Asthma

Dave Tanaka
General Internal Medicine Grand Rounds
May 13, 2014
Asthma

- Asthma is an inflammatory disease
- Asthma can be fatal
- Use anti-inflammatory medications early in treatment of asthma
- Inhaled steroids are safe and effective in the treatment of asthma
- Add long-acting Beta-agonist to low dose inhaled steroids prior to increasing to moderate dose inhaled steroids
- Involve the patient in monitoring and treatment. Teach patient how to use an inhaler effectively
Asthma

• The prevalence of asthma dramatically increased in the late 20\textsuperscript{th} century, this has since plateaued in most of the world
• Except in US where there has been 7-8\% increase from 2001-2010
• The prevalence of asthma varies from 5-16\% worldwide
Asthma

• The prevalence in US varies by social economic status
  • Below poverty 11.2%
  • 2 times poverty 8.7%
  • Higher incomes 7.3%
Asthma

• The dramatic increase in prevalence worldwide has lead to multiple guidelines

Case Vignette

• A 20-year-old college student with a history of asthma and allergic rhinitis, which were diagnosed in childhood, presents with cough and tightness of the chest that interfere with his sleep three or four times per month.

• He requires albuterol two or three times per week.

• He enjoys playing tennis but generally wheezes after a match.

• Last year, during the pollen season, he sought treatment in an emergency department for acute asthma but was not admitted to the hospital.

• His forced expiratory volume in 1 second (FEV\textsubscript{1}) is 93\% of the predicted value.

• How should this case be evaluated and managed?
What symptoms or elements of clinical history are helpful in diagnosis?

- Episodic wheezing
- Dyspnea
- Difficulty taking a deep breath
- Chest tightness
- **Cough** (especially if chronic and nocturnal, seasonal, or related to workplace or a specific activity)

History
- Symptoms often intermittent, remit spontaneously
- Symptoms may vary seasonally
- Symptoms may be associated with specific triggers
What physical exam findings are suggestive?

- Wheezing during tidal respirations or forced expiration
- Prolonged expiratory phase of breathing
- Hyperexpansion of chest
- Unless patient is having acute exacerbation physical examination is often less helpful than carefully elicited history
  - Sometimes most helpful in looking for evidence of alternative diagnoses
  - Inspiratory crackles may suggest ILD or CHF
  - Abnormal heart sounds might indicate CHF or other cardiac causes of dyspnea
What are the indications for spirometry in a patient whose clinical presentation is consistent with asthma?

- Indicated for all patients with possible asthma
  - Measure FEV1, FVC, FEV1–FVC ratio
  - Evaluate before and after bronchodilator use
  - Post-bronchodilator improvement ≥12% and 200mL of FEV1 or FVC indicates significant reversibility
  - Reversibility of airflow obstruction defines asthma
Table 1. Criteria for the Diagnosis of Asthma.*

Presence of episodic symptoms of airflow obstruction or airway hyperresponsiveness

Objective assessment consisting of one of the following

- Airflow obstruction that is at least partially reversible with the use of an inhaled short-acting beta$_2$-agonist, as shown by one of three variables
  - An increase in FEV$_1$ of ≥12% from baseline
  - An increase in predicted FEV$_1$ of ≥10 percentage points from baseline
  - An increase in PEF of ≥20% (or 60 liters/min) from baseline
- Diurnal variation in PEF (measured twice daily) of more than 10%

* FEV$_1$ denotes forced expiratory volume in 1 second, and PEF peak expiratory flow.
# Controller and Rescue Medications for the Treatment of Mild Asthma

## Table 2. Controller and Rescue Medications for the Treatment of Mild Asthma.

<table>
<thead>
<tr>
<th>Indication and Drug</th>
<th>Children 6–11 Yr</th>
<th>Children ≥12 Yr and Adults</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Daily Dose</td>
<td>Maximum Step-up Dose</td>
<td>Initial Daily Dose</td>
</tr>
<tr>
<td>Medications for quick relief</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-acting beta₂-agonists †</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuterol</td>
<td>200 µg, as needed</td>
<td>200 µg, six times a day ‡</td>
<td>200 µg, as needed</td>
</tr>
<tr>
<td>Terbutaline ‡</td>
<td>—</td>
<td>—</td>
<td>250 µg, as needed</td>
</tr>
<tr>
<td>Anticholinergic agent: ipratropium bromide ‡</td>
<td>40 µg, as needed</td>
<td>40 µg, four times a day</td>
<td>40 µg, as needed</td>
</tr>
<tr>
<td>Medications for long-term control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled glucocorticoids †</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beclomethasone</td>
<td>50 µg, twice a day</td>
<td>200 µg, twice a day</td>
<td>50 µg, twice a day</td>
</tr>
<tr>
<td>Budesonide</td>
<td>100 µg, once a day</td>
<td>200 µg, twice a day</td>
<td>100 µg, twice a day</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>50 µg, twice a day</td>
<td>250 µg, twice a day</td>
<td>50 µg, twice a day</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>—</td>
<td>80 µg, once a day</td>
<td>80 µg, once a day</td>
</tr>
<tr>
<td>Leukotriene modifier: oral montelukast †</td>
<td>5 mg, once a day</td>
<td>5 mg, once a day</td>
<td>5 mg, once a day</td>
</tr>
<tr>
<td>Cromones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium cromoglicate</td>
<td>5 mg, four times a day</td>
<td>10 mg, four times a day</td>
<td>10 mg, four times a day</td>
</tr>
<tr>
<td>Nedocromil sodium</td>
<td>2 mg, four times a day</td>
<td>4 mg, four times a day</td>
<td>2 mg, four times a day</td>
</tr>
<tr>
<td>Step-up or add-on medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-acting beta₂-agonists †</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Salmeterol</td>
<td>—</td>
<td>50 µg, twice a day</td>
<td>—</td>
</tr>
<tr>
<td>Formoterol</td>
<td>—</td>
<td>12 µg, twice a day</td>
<td>—</td>
</tr>
<tr>
<td>Oral theophylline</td>
<td>—</td>
<td>10 mg/kg, twice a day</td>
<td>—</td>
</tr>
</tbody>
</table>

* All drug doses are approximate doses and apply to metered-dose inhalers unless specified otherwise.
† This is a preferred therapy.
‡ Daily use of rescue medication is a warning of deterioration of asthma control and indicates the need to reassess treatment.
† Terbutaline Turbuhaler is not available in the United States.
‡ Anticholinergic agents can be used as second-line therapy after therapy with short-acting beta₂-agonists but do not have approval by the Food and Drug Administration for use in treatment of asthma. However, in many European countries, ipratropium bromide is approved for the treatment of asthma.
† Montelukast can also be used as a step-up medication with inhaled glucocorticoids. Pranlukast or zafirlukast can be substituted for montelukast in adults; doses vary according to medication type.
Case Vignette

• A 20-year-old college student with a history of asthma and allergic rhinitis, which were diagnosed in childhood, presents with cough and tightness of the chest that interfere with his sleep three or four times per month.

• He requires albuterol two or three times per week.

• He enjoys playing tennis but generally wheezes after a match.

• Last year, during the pollen season, he sought treatment in an emergency department for acute asthma but was not admitted to the hospital.

• His forced expiratory volume in 1 second (FEV$_1$) is 93% of the predicted value.

• How should this case be evaluated and managed?
Asthma Treatment

• Adrenal substance – “It has ... served to cut short a paroxysm... [and] been useful in averting the recurrence of paroxysms and in finally bringing about a state of freedom from fear of their recurrence.”

Solis-Cohen JAMA 1900
### Table 2

Dose equivalences for inhaled corticosteroids

<table>
<thead>
<tr>
<th>Drug name</th>
<th>Dose level; daily dose, µg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Beclomethasone dipropionate (hydrofluoralkane; HFA)*</td>
<td>100–250</td>
</tr>
<tr>
<td>Budesonide</td>
<td>200–400</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>100–200</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>100–250</td>
</tr>
</tbody>
</table>

*Dose equivalences for CFC and HFA propellants differ because of differences in particle size and resulting differences in airway deposition.*
# Inhaled Corticosteroids

<table>
<thead>
<tr>
<th>Corticosteroid</th>
<th>Micrograms</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beclomethasone</td>
<td>80</td>
<td>$200</td>
</tr>
<tr>
<td>Budesonide</td>
<td>180</td>
<td>$190</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>110</td>
<td>$200</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>$310</td>
</tr>
<tr>
<td></td>
<td>100(DPI)</td>
<td>$150</td>
</tr>
<tr>
<td></td>
<td>250(DPI)</td>
<td>$190</td>
</tr>
<tr>
<td>Mometsone</td>
<td>220</td>
<td>$180</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>160</td>
<td>$200</td>
</tr>
</tbody>
</table>
Intenittent asthma

Persistent asthma: Daily medication
Consult with asthma specialist if step 4 care or higher is required
Consider consultation at step 3

Step 1
Preferred: SABA PRN

Step 2
Preferred: Low-dose ICS
Alternative: Cromolyn, LTRA, nedocromil, or theophylline

Step 3
Preferred: Medium-dose ICS + LABA
Alternative: Low-dose ICS + 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
Preferred: High-dose ICS + LABA + oral corticosteroid
AND
Consider omalizumab for patients who have allergies

Each step: Patient education, environmental control, and management of comorbidities
Steps 2-4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma

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 case

• The spirometry on our patient returns completely normal
• FEV1, FVC are 90% predicted
• FEV1/FVC ratio is 80%
• No bronchodilator response
• What do you do now?
Does normal spirometry rule out a diagnosis of asthma? What additional testing should patients with normal spirometry have?

• Normal spirometry does not rule out asthma

• If signs suggest asthma but spirometry is normal
  – Bronchoprovocation with methacholine or histamine
    ▪ Helps establish Dx of seasonal / exercise-induced asthma
  – Marked diurnal variability
    ▪ Helps establish asthma Dx
    ▪ Record measurements ≥2 weeks in a peak flow diary
Other Studies for Asthma

• Bronchoprovocation
  – Positive results: diagnostic of airway hyperresponsiveness
  – Negative results essentially rule out asthma

• Chest radiograph
  – Mostly useful in ruling out other diagnoses

• Allergy testing
  – To evaluate the role of allergens in asthma management

• CBC with differential
  – Mild eosinophilia common in asthma

• Sputum evaluation
  – Not indicated for routine evaluation

• IgE
  – Mild elevation is common with asthma
When should clinicians consider provocative pulmonary testing?

- If symptoms suggest asthma but spirometry is normal

- Use: methacholine hyper-responsiveness test
  - Low PC20 result: diagnostic for airway hyper-responsiveness
  - Sensitive + high negative predictive value for asthma Dx
  - Highly reproducible + generally safe (but expensive)
  - Requires sophisticated instrumentation + labor-intensive
Inhaler technique

- Remove cap
- Shake inhaler and insert in back of Aerochamber
- Place mouthpiece in mouth (or mask over mouth and nose)
- Press the canister once to release a dose of the drug
- Take a deep, slow breath in. (If you hear a whistling sound, you are breathing in too quickly)
- Hold breath for about ten seconds, then breathe out through the mouthpiece
- Breathe in again but do not press canister
- Remove mouthpiece from mouth and breathe out
- 9. Wait a few seconds before a second dose is taken, and repeat steps 2-8
Asthma case

Sara is a 41-year-old secretary in an autobody shop who comes to see you for evaluation of intermittent episodes of wheezing and shortness of breath that have progressed over the past 2 years. She feels that she has more “colds” than her workplace colleague. Each episode lasts for 2–3 weeks, with persistent cough and dyspnea. She had wheezing and allergy symptoms in childhood, and her mother and 1 cousin have confirmed asthma. Over the past 6 months, she has noticed that because of her dyspnea, she is unable to keep up with her partner when they go salsa dancing. She is otherwise well and is taking no medications. She smokes a half package of cigarettes daily and has done so for 20 years.
Asthma case

When you first saw Sara a few weeks ago, you gave her a salbutamol inhaler; in addition, you arranged spirometry, both before and after administration of a bronchodilator. She reports that she has been using the salbutamol daily for dyspnea and when she wakens during the night with similar symptoms; the latter is still a weekly occurrence. Spirometry shows a mild obstructive defect, with forced expiratory volume in 1 second (FEV1) of 2.29 L (78% of predicted), forced vital capacity of 3.48 L (99% of predicted), a FEV1/FVC ratio of 66% and a 17% improvement in FEV1 after administration of an inhaled bronchodilator. You make a diagnosis of asthma. What is your proposed management?
Asthma

Adjust therapy to gain and maintain asthma control

Regularly reassess:
- Control/triggers
- Spirometry/peak flow
- Inhaler technique
- Adherence
- Comorbidities: allergic rhinitis/GER reflux
- Consider specialist referral for uncontrolled asthma

ICS

ICS/LABA combination

Prednisone
Anti-IgE

Fast-acting bronchodilator on demand

Environmental control, education and written action plan
Confirm diagnosis
Persistent asthma: Daily medication
Consult with asthma specialist if step 4 care or higher is required
Consider consultation at step 3

Step 1
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AND
Consider omalizumab for patients who have allergies

Step 6
Preferred: High-dose ICS + LABA + oral corticosteroids
AND
Consider omalizumab for patients who have allergies

Assess control
Step up if needed
(first check adherence, environmental control, and comorbid conditions)
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

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

### Table 2
Dose equivalences for inhaled corticosteroids

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*Dose equivalences for CFC and HFA propellants differ because of differences in particle size and resulting differences in airway deposition.
Asthma case

• When Sara returns 6 weeks later, she tells you that she “feels fine.” However, she reports that salsa dancing still leaves her winded and precipitates coughing. About once a week, she wakes up at 3 am feeling short of breath but feels better after taking a puff of salbutamol.
Asthma

Adjust therapy to gain and maintain asthma control

- Regularly reassess
  - Control/triggers
  - Spirometry/peak flow
  - Inhaler technique
  - Adherence
  - Comorbidities: allergic rhinitis/GE reflux
  - Consider specialist referral for uncontrolled asthma

ICS

ICS/LABA combination

Prednisone
Anti-IgE

Fast-acting bronchodilator on demand

Environmental control, education and written action plan
Confirm diagnosis
Asthma case

60 yo male with h/o smoking for 30+ years, 1-2 ppd, daily sputum for past several years. He presents after ED visit for “bronchitis”, tx with predisone and azithromycin with improvement.

No PMH or medicines

He has had episodes of “chest colds” but no previous ED visits, no h/o wheezing, breathing is worse with colds and exercise
Asthma case

• Spirometry shows FEV1 of 55% predicted and FVC of 65% predicted
• FEV1/FVC of 50%
• No bronchial dilator effect

What therapy do you recommend?
COPD treatment

• **Recommendation 4:** ACP, ACCP, ATS, and ERS recommend that clinicians prescribe monotherapy using either long-acting inhaled anticholinergics or long-acting inhaled β-agonists for symptomatic patients with COPD and FEV1 <60% predicted. (Grade: strong recommendation, moderate-quality evidence). Clinicians should base the choice of specific monotherapy on patient preference, cost, and adverse effect profile.
COPD treatment

- **Recommendation 5**: ACP, ACCP, ATS, and ERS suggest that clinicians may administer combination inhaled therapies (long-acting inhaled anticholinergics, long-acting inhaled β-agonists, or inhaled corticosteroids) for symptomatic patients with stable COPD and FEV1<60% predicted (Grade: weak recommendation, moderate-quality evidence).
Asthma Case

• 78 yo woman, never smoker presents to ED for worsening dyspnea, preceded by fever, T 38.0. examination reveals – tachypnea, tachycardia, diffuse wheezing and no edema. CXR – no pulmonary infiltrate, edema or effusions, labs pertinent for leukocytosis.

• PMH – Htn, depression, no medicines, multiple episodes of “bronchitis”

• She was admitted for “exacerbation of COPD”
Asthma in the elderly

• Prevalence of asthma in elderly is unknown but best estimates are that similar to general population 5-10%
• The differential includes all causes of dyspnea cardiac, COPD, etc
• Dx requires objective measurement of airflow obstruction and reversibility to bronchodilator
Asthma in the elderly

- COPD and asthma coexist not infrequently in the elderly
- Inhaled corticosteroids are still the mainstay of treatment of asthma in the elderly. Special attention to delivery may need to be addressed
- 2/3 of deaths attributed to asthma occur in people age 65 or older
Case Vignette

• A 46-year-old woman who has had two admissions to the intensive care unit (ICU) for asthma during the past year presents with a 4-day history of upper respiratory illness and a 6-hour history of shortness of breath and wheezing.

• An inhaled corticosteroid has been prescribed, but she takes it only when she has symptoms, which is rarely.

• She generally uses albuterol twice per day but has increased its use to six to eight times per day for the past 3 days.

• How should this case be managed in the emergency department?
Initial Assessment of a Patient Presenting to the Emergency Department with Asthma

Continued Management of Asthma in the Emergency Department

Reassess history, symptoms, vital signs, results of physical examination, PEF, and SaO₂ after 60–90 min of treatment

Patient has continued mild-to-moderate exacerbation
Continue treatment
- Oxygen to achieve SaO₂ ≥90%
- Short-acting β₂-agonists administered by means of a metered-dose inhaler with valved holding chamber or a nebulizer, every 60 min
- Oral corticosteroids
Continue treatment 1–3 hr, provided there is improvement

Patient has continued severe exacerbation
Continue treatment
- Oxygen to achieve SaO₂ ≥90%
- Short-acting β₂-agonists plus ipratropium bromide administered by means of a metered-dose inhaler with valved holding chamber or a nebulizer, every hr or continuously
- Oral corticosteroids
Consider magnesium sulfate or heparin

Within <4 hr, make decision to admit or discharge

Patient has good response
- FEV₁ or PEF ≥70% sustained for 60 min
- No distress
- Normal examination
- Discharge

Patient has incomplete response
- FEV₁ or PEF 40–69%
- Mild-to-moderate symptoms
- Discharge or admit, on the basis of risk factors, likelihood of adherence, and home environment

Patient has poor response
- FEV₁ or PEF <40%
- PaCO₂ ≥42 mm Hg
- Severe symptoms
- Drowsiness, confusion
- Admit

### Medications for Treatment of Asthma Exacerbation in the Emergency Department

**Table 1. Medications for Treatment of Asthma Exacerbation in the Emergency Department.**

<table>
<thead>
<tr>
<th>Drug and Available Formulation</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short-acting β₂-adrenergic agents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budesonide</td>
<td>8 puffs every 20 min as needed, for up to 3 hr</td>
<td>For optimal delivery, dilute solution to a minimum of 3 ml at a gas flow of 6-8 L/min. Use large-volume nebulizer for continuous administration.</td>
</tr>
<tr>
<td><strong>Long-acting β₂-adrenergic agents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inhalers</strong></td>
<td></td>
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</tr>
<tr>
<td>Albuterol Metered-dose inhaler (90 μg/puff) 2.5-5 mg every 20 min over the 1st hr, then 2.5-10 mg every 1-4 hr as needed or 9-15 mg/hr continuously</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (0.67 mg/ml, 2.25 mg/ml or 5.0 mg/ml)</td>
<td></td>
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</tr>
<tr>
<td>Nebulizer solution (0.67 mg/ml, 2.25 mg/ml or 5.0 mg/ml)</td>
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<td></td>
</tr>
<tr>
<td><strong>Ipratropium</strong></td>
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<tr>
<td>Metered-dose inhaler (25 μg/puff)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (2 mg/ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inhalers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Metformin hydrochloride</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metered-dose inhaler (37.5 μg/puff)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (2 mg/ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pulmonary delivery systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metered-dose inhaler (18 μg/puff)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (0.15 mg/ml)</td>
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<tr>
<td><strong>Protease inhibitors and corticosteroids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metered-dose inhaler</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systemic corticosteroids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisone or prednisolone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Adverse effects include tachycardia, palpitations, tremor, and hypokalemia.**

## Recommendations for Discharge from the Emergency Department

### Table 2. Recommendations for Discharge from the Emergency Department.*

<table>
<thead>
<tr>
<th>Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue inhaled short-acting $\beta_2$-adrenergic agonists every 1–2 hr, as needed</td>
</tr>
<tr>
<td>Continue oral corticosteroids at a dose of 40–80 mg/day for 3–10 days</td>
</tr>
<tr>
<td>If course is &lt;1 wk, no need to taper the dose</td>
</tr>
<tr>
<td>If course is 7–10 days, probably no need to taper, especially if patients are concurrently receiving inhaled corticosteroids</td>
</tr>
<tr>
<td>Continue or start an inhaled corticosteroid at a “medium dose” (e.g., beclomethasone [HFA], 240–480 $\mu$g/day; budesonide [DPI], 600–1200 $\mu$g/day; or fluticasone [DPI], 300–500 $\mu$g/day)</td>
</tr>
</tbody>
</table>

### Education
- Review purposes and doses of asthma medications with patient
- Review inhaler technique with patient
- Teach patient to monitor for signs and symptoms of poor asthma control
- Provide patient with an asthma action plan

### Follow-up
- Advise patient to call primary care provider within 3–5 days after discharge
- Schedule a follow-up appointment with provider to occur within 1–4 wk

* DPI denotes dry-powder inhaler, and HFA hydrofluoroalkane formulation.

Conclusions and Recommendations

- The patient described in the vignette has chronic uncontrolled asthma necessitating daily rescue use of albuterol, but she has not been receiving daily controller therapy.
- Her history of ICU admissions and excessive albuterol use indicate that she is at increased risk for death related to asthma.
Conclusions and Recommendations

• Treatment with oxygen, aerosolized albuterol and ipratropium, and systemic corticosteroids should be initiated.

• The patient should be monitored closely and her signs and symptoms reassessed frequently, and a decision to admit or discharge her should be made within 4 hours after presentation.

• If she is discharged from the emergency department, she should be educated about medications, inhaler technique, and steps for monitoring symptoms and for managing exacerbations.

• Emergency department staff should provide her with a discharge plan, schedule a follow-up appointment, and ensure that she has adequate medications or prescriptions to last until that appointment.

• Because of her previous admissions to the ICU and her history of consistently poor asthma control, referral to an asthma specialist would be prudent.
Asthma

- Death rates have decreased in young patients
- Danish cohort study found death rate from asthma 2 X controls, associated with age, FEV1, bronchodilator reversibility and hospital contact but not smoking
What factors identify patients with asthma at high risk for fatal or near-fatal events during an exacerbation?

- Prior intubation
- Multiple asthma-related exacerbations
- Emergency room visits for asthma in the previous year
- Nonuse or low adherence to inhaled corticosteroids
- History of depression, substance abuse, personality disorder, unemployment, or recent bereavement
Asthma

• Large increases in expenditures - $18 Billion /yr 2003-2005
• ED and hospitalizations are stable from 2001-2010
• In 1985 57% of asthma costs were for ED and hospitalizations
• Now drug treatment accounts for 75% of asthma costs
## Short acting Beta Agonists

<table>
<thead>
<tr>
<th>SABA</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proair HFA</td>
<td>$53</td>
</tr>
<tr>
<td>Ventolin HFA</td>
<td>$48</td>
</tr>
<tr>
<td>Proventil HFA</td>
<td>$62</td>
</tr>
<tr>
<td>Xopenex HFA</td>
<td>$57</td>
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</tbody>
</table>
## Inhaled Corticosteroids

<table>
<thead>
<tr>
<th>Corticosteroid</th>
<th>Micrograms</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beclomethasone</td>
<td>80</td>
<td>$200</td>
</tr>
<tr>
<td>Budesonide</td>
<td>180</td>
<td>$190</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>110</td>
<td>$200</td>
</tr>
<tr>
<td></td>
<td>220</td>
<td>$310</td>
</tr>
<tr>
<td></td>
<td>100(DPI)</td>
<td>$150</td>
</tr>
<tr>
<td></td>
<td>250(DPI)</td>
<td>$190</td>
</tr>
<tr>
<td>Mometsone</td>
<td>220</td>
<td>$180</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>160</td>
<td>$200</td>
</tr>
</tbody>
</table>
## ICS+LABA

<table>
<thead>
<tr>
<th>ICS+LABA</th>
<th>Micrograms</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluticasone + salmeterol (dpi)</td>
<td>100 / 50, 250/50, 500/50</td>
<td>$250, $310, $410</td>
</tr>
<tr>
<td>Budesonide + formoterol</td>
<td>80/4.5, 160/4.5</td>
<td>$240, $280</td>
</tr>
</tbody>
</table>
Asthma

- Asthma is an inflammatory disease
- Asthma can be fatal
- Use anti-inflammatory medications early in treatment of asthma
- Inhaled steroids are safe and effective in the treatment of asthma
- Add long-acting Beta-agonist to low dose inhaled steroids prior to increasing to moderate dose inhaled steroids
- Involve the patient in monitoring and treatment. Teach patient how to use an inhaler effectively
“Since the Cure of the Asthma is observed by all Physicians, who have attempted the Eradication of that Chronical Distemper, to be very difficult, and frequently unsuccessful; I may thence infer, that either the true Nature of that Disease is not thoroughly understood by them, or they have not found the Medicines by which the Cure may be effected.”

J Foley
A Treatise of the Asthma
1726