</td>
<td>0–1/year</td>
</tr>
</tbody>
</table>

Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time.

Exacerbations of any severity may occur in patients in any severity category.

### Recommended Step for Initiating Therapy

(See figure 4–1a for treatment steps.)

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3 and consider short course of oral systemic corticosteroids</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Classifying Asthma Severity and Initiating Treatment in Children 5–11 Years of Age

<table>
<thead>
<tr>
<th>Components of Severity</th>
<th>Classification of Asthma Severity (5–11 years of age)</th>
<th>Persistent</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermittent</td>
<td>Mild</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>&lt;2 days/week</td>
<td>&gt;2 days/week but not daily</td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>≤2x/month</td>
<td>3–4x/month</td>
<td>&gt;1x/week but not nightly</td>
</tr>
<tr>
<td></td>
<td>&lt;2 days/week but not daily</td>
<td>&gt;2 days/week</td>
<td>Daily</td>
</tr>
<tr>
<td>Impairment</td>
<td>Interference with normal activity</td>
<td>None</td>
<td>Minor limitation</td>
</tr>
<tr>
<td></td>
<td>Lung function</td>
<td>Normal FEV₁ between exacerbations</td>
<td>FEV₁ = &gt;80% predicted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FEV₁ &gt;80% predicted</td>
<td>FEV₁/FVC &gt;80%</td>
</tr>
<tr>
<td>Risk</td>
<td>Exacerbations requiring oral systemic corticosteroids</td>
<td>0–1/year (see note)</td>
<td>≥2/year (see note)</td>
</tr>
</tbody>
</table>

**Recommended Step for Initiating Therapy**
(See figure 4–1b for treatment steps.)

- **Step 1**: Evaluate level of asthma control that is achieved, and adjust therapy accordingly.
- **Step 2**: Step 3, medium-dose ICS option
- **Step 3**: Step 3, medium-dose ICS option, or step 4 and consider short course of oral systemic corticosteroids
## Classifying Asthma Severity and Initiating Treatment in Youths ≥12 Years of Age and Adults

<table>
<thead>
<tr>
<th>Components of Severity</th>
<th>Classification of Asthma Severity ≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Intermittent</strong></td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Nighttime awakenings</strong></td>
<td>≤2x/month</td>
</tr>
<tr>
<td><strong>Short-acting beta₂-agonist use for symptom control (not prevention of EIB)</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Interference with normal activity</strong></td>
<td>None</td>
</tr>
</tbody>
</table>

### Impairment

**Normal FEV₁/FVC:**
- 8–19 yr: 85%
- 20–39 yr: 80%
- 40–59 yr: 75%
- 60–80 yr: 70%

### Risk

<table>
<thead>
<tr>
<th>Exacerbations requiring oral systemic corticosteroids</th>
<th>0–1/year (see note)</th>
<th>≥2/year (see note)</th>
</tr>
</thead>
</table>

- Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category.
- Relative annual risk of exacerbations may be related to FEV₁.

### Recommended Step for Initiating Treatment

(See figure 4–5 for treatment steps.)

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4 or 5</th>
</tr>
</thead>
</table>

- In 2–6 weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly.
## ASSESSING ASTHMA CONTROL AND ADJUSTING THERAPY IN CHILDREN 0–4 YEARS OF AGE

<table>
<thead>
<tr>
<th>Components of Control</th>
<th>Classification of Asthma Control (0–4 years of age)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well Controlled</td>
</tr>
<tr>
<td><strong>Impairment</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≤1x/month</td>
</tr>
<tr>
<td>Interference with</td>
<td>None</td>
</tr>
<tr>
<td>normal activity</td>
<td></td>
</tr>
<tr>
<td>Short-acting</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>beta&lt;sub&gt;2&lt;/sub&gt;-agonist use for symptom control (not prevention of EIB)</td>
<td></td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>0–1/year</td>
</tr>
<tr>
<td>Exacerbations requiring oral systemic corticosteroids</td>
<td></td>
</tr>
<tr>
<td>Treatment-related</td>
<td>Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.</td>
</tr>
<tr>
<td>adverse effects</td>
<td></td>
</tr>
</tbody>
</table>

### Recommended Action for Treatment

(See figure 4–1a for treatment steps.)

- Maintain current treatment.
- Regular follow-up every 1–6 months.
- Consider step down if well controlled for at least 3 months.
- Step up (1 step) and reevaluate in 2–6 weeks.
- If no clear benefit in 4–6 weeks, consider alternative diagnoses or adjusting therapy.
- For side effects, consider alternative treatment options.
- Consider short course of oral systemic corticosteroids.
- Step up (1–2 steps), and reevaluate in 2 weeks.
- If no clear benefit in 4–6 weeks, consider alternative diagnoses or adjusting therapy.
- For side effects, consider alternative treatment options.
# Assessing Asthma Control and Adjusting Therapy in Children 5–11 Years of Age

## Components of Control

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Classification of Asthma Control (5–11 years of age)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well Controlled</strong></td>
<td><strong>Not Well Controlled</strong></td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>≤2 days/week but not more than once on each day</td>
</tr>
<tr>
<td><strong>Nighttime awakenings</strong></td>
<td>≤1x/month</td>
</tr>
<tr>
<td><strong>Interference with normal activity</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Short-acting beta₂-agonist use for symptom control (not prevention of EIB)</strong></td>
<td>≤2 days/week</td>
</tr>
<tr>
<td><strong>Lung function</strong></td>
<td></td>
</tr>
<tr>
<td>• FEV₁ or peak flow</td>
<td>&gt;80% predicted/personal best</td>
</tr>
<tr>
<td>• FEV₁/FVC</td>
<td>&gt;80%</td>
</tr>
<tr>
<td><strong>Exacerbations requiring oral systemic corticosteroids</strong></td>
<td>0–1/year</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Reduction in lung growth</strong></td>
<td>Evaluation requires long-term followup.</td>
</tr>
<tr>
<td><strong>Treatment-related adverse effects</strong></td>
<td>Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.</td>
</tr>
</tbody>
</table>

## Recommended Action for Treatment

(See figure 4–1b for treatment steps.)

- Maintain current step.
- Regular followup every 1–6 months.
- Consider step down if well controlled for at least 3 months.

- Step up at least 1 step and
- Reevaluate in 2–6 weeks.
- For side effects: consider alternative treatment options.

- Consider short course of oral systemic corticosteroids,
- Step up 1–2 steps, and
- Reevaluate in 2 weeks.
- For side effects, consider alternative treatment options.
### ASSESSING ASTHMA CONTROL AND ADJUSTING THERAPY IN YOUTHS ≥12 YEARS OF AGE AND ADULTS

<table>
<thead>
<tr>
<th>Components of Control</th>
<th>Classification of Asthma Control (≥12 years of age)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Well Controlled</td>
</tr>
<tr>
<td>Impairment</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2x/month</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>None</td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Short-acting beta₂-agonist use for symptom control (not prevention of EIB)</td>
<td>&gt;80% predicted/ personal best</td>
</tr>
<tr>
<td>FEV₁ or peak flow</td>
<td>Validated questionnaires</td>
</tr>
<tr>
<td></td>
<td>0 ≤0.75*</td>
</tr>
<tr>
<td></td>
<td>≥20</td>
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<tr>
<td>Exacerbations requiring oral systemic corticosteroids</td>
<td>0–1/year</td>
</tr>
<tr>
<td>Risk</td>
<td>Consider severity and interval since last exacerbation</td>
</tr>
<tr>
<td></td>
<td>Evaluation requires long-term followup care</td>
</tr>
<tr>
<td>Progressive loss of lung function</td>
<td>Treatment-related adverse effects</td>
</tr>
<tr>
<td></td>
<td>Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.</td>
</tr>
</tbody>
</table>

#### Recommended Action for Treatment
(see figure 4–5 for treatment steps)

- Maintain current step.
- Regular followups every 1–6 months to maintain control.
- Consider step down if well controlled for at least 3 months.
- Step up 1 step and reevaluate in 2–6 weeks.
- For side effects, consider alternative treatment options.
- Consider short course of oral systemic corticosteroids,
- Step up 1–2 steps, and reevaluate in 2 weeks.
- For side effects, consider alternative treatment options.
STEPWISE APPROACH FOR MANAGING ASTHMA IN CHILDREN 0–4 YEARS OF AGE

**Step 1**
- Preferred: Medium-dose ICS
- Alternative: Cromolyn or Montelukast

**Step 2**
- Preferred: Medium-dose ICS + either LABA or Montelukast

**Step 3**
- Preferred: High-dose ICS + either LABA or Montelukast

**Step 4**
- Preferred: High-dose ICS + either LABA or Montelukast
- Oral systemic corticosteroids

**Step 5**
- Preferred: High-dose ICS + either LABA or Montelukast

**Step 6**
- Step up if needed (first, check adherence, inhaler technique, and environmental control)
  - Step down if possible (and asthma is well controlled at least 3 months)

**Patient Education and Environmental Control at Each Step**

**Quick-Relief Medication for All Patients**
- SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms.
- With viral respiratory infection: SABA q 4–6 hours up to 24 hours (longer with physician consult). Consider short course of oral systemic corticosteroids if exacerbation is severe or patient has history of previous severe exacerbations.
- Caution: Frequent use of SABA may indicate the need to step up treatment. See text for recommendations on initiating daily long-term-control therapy.
### Stepwise Approach for Managing Asthma in Children 5–11 Years of Age

**Intermittent Asthma**
- Consult with asthma specialist if step 4 care or higher is required.
- Consider consultation at step 3.

| Step 1 | Preferred: Low-dose ICS  
|--------|---------------------------|
|        | Alternative: Cromolyn, LTRA, Nedocromil, or Theophylline  

| Step 2 | Preferred: Medium-dose ICS + LABA  
|--------|----------------------------------|
|        | Alternative: either LTRA or Theophylline  

| Step 3 | Preferred: High-dose ICS + LABA  
|--------|----------------------------------|
|        | Alternative: either LTRA or Theophylline  

| Step 4 | Preferred: High-dose ICS + LABA + oral systemic corticosteroid  
|--------|---------------------------------------------------------------|
|        | Alternative: High-dose ICS + either LTRA or Theophylline  

| Step 5 | Preferred: High-dose ICS + LABA + oral systemic corticosteroid  
|--------|---------------------------------------------------------------|
|        | Alternative: High-dose ICS + either LTRA or Theophylline  

| Step 6 | Preferred: High-dose ICS + LABA + oral systemic corticosteroid  
|--------|---------------------------------------------------------------|
|        | Alternative: High-dose ICS + either LTRA or Theophylline  

**Quick-Relief Medication for All Patients**
- SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms; up to 3 treatments at 20-minute intervals as needed. Short course of oral systemic corticosteroids may be needed.
- Caution: Increasing use of SABA or use >2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.

**Each step:** Patient education, environmental control, and management of comorbidities.
Steps 2–4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma (see notes).
STEPWISE APPROACH FOR MANAGING ASTHMA IN YOUTHS ≥12 YEARS OF AGE AND ADULTS

**Step 1**
Preferred: Low-dose ICS
Alternative: Cromolyn, LTRA, Nedocromil, or Theophylline

**Step 2**
Preferred: Low-dose ICS + LABA
Alternative: Medium-dose ICS + LABA

**Step 3**
Preferred: Medium-dose ICS + LABA
Alternative: Medium-dose ICS + either LTRA, Theophylline, or Zileuton

**Step 4**
Preferred: High-dose ICS + LABA
AND
Consider Omalizumab for patients who have allergies

**Step 5**
Preferred: High-dose ICS + LABA + oral corticosteroid
AND
Consider Omalizumab for patients who have allergies

**Step 6**
Step up if needed (first, check adherence, environmental control, and comorbid conditions)
Assess control
Step down if possible (and asthma is well controlled at least 3 months)

Each step: Patient education, environmental control, and management of comorbidities.
Steps 2–4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma (see notes).

Quick-Relief Medication for All Patients
- SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-minute intervals as needed. Short course of oral systemic corticosteroids may be needed.
- Use of SABA ≥2 days a week for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.
## Asthma Classification

<table>
<thead>
<tr>
<th>Mild Intermittent</th>
<th>Mild Persistent</th>
<th>Moderate Persistent</th>
<th>Severe Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sxs &lt; 2x/wk</td>
<td>Sxs &gt; 2x/wk, but &lt; 1x/d exacerbations may affect activity</td>
<td>Daily sxs, daily use of inhaled SABA, exacerbations affect activity, exacerbations &gt; 2x/wk; may last days</td>
<td>Continual sxs, limited physical activity, frequent exacerbations</td>
</tr>
<tr>
<td>Nocturnal sxs &lt; 2x/mo</td>
<td>Nocturnal sxs &gt; 2x/mo</td>
<td>Nocturnal sxs &gt; 1x/wk</td>
<td>Frequent nocturnal sxs</td>
</tr>
<tr>
<td>FEV1 or PEF &gt; 80% predicted</td>
<td>FEV1 or PEF &gt; 80% predicted</td>
<td>FEV1 or PEF 60%-80% predicted</td>
<td>FEV1 or PEF &lt; 60% predicted</td>
</tr>
<tr>
<td>PEF variability 20%-30%</td>
<td>PEF variability &gt; 30%</td>
<td>PEF variability &gt; 30%</td>
<td></td>
</tr>
</tbody>
</table>

*Am Fam Physician. 2011 Jul 1;84(1):40-47*
7. In classifying the asthmatic patient, an individual with daily symptoms, daily use of a SABA > 2 times/wk but not daily, and with nocturnal symptoms < 1 time/wk would be classified as:

A. Mild intermittent
B. Mild persistent
C. Moderate persistent
D. Severe persistent
7. In classifying the asthmatic patient, an individual with daily symptoms, daily use of a SABA > 2 times/wk but not daily, and with nocturnal symptoms < 1 time/wk would be classified as:

A. Mild intermittent
B. Mild persistent
C. Moderate persistent
D. Severe persistent

15%  A. Mild intermittent
56%  B. Mild persistent
33%  C. Moderate persistent
1%   D. Severe persistent
Stepwise “Preferred” Treatment 0-4 Years of Age

Most recommendations are based on limited data.

Step 1: SABA PRN
Step 2: Low-dose ICS
Step 3: Medium-dose ICS
Step 4: Medium-dose ICS and LABA or montelukast (Singulair)
Step 5: High-dose ICS and LABA or montelukast
Step 6: High-dose ICS and oral corticosteroid and LABA or montelukast
Stepwise “Preferred” Treatment 5-11 Years of Age

Step 1: SABA PRN
Step 2: Low-dose ICS
Step 3: Low-dose ICS and LABA, LTRA or theophylline, OR medium dose ICS
Step 4: Medium-dose ICS and LABA
Step 5: High-dose ICS and LABA
Step 6: High-dose ICS and LABA and oral corticosteroids
Stepwise “Preferred” Treatment ≥ 12 Years of Age

Step 1:  SABA PRN
Step 2:  Low-dose ICS
Step 3:  Low-dose ICS and LABA OR medium dose ICS
Step 4:  Medium-dose ICS and LABA
Step 5:  High-dose ICS and LABA; consider omalizumab (Xolair) if allergies
Step 6:  High-dose ICS and LABA and oral corticosteroid; consider omalizumab if allergies
8. Which of the following is NOT true?

A. Long-acting beta-agonists like salmeterol can increase mortality if used alone
B. ICS use is indicated if PRN use of albuterol exceeds 2 times/wk
C. Oral corticosteroids are as effective as IV
D. Codeine is an excellent recommended cough suppressant in acute asthma patients
8. Which of the following is NOT true?

A. Long-acting beta-agonists like salmeterol can increase mortality if used alone
B. ICS use is indicated if PRN use of albuterol exceeds 2 times/wk
C. Oral corticosteroids are as effective as IV
D. Codeine is an excellent recommended cough suppressant in acute asthma patients
Albuterol

- The most appropriate treatment for acute bronchospasm is an inhaled SABA
  - Can use a spacer
- Codeine or other cough suppressants are basically ineffective.
- Nasal and inhaled steroids have an onset that is slow.
Treatment

Inhaled corticosteroids (ICS)

• Most potent and effective long-term controller therapy
• Foundation of therapy for patients of all ages who have persistent asthma (SOR A)
• ICS improve long-term outcomes in children with mild to moderate persistent asthma (SOR A)
• Studies are limited comparing them to other alternative treatments
The Expert Panel Recommends

- For patients $\geq 5$ years of age with mild or moderate persistent asthma, the preferred therapy is inhaled corticosteroids (low-dose) (SOR A)
- Alternative therapies (listed alphabetically due to insufficient data to rank)
  - Cromolyn (only nebulized form available)
  - LTRAs (leukotriene receptor antagonists)
  - Sustained-release theophylline
Clinical Trials Following Children for Up to 6 Years (Strong Evidence)

• Inhaled corticosteroids at recommended doses
  – Do not have long-term, clinically significant, or irreversible effects on any of the outcomes reviewed
    • Vertical growth
    • Bone mineral density (BMD)
    • Ocular toxicity
    • Suppression of adrenal/pituitary axis
  – Do improve health outcomes (SOR A, B)
    • For children with mild or moderate persistent asthma
    • The potential, but small, risk of delayed growth is well balanced by their effectiveness
Early Intervention with ICS and the Progression of Asthma

• Evidence is insufficient to draw conclusions
  – Early intervention with inhaled steroids likely will improve overall asthma management, but its effect on preventing irreversible airway injury remains to be determined (SOR A, B)
Treatment: Key Points

• Long-acting inhaled Beta₂-agonists (LABA):
  – Used concomitantly with low- to medium-dose ICS are the preferred combination therapy for long-term control and prevention of symptoms in *moderate and severe persistent asthma* (SOR A, B)
Treatment: Key Points

• Cromolyn
  – Used as alternative (not preferred) medications for the treatment of mild persistent asthma (SOR A, B)

• Leukotriene modifiers
  – Again as an alternative (not preferred) medication for the treatment of mild persistent asthma (SOR B)
Treatment: Key Points

- Safety is a key consideration
- Weigh the benefits and risks of therapy
  - Systemic effects of higher doses of ICS
  - “Rare” but potential risk of life-threatening or fatal exacerbations with daily LABA Rx
  - Oral corticosteroid use regardless of age
Reassessment

• Follow-up
  – Every 2-6 wk intervals for starting Rx or those that require a step up to regain control
  – Once controlled, reassess at least every 1-6 mo
    • Measures of control are the same as those to assess severity plus use of,
    • Validated multidimensional questionnaires like the asthma control test (ACT)

• A step down is recommended for patients whose asthma is well controlled for 3 months or more

• Decrease dose of ICS gradually
  – 25% to 50% q 3 mo
  – Deterioration in asthma control is highly variable
9. In considering the use of an asthma action plan, which of the following is true?

A. Data is sufficient to support the benefits of verbal action plans.
B. A PEF of 80% or more defines the Yellow Zone.
C. The use of written action plans is recommended.
D. It is recommended that home peak expiratory monitoring be used in patients with mild intermittent asthma.
9. In considering the use of an asthma action plan, which of the following is true?

A. Data is sufficient to support the benefits of verbal action plans.
B. A PEF of 80% or more defines the Yellow Zone.
C. The use of written action plans is recommended.
D. It is recommended that home peak expiratory monitoring be used in patients with mild intermittent asthma.

- A: 2%
- B: 1%
- C: 87%
- D: 11%
Asthma Action Plans

• Data are insufficient to support or refute the benefits of written action plans (SOR B)
• Expert Panel opinion
  – Use of written action plans is recommended (SOR B, C)
    • Especially for patients with moderate or severe persistent asthma
    • Patients with a history of severe exacerbations
  – Action plans should
    • Address individual sx, and/or PEF measurements
    • Include self-management instructions
Asthma Action Plan

**Green Zone:**
- Usual activity
- PEF 80% or more of personal best

**Yellow Zone:**
- Some of usual activity
- PEF 50%-80% of personal best

**Red Zone:**
- Cannot do usual activities
- PEF less than 50% of personal best
Home Peak Expiratory Flow (PEF) Monitoring

- Evidence neither supports nor refutes the benefits of peak flow monitoring
  - Expert Panel opinion (SOR B)
    - PEF monitoring should be considered for
      - Patients with moderate or severe persistent asthma
      - Difficulty recognizing signs of exacerbations
      - History of severe exacerbations
    - It may enhance clinician-patient communication
    - It may increase patient and caregiver awareness of the disease status and control
Patient Education

• Control is enhanced
  – Ensuring access to education about asthma
  – Skills necessary to manage it
    • Self-monitoring
    • Correct use of inhalers
    • Following a plan for managing asthma long-term
    • Promptly handling signs of worsening asthma
10. A patient who comes to the emergency department in acute respiratory distress caused by a severe attack of asthma should be treated with all of the following EXCEPT:

A. IV fluids
B. Humidified, high-flow-rate oxygen
C. IV corticosteroids
D. IV antibiotics
10. A patient who comes to the emergency department in acute respiratory distress caused by a severe attack of asthma should be treated with all of the following EXCEPT:

A. IV fluids
B. Humidified, high-flow-rate oxygen
C. IV corticosteroids
D. IV antibiotics

- 6% A. IV fluids
- 2% B. Humidified, high-flow-rate oxygen
- 1% C. IV corticosteroids
- 90% ✅ D. IV antibiotics
Acute Asthma Exacerbation

• Symptoms
  – Progressive breathlessness
  – Cough
  – Wheezing
  – Chest tightness

• Severity assessment is critical
  – Using objective measures
  – Focused H&P
  – Measurement of airflow
    • FEV1
    • PEF
Acute Asthma Exacerbation

• Characterized by
  – Decreased PEF (< 50% predicted normal)
    • FEV1 may be more useful in predicting exacerbations
  – Failure to respond to a beta$_2$-agonist
  – Extreme anxiety due to breathlessness
  – Gasping for air, sweaty, or cyanotic
  – Rapid deterioration over a few hours
  – Severe retractions and nasal flaring
  – Hunched forward
# Acute Asthma Exacerbation

<table>
<thead>
<tr>
<th>Degree of Severity</th>
<th>Symptoms &amp; Signs</th>
<th>Initial PEF or FEV1</th>
<th>Clinical Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>Dyspnea only with activity</td>
<td>PEF &gt; 70% predicted or PB (personal best)</td>
<td>Rx at home, prompt relief with SABA, possible oral steroids</td>
</tr>
<tr>
<td>Moderate</td>
<td>Dyspnea interferes with or limits activity</td>
<td>PEF 40-69% predicted or PB</td>
<td>Office or ED visit; relief with frequent use of SABA, oral steroids</td>
</tr>
<tr>
<td>Severe</td>
<td>Dyspnea at rest interferes with conversation</td>
<td>PEF &lt; 40% predicted or PB</td>
<td>ED visit and likely admission, partial relief from frequent SABA, oral steroids, and adjunctive RX</td>
</tr>
<tr>
<td>Life Threatening</td>
<td>Too dyspneic to speak, sweating</td>
<td>PEF &lt; 25% predicted or PB</td>
<td>ED visit, possible ICU admission, little to no relief from frequent SABA, IV steroids, adjunctive Rx</td>
</tr>
</tbody>
</table>

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Acute Asthma Exacerbation

Risk factors for death from asthma

- History of sudden severe exacerbations
- Prior intubation for asthma
- Prior admission to ICU for asthma
- ≥ 3 emergency care visits for asthma in the past year
- Hospitalization or an emergency care visit for asthma within past month
- > 2 canisters per month of inhaled short-acting beta$_2$-agonist
Acute Asthma Exacerbation

Risk factors for death from asthma (cont)

- Current use or recent withdrawal from systemic corticosteroids
- Difficulty perceiving airflow obstruction or its severity
- Serious psychiatric disease or psychosocial problems
- Low SES and urban residence
- Illicit drug use
- Sensitivity to alternaria (ascomycete fungi)
Exacerbation Management

• SABA by MDI or nebulizer
• Corticosteroids – oral or IV
  – Strongly consider systemic use
  • Aids symptom resolution
  • Prevents asthma relapse
Exacerbation Management

• Alternatives
  – Epinephrine (1:1000)
  – Ipratropium added to nebulized SABA
    • Improves lung function and decreases hospitalizations in children 1-18 yrs of age with mild moderate or severe exacerbations
  – Levalbuterol
  – Corticosteroids
    • Initiate or increase anti-inflammatory medication
      – ICS
      – Cromolyn
      – Consider leukotriene modifiers
ED or inpatient management

- Most children who require hospitalization can be identified by a repeat assessment 1 hr after initial treatment.
- If a patient meets criteria for:
  - Severe exacerbation, > 86% chance of hospitalization
  - Moderate exacerbation, 84% chance of hospitalization
  - Mild exacerbation, 18% chance of hospitalization
Status Asthmaticus

Poor response to treatment

- Early intervention with BiPAP may prevent mechanical intubations
- Heliox may be a secondary therapy if no response to first-line Rx
- Ketamine—Consider for use only in severe exacerbations
- Magnesium sulfate IV for severe exacerbations
  - Decreases hospitalization in children 1-18 yrs of age, not adults
- Reassess pt shortly after inpatient admission
- Decision when to D/C from ED or admit must be individualized and depends on response to treatment, pulmonary function, and socioeconomic factors
Exacerbation Management

Intermittent nebs vs continuous nebs?

• Data suggests continuous is better in the ED setting
• Admission to the hospital was reduced (RR 0.68, 95% CI 0.5-0.9)
• No difference in pulse rate or blood pressure between groups

Cochrane Review 2011.
Exacerbations and Antibiotics

• Benefit from antibiotic therapy for asthma exacerbations has not been demonstrated:
  – Whether administered routinely
  – When suspicion of bacterial infection is low (SOR B)
Exercise-Induced Bronchospasm (EIB)

• Occurs in
  – 90% of pts with asthma
  – > 10% of general population
• Often indicates poorly controlled asthma
  – Use long-term control therapy if appropriate
• Pretreatment prior to exercise
  – SABAs, LABAs are effective in up to 80% of pts
  – LTRAs are effective in up to 50% of pts
• Encourage pts to warm up prior to exercise and consider wearing a mask or scarf in cold weather
Goals of Therapy—Asthma Control Summary

- Minimal or no chronic symptoms day or night
- Minimal or no exacerbations
- No limitations on activities; no school or work missed
- Maintain (near) normal pulmonary function
- Minimal use of short-acting inhaled beta$_2$-agonist
- Minimal or no adverse effects from medications
Websites

Expert Panel Report 3 (EPR3): Guidelines for the Diagnosis and Management of Asthma (440 pgs)
http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm

ICSI Heath Care Guidelines: Diagnosis and Management of Asthma (70 pgs)
https://www.icsi.org/_asset/rsjvnd/Asthma.pdf

The Journal of Family Practice: Help Patients Gain Better Asthma Control (10 pgs)
http://www.jfponline.com/Pages.asp?AID=6634
Asthma During Pregnancy

• Increased risk
  – Perinatal mortality
  – Preeclampsia
  – Preterm birth
  – LBW infants
  • LBW infants at greater risk for: DM, hypertension, heart disease as adults

Asthma During Pregnancy

• Cohort study (140,299 pregnancies Tennessee Medicaid program from 1995-2003)

• 23% of white pts, 40% of black pts had a hospitalization or ED visit during their pregnancy
  – Black pts were 1.6 times more likely than white pts to receive care for an exacerbation (95% CI 1.5-1.7)

• 77% of pts did not use control medications

• Dose response trend ($P < 0.001$) between LBW and increasing use of oral corticosteroids
Asthma During Pregnancy

- Monthly evaluation of asthma history and pulmonary function
- Albuterol is the preferred SABA
- ICSs are preferred controller medication
  - Budesonide has the most reliable safety profile
  - Cromolyn, LTRAs, and LABAs may be alternatives, but have lower efficacy or less safety data available
  - LABA should not be used as monotherapy
- Comorbid allergic rhinitis can be managed with intranasal steroids
Asthma During Pregnancy

• Extremely variable—symptom severity may improve, worsen, or remain unchanged in approximately equal portions as compared with the pregravid state
• Uncontrolled asthma—maternal and fetal complications
  – Hyperemesis
  – HDP
  – Vaginal bleeding
  – Complicated labor
  – IUGR
  – Preterm birth
  – Neonatal hypoxemia
Management

Treatment is organized around 4 components of management

| 1. Assessment and monitoring of asthma, including objective measurement of pulmonary function | Spirometry Ultrasound |
| 2. Control of factors contributing to asthma severity | Allergens Irritants |
| 3. Patient education | Access Skills |
| 4. A stepwise approach to pharmacologic therapy | Medications Frequency |
Quick Relief

- **Short-acting bronchodilator**
  - 2-4 puffs as needed for symptoms
- **Intensity of treatment will depend on severity of exacerbation**
  - Up to 3 treatments at 20-minute intervals or a single nebulizer treatment as needed
  - Course of systemic corticosteroids may be needed
- **Use of SABA > 2 times/week in intermittent asthma, or daily use in persistent asthma, may indicate the need to initiate (or increase) long-term control therapy**
Theophylline

- Studies and clinical experience confirm the safety of theophylline at recommended doses during pregnancy
  - Serum concentration 5-12 mcg/mL
- What one sees—increased side effects and discontinuation of medication
<table>
<thead>
<tr>
<th>Severity</th>
<th>Symptoms/Day</th>
<th>Preferred Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Symptoms/Night</td>
<td></td>
</tr>
<tr>
<td>Mild Intermittent</td>
<td>≤ 2d/week</td>
<td>No daily medication</td>
</tr>
<tr>
<td></td>
<td>≤ 2n/month</td>
<td></td>
</tr>
<tr>
<td>Mild Persistent</td>
<td>&gt; 2d/w, but &lt; daily</td>
<td>Low-dose inhaled corticosteroid* (FDA Category C)</td>
</tr>
<tr>
<td></td>
<td>&gt; 2n/month</td>
<td></td>
</tr>
<tr>
<td>Moderate Persistent</td>
<td>Daily</td>
<td>Low-dose inhaled or medium-dose inhaled corticosteroid; +/- long acting inhaled beta₂-agonist (FDA Category C)</td>
</tr>
<tr>
<td></td>
<td>&gt; 1n/week</td>
<td></td>
</tr>
<tr>
<td>Severe Persistent</td>
<td>Continual</td>
<td>High-dose inhaled corticosteroid AND long-acting inhaled beta₂-agonist, AND, if needed, systemic corticosteroid (FDA Category C)</td>
</tr>
<tr>
<td></td>
<td>Frequent</td>
<td></td>
</tr>
</tbody>
</table>

* More data on using budesonide during pregnancy than on using other inhaled corticosteroids
Answers

1. A
2. D
3. A
4. B
5. C
6. A
7. B
8. D
9. C
10. D