Asthma Essentials: 
Keys to Best Practice in Asthma Care

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Learning Objectives

- Emphasize the importance of formulating a long-term plan in partnership with the family.
- Describe the role of special clinical services (reimbursement) in the management of asthma, including 94664, 99401 (02) and 94010 (60).
- Select two high priority actions to improve asthma care in individual practice for the next 100 days.

The Goal of Asthma Management

- Children should live happy, healthy, physically active lives, without asthma symptoms slowing them down.

Asthma Care Challenges

- Most money is spent on inappropriate Rx & acute care for managing exacerbations
- Asthma disability is widespread
- Low rate of prescribing ICS in primary care
- Low pharmacy ICS fill rates (poor adherence)
- 95% have poor inhalation technique
- Low level of knowledge (among child, family)

Disclosures

- Tammy Rood has no relationship with any commercial firm having products related to topics discussed at this conference.
Don’t Do More.
Do What Needs to Be Done.
focus on a few essential actions

A Four Component Approach is Effective for Controlling Asthma (EPR3, p. 35)

- Assessment & Monitoring
- Education for a Partnership in Care
- Control of Environmental Factors and Comorbid Conditions that Affect Asthma
- Medications

Asthma Diagnosis
(by history, the patient must meet three criteria):

- Symptoms of asthma occur in response to an allergen trigger or airway irritant (airway hyperreactivity)
- Repeated episodes of symptoms (recurrence)
- Response to treatment (reversibility) measured objectively by spirometry with a significant increase post-bronchodilator or relief of symptoms (EPR3)
Assessment Components

- Impairment
- Risk
- Responsiveness
  - “The ease with which asthma control is achieved by therapy.”
  - Exacerbations – reversibility of airflow obstruction and symptoms to treatments at home (p. 382) & clinic/ED (p. 380)

Severity Level ➔ Rx Step

Intermittent
Mild Persistent
Moderate Persistent
Severe Persistent

Control Classifications

- Well Controlled
- Not Well Controlled
- Very Poorly Controlled

“Children’s school absences and their parents’ absences from work represented the greatest economic burden of impairment in children with severe asthma (observational study, 600 children).”

Chest Physician, vol. 5:12, p. 21, December 2016

Component Criteria

**Impairment**
- Days/week of asthma symptoms
- Asthma-related nighttime awakenings
- Days/week of SABA use (not for SABA used to prevent EIB)
- Interference with normal activity
- Lung function, FEV1, FEV1/FVC-preferred

**Risk**
- Oral systemic steroid burst - OSB
- Medication side-effects

Severity — Initiating Therapy
Use Objective Measures of Airflow

Spirometric parameters improve assessment of severity, control exacerbations and response to therapy (FEV1, FEV1/FVC ratio and PEF).

Symptom reports are also useful, but under-estimate the degree of airway obstruction in many individuals.

(p. 43-45)

Assessment Criteria (airflow)

Clinic
- Severity: FEV1/FVC*, FEV1
- Control: FEV1/FVC*, FEV1
- Exacerbations: FEV1*, PEF

Home
- ✔ Control/Exacerbations
- PEF (or FEV1*)

* preferred (more sensitive)

Sensitivity of FEV1, PEF with Increasing Airflow Obstruction by Ratio


Case Study Assessing Airflow

9 yr male, pre-albuterol values of PEF of 121% predicted (4.63 L/sec or 278 LPM), FEV1 = 78% predicted, ratio = 0.68, FEF75 = 17% predicted
**Exacerbation – Treatment Response**

- **Good response**
- **Incomplete response**
- **Poor response** (Life-threatening)

**FEV1 is the vital sign of asthma!!!**

**Digital Flow Meter**

- **FEV1 & PEF**
  - Exacerbations
  - Peak flow zone determination
  - $40, multi-use
  - $0.38/patient

**Digital Lung Monitor**

- **FEV1, FEV6 & ratio**
  - Assess control
  - Age, height race & gender
  - $100, multi-use
  - $0.38/patient

**Home Peak Flow Meters**

- **Home Monitoring**
  - Poor perceivers
  - Hx of severe attacks
  - $25 (Internet price)
  - Diurnal variability
  - When Sx are present or Rx changing

**You Must Measure Airflow to Know How Much Asthma is Limiting Your Breathing**

- Spirometry is the measurement of airflow
- EPR3 guidelines recommend spirometry every 1 to 2 years
- However airflow should be checked at EVERY encounter with a hand-held electronic device to compare personal best FEV1
- Home peak flow meters are useful for high risk people

**Overview-Asthma Management**

- Initiate therapy based on Severity
- Modify therapy based on Control
- Manage exacerbations based on initial assessment and ongoing evaluation of Responsiveness to treatments
- Use EPR3 tables to guide care decisions.
There are 6 Asthma Therapy Steps—Higher Steps Needed for More Severe Asthma

- Know which therapy step you are on
- Higher steps might put you at risk for more side effects
- Over time with good adherence and good inhalation technique most people require lower therapy steps to maintain asthma control
- Spirometry is required (age 5 years and older) to adjust therapy steps

Inhaled corticosteroids (ICS) are the foundation of asthma therapy.
- Intermittent Asthma requires only SABA
- Preferred treatment for all levels of persistent asthma includes ICS
- Both SABA & ICS are inhaled medications!!!
- Comparative dose tables are available to aid in the determination of low, medium, or high dose ICS therapy for the various age groups.

Respiratory Inhaler Chart

ICS – Are You Prescribing, & Are Your Patients Using the GOLD Standard?!

For all age groups—ICS preferred

Comparable ICS doses
Effects of Inhaled Corticosteroids on Inflammation

ICS closely resemble naturally occurring hormones called glucocorticosteroids.

When inhaled deeply into the lungs ICS suppress inflammation and allow healing of the lungs.

Cilia regrow, eosinophils that infiltrated the airways go away and the build up of histamine, leukotrienes and other substances of inflammation is reversed.

You have to consume ICS for about 90 days to realize the full benefit of this medicine.

- Very few people use enough of their ICS to experience the full benefit of this medication.
- Only 5% of Medicaid children in a large state study had access to enough ICS to take it daily for 3 months. Pharmacy records showed most families did not pick up enough ICS to expect a good response.
- EPR3 urges review of adherence for this reason.

To improve adherence “couple” taking ICS with an established behavior (eating)

- Find out what is already being done habitually
- Tooth brushing? Key board time?
- Hair-brushing, eating, contact lens or glasses care routines, etc.

EPR3 Guide to Stepping Therapy Up or Down

- **Step up IF** needed
  - FIRST, check adherence
  - THEN, check inhaler technique
  - AND, check environmental control

- **Step Down**, IF asthma is well controlled for 3 months or longer

  Must base therapy step changes on assessment of adherence, inhalation technique and triggers

“Preferred” vs. “Alternative”

“If alternative treatment is used and response is inadequate, DISCONTINUE it and use the preferred treatment BEFORE stepping up.”

(p. 305, 306 & 343)
You can have side effects or unwanted results from taking asthma medications

- Side effects are most common with three medications:
  - montelukast (Singulair)
  - albuterol and
  - inhaled corticosteroids

Side Effects from montelukast include sleep disturbance, mood and behavior change

- If you or your child begin taking any leukotriene antagonist type medication be alert for:
  - night terrors, restless sleep, aggression, anger, inattention or depression, including thoughts about hurting yourself or others.
- Stop this medication if side effects happen

After “asthma is well controlled at least 3 months” step down if possible (p. 305)

Usually possible to reduce ICS dose over time, if not reconsider

- Adherence
- Inhalation technique
- Contributing factors (triggers, comorbid)

Expect to be able to step down

Families can monitor use of ICS by periodically checking the dose counter

- Know how long an ICS inhaler should last
- If there are 120 usable doses and the plan is for 2 puffs twice daily (4 total/day) counter should be 0 in 30 days
- In 15 days the counter should read 60 puffs remaining
- If instead there are 95, then 35 puffs were missed

Caregiver should observe & coach every dose if <12, weekly for youths and adults

- “Bring your inhaler & spacer here and let’s take your ICS”
- “Old air out.” (gently and completely exhale your air)
- “Aim up.” (create a downhill path for the medicine)
- “Fill up in your target time.”

Assess for Exacerbating Factors

- Viral Infections
- Weather changes
- Strong emotions (laughing or crying hard)
- Exercise
- Medications
- Gastroesophageal reflux disease
- Rhinitis
- Sinusitis
- Overweight

Allergens:
- Pollen
- Animal dander
- Dust mites
- Mold
- Food and food additives

Airborne Irritants
- Smoke (tobacco or wood)
- Air pollution
- Some stove or heater emissions
- Volatile organic compounds (odors, perfumes, sprays)
Teach Nasal Hygiene

How to Rinse the Nose with Salt Water

Appropriate to use twice per day or as needed with soap. Warm water and soap, rinse, rinse, rinse...

Benefits of rinsing the nose with salt water

- Help rinse away nasal mucus
- Relieve dryness and irritation
- Reduces nasal congestion

Check Electronic Claims or Call Pharmacy

- Last 3 dates ICS containing inhalers
- SABA units in the last year (risk of fatal)
- Systemic & Oral Steroids (SOS)
- Antibiotics for respiratory infections

Inhalation technique is critical and requires correct use of assistive devices and objective assessment of inspiratory flow rate & time for MDIs and DPIs.

EPR3 Specifies IFR and IFT

- IFR = inspiratory flow rate
- IFT = inspiratory flow time
- MDI – 30 LPM or 3-5 seconds (p. 250)
- DPI – 60 LPM or 1-2 seconds (p. 249)

How do you measure IFR & IFT?

How do you bill for this care? (See 94664 fact sheet)
Inspiratory Flow Influences Drug Deposition

- Too Slow: Mouth
- Too Fast: Throat
- Correct Speed: Lungs

Common MDI Inhalation Errors

- Failure to exhale fully prior to dose resulting in inadequate volume of inhaled air with lower net dose
- Inhalation too rapid, leading to impaction of drug against pharynx and bifurcations of the airway

Without a valved holding chamber (spacer), most MDI medication is swallowed

- Neither adults nor children are capable of avoiding swallowing most of their MDI medication unless a VHC is used.

“Naked Inhaler”

- When an inhaler is used alone, medicine ends up in the mouth, throat, stomach and lungs.
- Medicine left in the mouth, throat and stomach may cause unpleasant taste and side effects.
Don’t “Stack” Puffs

- Discharge only one puff into the spacer at a time
- Many people spray all puffs into the chamber at once
- This method reduces drug delivery to the lungs

In-Check Dial™ Device

Inhalation Technique

- Set resistance for inhaler type
- Use disposable one-way filter
- Train for optimal IFR and IFT
- MDI IFT = 2 x FEV1

Provide an Integrated Asthma Action Plan

- **Green** – well controlled
- **Yellow** – not well controlled
- **Red** – urgent need for care

- Best FEV1 on record
- Last ACT score
- Known triggers
- Plan for comorbidities

Education for a Partnership in Care (p. 93-164)
Organizing Practice for Asthma Care

Block schedule new/return patients

Pair appointments with a clinic or community educator and a provider (15/15 min)

“Educator” 1st
* obtain claims data
* impairment score (ACT)
* airflow measures (FEV1, FEV1/FVC ratio)
* assessment of inhalation technique
* deliver preventive medicine counseling for risk reduction (99401)

Use modifiers for “incident to” services (-25, -59)

Education based on Real Need, Right Service, Reasonable Cost...

<table>
<thead>
<tr>
<th>Message Type</th>
<th>Audience</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Asthma Literacy</td>
<td>Everyone w/asthma</td>
<td>Low</td>
</tr>
<tr>
<td>2) Key Messages</td>
<td>Patient and family</td>
<td>Low</td>
</tr>
<tr>
<td>3) Risk Reduction</td>
<td>Patient and family</td>
<td>Medium</td>
</tr>
<tr>
<td>4) Self-management</td>
<td>Patient and family</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Stratified intensity (cost) of care is appropriate for burden of disease (not just the dollars spent on health care)

I don’t get it...

1. Asthma literacy focuses on the “have to know” messages, meets the needs of specific populations, is delivered in familiar settings (home, school, work)
2. Key messages are delivered at no extra charge by a provider who bills for a clinical encounter

Go on, I’m listening...

3. Asthma education provided by a health care worker that meets insurer criteria lasting >14 or >29 minutes, is billable (CPT 99401 or 99402, respectively, “Preventive Medicine Counseling for Risk Reduction”) Some insurers pay, some don’t. We need to influence payer policy!

See poster #5, AAE 2010 conference, Neuner & Francisco

Got it!

4. Formal asthma self-management education provided by a health care worker (not a physician or NP) delivered in 30 minute increments (Self-management education, CPT 98960, 61 or 62)

Generally not reimbursed without contractual agreement with the particular payer. Clearly needed as a form of special care for many with “very poorly controlled” asthma.

Routine $ vs. Special Care $$

- High quality “routine care” can meet the needs of most people with asthma
- However, some people need special care (added cost must be justified with long-term savings and improved QOL)
Relative Cost of Medical Encounters

1. Put Asthma Guidelines into Action for all children with asthma.
   Essential components:
   • Use inhaled corticosteroids
   • Use written asthma action plans
   • Assess asthma severity
   • Assess and monitor asthma control
   • Schedule follow-up visits
   • Control exposure to allergens and irritants

2. Develop asthma plan with child and family.
   Essential components:
   • Make asthma plan easy to read.

3. Bill for asthma services.

4. Start by choosing two high priority actions to improve asthma care in YOUR practice for the next 100 days.
Group Activity

“Asthma Routines in My Practice®”
Asthma Ready® Communities

https://fs2.formsite.com/openform/form30/index.html

www.asthmaready.org

Click on [Resources] tab
Click on [Asthma Care Routines]
Complete/Submit the brief survey
For [Organization or Clinic Name] enter NAPNAP 2018

Questions?

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References
The goal of this asthma care quick reference guide is to help clinicians provide quality care to people who have asthma.

Quality asthma care involves not only initial diagnosis and treatment to achieve asthma control, but also long-term, regular follow-up care to maintain control.

Asthma control focuses on two domains: (1) reducing impairment—the frequency and intensity of symptoms and functional limitations currently or recently experienced by a patient; and (2) reducing risk—the likelihood of future asthma attacks, progressive decline in lung function (or, for children, reduced lung growth), or medication side effects.

Achieving and maintaining asthma control requires providing appropriate medication, addressing environmental factors that cause worsening symptoms, helping patients learn self-management skills, and monitoring over the long term to assess control and adjust therapy accordingly.

The diagram (right) illustrates the steps involved in providing quality asthma care.
### KEY CLINICAL ACTIVITIES FOR QUALITY ASTHMA CARE

(See complete table in Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma [EPR-3])

<table>
<thead>
<tr>
<th>Clinical Issue</th>
<th>Key Clinical Activities and Action Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASTHMA DIAGNOSIS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Establish asthma diagnosis.</strong></td>
<td></td>
</tr>
<tr>
<td>▪ Determine that symptoms of recurrent airway obstruction are present, based on history and exam.</td>
<td></td>
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<tr>
<td></td>
<td>▪ History of cough, recurrent wheezing, recurrent difficulty breathing, recurrent chest tightness</td>
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<tr>
<td></td>
<td>▪ Symptoms occur or worsen at night or with exercise, viral infection, exposure to allergens and irritants, changes in weather, hard laughing or crying, stress, or other factors</td>
</tr>
<tr>
<td></td>
<td>▪ In all patients ≥5 years of age, use spirometry to determine that airway obstruction is at least partially reversible.</td>
</tr>
<tr>
<td></td>
<td>▪ Consider other causes of obstruction.</td>
</tr>
</tbody>
</table>

| **LONG-TERM ASTHMA MANAGEMENT** | |
| **GOAL:** Asthma Control | |
| **Reduce Impairment** | |
| ▪ Prevent chronic symptoms. | |
| ▪ Require infrequent use of short-acting beta₂-agonist (SABA). | |
| ▪ Maintain (near) normal lung function and normal activity levels. | |
| **Reduce Risk** | |
| ▪ Prevent exacerbations. | |
| ▪ Minimize need for emergency care, hospitalization. | |
| ▪ Prevent loss of lung function (or, for children, prevent reduced lung growth). | |
| ▪ Minimize adverse effects of therapy. | |

| Assessment and Monitoring | |
| **INITIAL VISIT:** Assess asthma severity to initiate treatment (see page 5). | |
| **FOLLOW-UP VISITS:** Assess asthma control to determine if therapy should be adjusted (see page 6). | |
| ▪ Assess at each visit: asthma control, proper medication technique, written asthma action plan, patient adherence, patient concerns. | |
| ▪ Obtain lung function measures by spirometry at least every 1–2 years; more frequently for asthma that is not well controlled. | |
| ▪ Determine if therapy should be adjusted: Maintain treatment; step up, if needed; step down, if possible. | |
| **Schedule follow-up care.** | |
| ▪ Asthma is highly variable over time. See patients: | |
| | ▪ Every 2–6 weeks while gaining control | |
| | ▪ Every 1–6 months to monitor control | |
| | ▪ Every 3 months if step down in therapy is anticipated | |

| Use of Medications | |
| **Select medication and delivery devices that meet patient’s needs and circumstances.** | |
| ▪ Use stepwise approach to identify appropriate treatment options (see page 7). | |
| ▪ Inhaled corticosteroids (ICSs) are the most effective long-term control therapy. | |
| ▪ When choosing treatment, consider domain of relevance to the patient (risk, impairment, or both), patient’s history of response to the medication, and willingness and ability to use the medication. | |
| **Review medications, technique, and adherence at each follow-up visit.** | |
### KEY CLINICAL ACTIVITIES FOR QUALITY ASTHMA CARE

#### (continued)

<table>
<thead>
<tr>
<th>Clinical Issue</th>
<th>Key Clinical Activities and Action Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient Education for Self-Management</strong></td>
<td><strong>Teach patients how to manage their asthma.</strong></td>
</tr>
<tr>
<td></td>
<td>• Teach and reinforce at each visit:</td>
</tr>
<tr>
<td></td>
<td>• Self-monitoring to assess level of asthma control and recognize signs of worsening asthma (either symptom or peak flow monitoring)</td>
</tr>
<tr>
<td></td>
<td>• Taking medication correctly (inhaler technique, use of devices, understanding difference between long-term control and quick-relief medications)</td>
</tr>
<tr>
<td></td>
<td>- <strong>Long-term control medications</strong> (such as inhaled corticosteroids, which reduce inflammation) prevent symptoms. Should be taken daily; will not give quick relief.</td>
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<tr>
<td></td>
<td>- <strong>Quick-relief medications</strong> (short-acting beta2-agonists or SABAs) relax airway muscles to provide fast relief of symptoms. Will not provide long-term asthma control. If used &gt;2 days/week (except as needed for exercise-induced asthma), the patient may need to start or increase long-term control medications.</td>
</tr>
<tr>
<td></td>
<td>• Avoiding environmental factors that worsen asthma</td>
</tr>
<tr>
<td></td>
<td><strong>Develop a written asthma action plan</strong> in partnership with patient/family (sample plan available at <a href="http://www.nhlbi.nih.gov/health/public/lung/asthma/asthma_actplan.pdf">www.nhlbi.nih.gov/health/public/lung/asthma/asthma_actplan.pdf</a>).</td>
</tr>
<tr>
<td></td>
<td>• Agree on treatment goals.</td>
</tr>
<tr>
<td></td>
<td>• Teach patients how to use the asthma action plan to:</td>
</tr>
<tr>
<td></td>
<td>• Take daily actions to control asthma</td>
</tr>
<tr>
<td></td>
<td>• Adjust medications in response to worsening asthma</td>
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<td></td>
<td>• Seek medical care as appropriate</td>
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<tr>
<td></td>
<td>• Encourage adherence to the asthma action plan.</td>
</tr>
<tr>
<td></td>
<td>• Choose treatment that achieves outcomes and addresses preferences important to the patient/family.</td>
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<tr>
<td></td>
<td>• Review at each visit any success in achieving control, any concerns about treatment, any difficulties following the plan, and any possible actions to improve adherence.</td>
</tr>
<tr>
<td></td>
<td>• Provide encouragement and praise, which builds patient confidence. Encourage family involvement to provide support.</td>
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<td></td>
<td><strong>Integrate education into all points of care involving interactions with patients.</strong></td>
</tr>
<tr>
<td></td>
<td>• Include members of all health care disciplines (e.g., physicians, pharmacists, nurses, respiratory therapists, and asthma educators) in providing and reinforcing education at all points of care.</td>
</tr>
<tr>
<td><strong>Control of Environmental Factors and Comorbid Conditions</strong></td>
<td><strong>Recommend ways to control exposures to allergens, irritants, and pollutants that make asthma worse.</strong></td>
</tr>
<tr>
<td></td>
<td>• Determine exposures, history of symptoms after exposures, and sensitivities. (In patients with persistent asthma, use skin or in vitro testing to assess sensitivity to perennial indoor allergens to which the patient is exposed.)</td>
</tr>
<tr>
<td></td>
<td>• Recommend multifaceted approaches to control exposures to which the patient is sensitive; single steps alone are generally ineffective.</td>
</tr>
<tr>
<td></td>
<td>• Advise all asthma patients and all pregnant women to avoid exposure to tobacco smoke.</td>
</tr>
<tr>
<td></td>
<td>• Consider allergen immunotherapy by trained personnel for patients with persistent asthma when there is a clear connection between symptoms and exposure to an allergen to which the patient is sensitive.</td>
</tr>
<tr>
<td></td>
<td><strong>Treat comorbid conditions.</strong></td>
</tr>
<tr>
<td></td>
<td>• Consider allergic bronchopulmonary aspergillosis, gastroesophageal reflux, obesity, obstructive sleep apnea, rhinitis and sinusitis, and stress or depression. Treatment of these conditions may improve asthma control.</td>
</tr>
<tr>
<td></td>
<td>• Consider inactivated flu vaccine for all patients &gt;6 months of age.</td>
</tr>
</tbody>
</table>
### Exercise-Induced Bronchospasm

**Prevent EIB.**
- Physical activity should be encouraged. For most patients, EIB should not limit participation in any activity they choose.
- Teach patients to take treatment before exercise. SABAs* will prevent EIB in most patients; LTRAs,* cromolyn, or LABAs* also are protective. Frequent or chronic use of LABA to prevent EIB is discouraged, as it may disguise poorly controlled persistent asthma.
- Consider long-term control medication. EIB often is a marker of inadequate asthma control and responds well to regular anti-inflammatory therapy.
- Encourage a warm-up period or mask or scarf over the mouth for cold-induced EIB.

**Pregnancy**

**Maintain asthma control through pregnancy.**
- Check asthma control at all prenatal visits. Asthma can worsen or improve during pregnancy; adjust medications as needed.
- Treating asthma with medications is safer for the mother and fetus than having poorly controlled asthma. Maintaining lung function is important to ensure oxygen supply to the fetus.
- ICSs* are the preferred long-term control medication.
- Remind patients to avoid exposure to tobacco smoke.

### MANAGING EXACERBATIONS

#### Home Care

**Develop a written asthma action plan** (see Patient Education for Self-Management, page 3).

- **Teach patients how to:**
  - Recognize early signs, symptoms, and PEF* measures that indicate worsening asthma.
  - Adjust medications (increase SABA* and, in some cases, add oral systemic corticosteroids) and remove or withdraw from environmental factors contributing to the exacerbation.
  - Monitor response.
  - Seek medical care if there is serious deterioration or lack of response to treatment. Give specific instructions on who and when to call.

#### Urgent or Emergency Care

**Assess severity by lung function measures (for ages ≥5 years), physical examination, and signs and symptoms.**

- **Treat to relieve hypoxemia and airflow obstruction; reduce airway inflammation.**
  - Use supplemental oxygen as appropriate to correct hypoxemia.
  - Treat with repetitive or continuous SABA,* with the addition of inhaled ipratropium bromide in severe exacerbations.
  - Give oral systemic corticosteroids in moderate or severe exacerbations or for patients who fail to respond promptly and completely to SABA.
  - Consider adjunctive treatments, such as intravenous magnesium sulfate or heliox, in severe exacerbations unresponsive to treatment.

- **Monitor response with repeat assessment of lung function measures, physical examination, and signs and symptoms, and, in emergency department, pulse oximetry.**

- **Discharge with medication and patient education:**
  - Medications: SABA, oral systemic corticosteroids; consider starting ICS*.
  - Referral to follow-up care.
  - Asthma discharge plan.
  - Review of inhaler technique and, whenever possible, environmental control measures.

*Abbreviations: EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, long-acting beta₂-agonist; LTRA, leukotriene receptor antagonist; PEF, peak expiratory flow; SABA, short-acting beta₂-agonist.
**INITIAL VISIT: CLASSIFYING ASTHMA SEVERITY AND INITIATING THERAPY**

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

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

<table>
<thead>
<tr>
<th>Components of Severity</th>
<th>Intermittent</th>
<th>Persistent Mild</th>
<th>Persistent Moderate</th>
<th>Persistent Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ages 0–4 years</td>
<td>Ages 5–11 years</td>
<td>Ages ≥12 years</td>
<td>Ages 0–4 years</td>
<td>Ages 5–11 years</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SABA use for symptom control (not to prevent EIB)</td>
<td>≤2x/week</td>
<td>&gt;2x/week but not daily</td>
<td>&gt;2x/week but not daily and not more than once on any day</td>
<td>Daily</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long function</td>
<td>Normal FEV₁ between exacerbations</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>FEV₁ % predicted</strong></td>
<td>&gt;85%</td>
<td>&gt;80%</td>
<td>&gt;80%</td>
<td>&gt;80%</td>
</tr>
<tr>
<td><strong>FEV₁/FVC</strong></td>
<td>Normal†</td>
<td>Normal†</td>
<td>Reduced &gt;5%†</td>
<td>Reduced &gt;5%†</td>
</tr>
<tr>
<td><strong>Lung function</strong></td>
<td>Normal†</td>
<td>Normal†</td>
<td>Reduced 5%†</td>
<td>Reduced &gt;5%†</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma exacerbations requiring oral systemic corticosteroids‡</td>
<td>0–1/year</td>
<td>≥2 exacerb. in 6 months, or wheezing ≥4x per year lasting &gt;1 day</td>
<td>≥2/year</td>
<td>≥2/year</td>
</tr>
<tr>
<td><strong>Recommended Step for Initiating Therapy</strong></td>
<td>Step 1</td>
<td>Step 2</td>
<td>Step 3</td>
<td>Step 4</td>
</tr>
</tbody>
</table>

Relative annual risk of exacerbations may be related to FEV₁.

*Abbreviations:* EIB, exercise-induced bronchospasm; FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity; ICS, inhaled corticosteroid; SABA, short-acting beta₂-agonist.

† Normal FEV₁/FVC by age: 8–19 years, 85%; 20–39 years, 80%; 40–59 years, 75%; 60–80 years, 70%.

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

In 2–6 weeks, depending on severity, assess level of asthma control achieved and adjust therapy as needed.

For children 0–4 years old, if no clear benefit is observed in 4–6 weeks, consider adjusting therapy or alternate diagnoses.
### Components of Control

<table>
<thead>
<tr>
<th>Impairment</th>
<th>Well Controlled</th>
<th>Not Well Controlled</th>
<th>Very Poorly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well Controlled</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ages 0–4 years</strong></td>
<td><strong>Ages 5–11 years</strong></td>
<td><strong>Ages ≥12 years</strong></td>
<td><strong>Ages 0–4 years</strong></td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>≤2 days/week</td>
<td>≤2 days/week but not more than once on each day</td>
<td>&gt;2 days/week</td>
</tr>
<tr>
<td><strong>Nighttime awakenings</strong></td>
<td>≤1x/month</td>
<td>≤2x/month</td>
<td>&gt;1x/month</td>
</tr>
<tr>
<td><strong>Interference with normal activity</strong></td>
<td>None</td>
<td>Some limitation</td>
<td>Extremely limited</td>
</tr>
<tr>
<td><strong>Lung function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FEV&lt;sub&gt;1&lt;/sub&gt;/FVC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SABA&lt;sup&gt;®&lt;/sup&gt; use for symptom control (not to prevent EIB&lt;sup&gt;®&lt;/sup&gt;)</strong></td>
<td>≤2 days/week</td>
<td>&gt;2 days/week</td>
<td>Several times per day</td>
</tr>
<tr>
<td><strong>Validated questionnaires†</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATAQ&lt;sup&gt;©&lt;/sup&gt;</strong></td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>ACQ&lt;sup&gt;©&lt;/sup&gt;</strong></td>
<td>≤0.75&lt;sup&gt;†&lt;/sup&gt;</td>
<td>≥20</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>ACT&lt;sup&gt;TM&lt;/sup&gt;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asthma exacerbations requiring oral systemic corticosteroids§</strong></td>
<td>0–1/year</td>
<td>2–3/year</td>
<td>&gt;3/year</td>
</tr>
<tr>
<td><strong>Reduction in lung growth/Progressive loss of lung function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Treatment-related adverse effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>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.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Risk

<table>
<thead>
<tr>
<th>Risk</th>
<th>Well Controlled</th>
<th>Not Well Controlled</th>
<th>Very Poorly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ages 0–4 years</strong></td>
<td><strong>Ages 5–11 years</strong></td>
<td><strong>Ages ≥12 years</strong></td>
<td><strong>Ages 0–4 years</strong></td>
</tr>
<tr>
<td><strong>Asthma exacerbations requiring oral systemic corticosteroids§</strong></td>
<td>0–1/year</td>
<td>2–3/year</td>
<td>&gt;3/year</td>
</tr>
<tr>
<td><strong>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.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Recommended Action for Treatment

(See “Stepwise Approach for Managing Asthma Long Term,” page 7)

The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.

**Maintain current step.**

Regular follow-up every 1–6 months. Consider step down if well controlled for at least 3 months.

- **Step up 1 step**
  - Step up at least 1 step
  - Step up 1 step
  - Consider short course of oral systemic corticosteroids.
  - Step up 1-2 steps.
  - Reevaluate in 2 weeks to achieve control.
  - Reevaluate in 2 weeks to achieve control.
  - Before step up in treatment:
  - Review adherence to medication, inhaler technique, and environmental control. If alternative treatment was used, discontinue and use preferred treatment for that step. For side effects, consider alternative treatment options.

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

† Minimal important difference: 1.0 for the ATAQ; 0.5 for the ACQ; not determined for the ACT.

‡ ACQ values of 0.76–1.4 are indeterminate regarding well-controlled asthma.

§ Data are insufficient to link frequencies of exacerbations with different levels of asthma control. Generally, more frequent and intense exacerbations (e.g., requiring urgent care, hospital or intensive care admission, and/or oral corticosteroids) indicate poorer asthma control.
**STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM**

The stepwise approach tailors the selection of medication to the level of asthma severity (see page 5) or asthma control (see page 6). The stepwise approach is meant to help, not replace, the clinical decisionmaking needed to meet individual patient needs.

**ASSESS CONTROL:**

<table>
<thead>
<tr>
<th>STEP UP IF NEEDED</th>
<th>STEPDOWN IF POSSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(first, check medication adherence, inhaler technique, environmental control, and comorbidities)</td>
<td>(and asthma is well controlled for at least 3 months)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0–4 years of age</th>
<th>5–11 years of age</th>
<th>≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferred Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermittent Asthma</td>
<td>SABA* as needed</td>
<td>low-dose ICS*</td>
</tr>
<tr>
<td>Persistent Asthma: Daily Medication</td>
<td>Consult with asthma specialist if step 3 care or higher is required. Consider consultation at step 2.</td>
<td>low-dose ICS* + either LABA* or theophylline</td>
</tr>
<tr>
<td>Alternative Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermittent Asthma</td>
<td>Cromolyn or montelukast</td>
<td>Consider subcutaneous allergen immunotherapy for patients who have persistent, allergic asthma.**</td>
</tr>
<tr>
<td>Persistent Asthma: Daily Medication</td>
<td>Consult with asthma specialist if step 4 care or higher is required. Consider consultation at step 3.</td>
<td>medium-dose ICS* + LABA*</td>
</tr>
<tr>
<td>Quick-Relief Medication</td>
<td>SABA* as needed</td>
<td>high-dose ICS* + LABA*</td>
</tr>
</tbody>
</table>

### 0–11 years of age

- **Intermittent Asthma**
  - Immediate: SABA* as needed
  - Medium: low-dose ICS
  - High: medium-dose ICS + either LABA* or theophylline

### ≥12 years of age

- **Intermittent Asthma**
  - Immediate: SABA* as needed
  - Medium: low-dose ICS + LABA* OR medium-dose ICS + either LABA* or theophylline
  - High: medium-dose ICS + either LABA* or theophylline + LABA* or theophylline + LABA* or theophylline + LABA* or theophylline

**Quick-Relief Medication**

- SABA* as needed for symptoms. The intensity of treatment depends on severity of symptoms: up to 3 treatments every 20 minutes as needed. Short course of oral systemic corticosteroids may be needed.
- Caution: Increasing use of SABA or use >2 days/week for symptom relief (not to prevent EIB) generally indicates inadequate control and the need to step up treatment.

---

**Abbreviations:** EIB, exercise-induced bronchospasm; ICS, inhaled corticosteroid; LABA, inhaled long-acting beta,-agonist; LTRA, leukotriene receptor antagonist; SABA, inhaled short-acting beta,-agonist.

† Treatment options are listed in alphabetical order, if more than one.

† Alternative treatment is used and response is inadequate, discontinue and use preferred treatment before stepping up.

§ Theophylline is a less desirable alternative because of the need to monitor serum concentration levels.

** Based on evidence for dust mites, animal dander, and pollen; evidence is weak or lacking for molds and cockroaches. Evidence is strongest for immunotherapy with single allergens.

The role of allergy in asthma is greater in children than in adults.

Clinicians who administer immunotherapy or omalizumab should be prepared to treat anaphylaxis that may occur.

Zileuton is less desirable because of limited studies as adjutantive therapy and the need to monitor liver function.

Before oral corticosteroids are introduced, a trial of high-dose ICS + LABA + either LTRA, theophylline, or zileuton, may be considered, although this approach has not been studied in clinical trials.
## ESTIMATED COMPARATIVE DAILY DOSAGES: INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>0–4 years of age</th>
<th>5–11 years of age</th>
<th>≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Daily Dose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beclomethasone MDI</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>40 mcg/puff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 mcg/puff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budesonide DPI†</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>90 mcg/inhalation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180 mcg/ inhalation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budesonide Nebules</td>
<td>0.25–0.5 mg</td>
<td>&gt;0.5–1.0 mg</td>
<td>&gt;1.0 mg</td>
</tr>
<tr>
<td>0.25 mg</td>
<td>1–2 nebs/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 mg</td>
<td>1 nebs/day</td>
<td>2 nebs/day</td>
<td>3 nebs/day</td>
</tr>
<tr>
<td>1.0 mg</td>
<td>1 nebs/day</td>
<td>2 nebs/day</td>
<td></td>
</tr>
<tr>
<td>Ciclosporin MDI†</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>80 mcg/puff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160 mcg/puff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flunisolide MDI†</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>80 mcg/puff</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

† Abbreviations: DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); neb, nebulizer.
### ESTIMATED COMPARATIVE DAILY DOSAGES:
**INHALED CORTICOSTEROIDS FOR LONG-TERM ASTHMA CONTROL (continued)**

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>0–4 years of age</th>
<th>5–11 years of age</th>
<th>≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium*</td>
<td>High*</td>
</tr>
<tr>
<td><strong>Daily Dose</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fluticasone MDI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 mcg/puff</td>
<td>2 puffs 2x/day</td>
<td>3–4 puffs 2x/day</td>
<td>1 puff 2x/day</td>
</tr>
<tr>
<td>220 mcg/puff</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Fluticasone DPI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 mcg/inhalation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100 mcg/inhalation</td>
<td>1 inh' 2x/day</td>
<td>2 inhs' 2x/day</td>
<td>1–2 inhs' 2x/day</td>
</tr>
<tr>
<td>250 mcg/inhalation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Mometasone DPI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 mcg/inhalation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>220 mcg/inhalation</td>
<td>1 inh'/day</td>
<td>1–2 inhs' 2x/day</td>
<td>1–2 inhs' 2x/day</td>
</tr>
</tbody>
</table>

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

**Abbreviations:** DPI, dry powder inhaler (requires deep, fast inhalation); inh, inhalation; MDI, metered dose inhaler (releases a puff of medication); neb, nebulize.

### Therapeutic Issues Pertaining to Inhaled Corticosteroids (ICSs) for Long-Term Asthma Control

- **The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy.** The clinician must monitor the patient's response on several clinical parameters (e.g., symptoms; activity level; measures of lung function) and adjust the dose accordingly. Once asthma control is achieved and sustained at least 3 months, the dose should be carefully titrated down to the minimum dose necessary to maintain control.

- Some doses may be outside package labeling, especially in the high-dose range. Budesonide nebulizer suspension is the only inhaled corticosteroid (ICS) with FDA-approved labeling for children <4 years of age.

- Metered-dose inhaler (MDI) dosages are expressed as the actuator dose (amount leaving the actuator and delivered to the patient), which is the labeling required in the United States. This is different from the dosage expressed as the valve dose (amount of drug leaving the valve, not all of which is available to the patient), which is used in many European countries and in some scientific literature. Dry powder inhaler (DPI) doses are expressed as the amount of drug in the inhaler following activation. For children <4 years of age: The safety and efficacy of ICSs in children <1 year of age has not been established. Children <4 years of age generally require delivery of ICS (budesonide and fluticasone MDI) through a face mask that fits snugly over nose and mouth to avoid nebulizing in the eyes. Face should be washed after treatment to prevent local corticosteroid side effects. For budesonide, the dose may be given 1–3 times daily. Budesonide suspension is compatible with albuterol, ipratropium, and levalbuterol nebulizer solutions in the same nebulizer. Use only jet nebulizers, as ultrasonic nebulizers are ineffective for suspensions. For fluticasone MDI, the dose should be divided 2 times daily; the low dose for children <4 years of age is higher than for children 5–11 years of age because of lower dose delivered with face mask and data on efficacy in young children.
### USUAL DOSAGES FOR OTHER LONG-TERM CONTROL MEDICATIONS*

<table>
<thead>
<tr>
<th>Medication</th>
<th>0–4 years of age</th>
<th>5–11 years of age</th>
<th>≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Combined Medication (inhaled corticosteroid + long-acting ( \beta )-agonist)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluticasone/Salmeterol — DPI</td>
<td>N/A(^\d)</td>
<td>1 inhalation 2x/day; dose depends on level of severity or control</td>
<td>1 inhalation 2x/day; dose depends on level of severity or control</td>
</tr>
<tr>
<td>Fluticasone/Salmeterol — MDI</td>
<td>N/A(^\d)</td>
<td>2 inhalations 2x/day; dose depends on level of severity or control</td>
<td>2 inhalations 2x/day; dose depends on level of severity or control</td>
</tr>
<tr>
<td>Budesonide/Formoterol — DPI</td>
<td>N/A(^\d)</td>
<td>2 puffs 2x/day; dose depends on level of severity or control</td>
<td>2 puffs 2x/day; dose depends on level of severity or control</td>
</tr>
<tr>
<td>Budesonide/Formoterol — MDI</td>
<td>N/A(^\d)</td>
<td>2 inhalations 2x/day; dose depends on severity of asthma</td>
<td>2 inhalations 2x/day; dose depends on severity of asthma</td>
</tr>
<tr>
<td><strong>Leukotriene Modifiers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Montelukast — 4 mg or 5 mg chewable tablet, 4 mg granule packets, 10 mg tablet</td>
<td>4 mg every night at bedtime (1–5 years of age)</td>
<td>5 mg every night at bedtime (6–14 years of age)</td>
<td>10 mg every night at bedtime</td>
</tr>
<tr>
<td>Zafirlukast — 10 mg or 20 mg tablet</td>
<td>N/A(^\d)</td>
<td>10 mg 2x/day (7–11 years of age)</td>
<td>40 mg daily (20 mg tablet 2x/day)</td>
</tr>
<tr>
<td><strong>5-Lipoxygenase Inhibitor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zileuton — 600 mg tablet</td>
<td>N/A(^\d)</td>
<td>N/A(^\d)</td>
<td>2,400 mg daily (give 1 tablet 4x/day)</td>
</tr>
<tr>
<td><strong>Immunomodulators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omalizumab (Anti IgE) — Subcutaneous injection, 150 mg/1.2 mL following reconstitution with 1.4 mL sterile water for injection</td>
<td>N/A(^\d)</td>
<td>N/A(^\d)</td>
<td>150–375 mg subcutaneous every 2–4 weeks, depending on body weight and pretreatment serum IgE level</td>
</tr>
<tr>
<td><strong>Methylxanthines</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theophylline — Liquids, sustained-release tablets, and capsules</td>
<td>Starting dose 10 mg/kg/day; usual maximum: 800 mg/day</td>
<td>Starting dose 10 mg/kg/day; usual maximum: 16 mg/kg/day</td>
<td>Starting dose 10 mg/kg/day up to 300 mg maximum; usual maximum: 800 mg/day</td>
</tr>
<tr>
<td><strong>Inhaled Long-Acting Beta( \beta )-Agonists (LABAs) — used in conjunction with ICS for long-term control; LABA is NOT to be used as monotherapy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmeterol — DPI</td>
<td>N/A(^\d)</td>
<td>1 blister every 12 hours</td>
<td>1 blister every 12 hours</td>
</tr>
<tr>
<td>Formoterol — DPI</td>
<td>N/A(^\d)</td>
<td>1 capsule every 12 hours</td>
<td>1 capsule every 12 hours</td>
</tr>
<tr>
<td><strong>Oral Systemic Corticosteroids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone — 2, 4, 8, 16, 32 mg tablets</td>
<td>N/A(^\d)</td>
<td>0.25–2 mg/kg daily in single dose in a.m. or every other day as needed for control</td>
<td>75–60 mg daily in single dose in a.m. or every other day as needed for control</td>
</tr>
<tr>
<td>Prednisolone — 5 mg tablets; 5 mg/5 cc, 15 mg/5 cc</td>
<td>N/A(^\d)</td>
<td>Short course “burst”: 1–2 mg/kg/day, max 60 mg/d for 3–10 days</td>
<td>Short course “burst”: to achieve control, 40–60 mg/day as single or 2 divided doses for 3–10 days</td>
</tr>
<tr>
<td>Prednisone — 1, 2.5, 5, 10, 20, 50 mg tablets; 5 mg/cc, 5 mg/5 cc</td>
<td>N/A(^\d)</td>
<td>0.25–2 mg/kg daily in single dose in a.m. or every other day as needed for control</td>
<td>75–60 mg daily in single dose in a.m. or every other day as needed for control</td>
</tr>
<tr>
<td><strong>Abbreviations:</strong> DPI, dry powder inhaler; IgE, immunoglobulin E; MDI, metered-dose inhaler; N/A, not available (not approved, no data available, or safety and efficacy not established for this age group).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Dosages are provided for those products that have been approved by the U.S. Food and Drug Administration or have sufficient clinical trial safety and efficacy data in the appropriate age ranges to support their use.

The most important determinant of appropriate dosing is the clinician’s judgment of the patient’s response to therapy. The clinician must monitor the patient’s response on several clinical parameters (e.g., symptoms; activity level; measures of lung function) and adjust the dose accordingly. Once asthma control is achieved and sustained at least 3 months, the dose should be carefully titrated down to the minimum dose necessary to maintain control.
RESPONDING TO PATIENT QUESTIONS ABOUT INHALED CORTICOSTEROIDS

Questions and varying beliefs about inhaled corticosteroids (ICSs) are common and may affect adherence to treatment. Following are some key points to share with patients and families.

- **ICSs are the most effective medications for long-term control of persistent asthma.** Because ICSs are inhaled, they go right to the lungs to reduce chronic airway inflammation. In general, ICSs should be taken every day to prevent asthma symptoms and attacks.

- **The potential risks of ICSs are well balanced by their benefits.** To reduce the risk of side effects, patients should work with their doctor to use the lowest dose that maintains asthma control, and be sure to take the medication correctly.
  - Mouth irritation and thrush (yeast infection), which may be associated with ICSs at higher doses, can be avoided by rinsing the mouth and spitting after ICS use and, if appropriate for the inhaler device, by using a valved holding chamber or spacer.
  - ICS use may slow a child’s growth rate slightly. This effect on linear growth is not predictable and is generally small (about 1 cm), appears to occur in the first several months of treatment, and is not progressive. The clinical significance of this potential effect has yet to be determined. Growth rates are highly variable in children, and poorly controlled asthma can slow a child’s growth.
  - Mouth irritation and thrush (yeast infection), which may be associated with ICSs at higher doses, can be avoided by rinsing the mouth and spitting after ICS use and, if appropriate for the inhaler device, by using a valved holding chamber or spacer.
  - ICS use may slow a child’s growth rate slightly. This effect on linear growth is not predictable and is generally small (about 1 cm), appears to occur in the first several months of treatment, and is not progressive. The clinical significance of this potential effect has yet to be determined. Growth rates are highly variable in children, and poorly controlled asthma can slow a child’s growth.

- **ICSs are generally safe for pregnant women.** Controlling asthma is important for pregnant women to be sure the fetus receives enough oxygen.

- **ICSs are not addictive.**

- **ICSs are not the same as anabolic steroids that some athletes use illegally to increase sports performance.**

RESPONDING TO PATIENT QUESTIONS ABOUT LONG-ACTING BETA₂-AGONISTS

Keep the following key points in mind when educating patients and families about long-acting beta₂-agonists (LABAs).

- **The addition of LABA (salmeterol or formoterol) to the treatment of patients who require more than low-dose inhaled corticosteroid (ICS) alone to control asthma improves lung function, decreases symptoms, and reduces exacerbations and use of short-acting beta₂-agonists (SABA) for quick relief in most patients to a greater extent than doubling the dose of ICS.**

- **A large clinical trial found that slightly more deaths occurred in patients taking salmeterol in a single inhaler every day in addition to usual asthma therapy** (13 out of about 13,000) compared with patients taking a placebo in addition to usual asthma therapy (3 out of about 13,000). Trials for formoterol in a single inhaler every day in addition to usual therapy* found more severe asthma exacerbations in patients taking formoterol, especially at higher doses, compared with those taking a placebo added to usual therapy. Therefore, the Food and Drug Administration placed a Black Box warning on all drugs containing a LABA.

- **The established benefits of LABAs added to ICS for the great majority of patients who require more than low-dose ICS alone to control asthma should be weighed against the risk of severe exacerbations, although uncommon, associated with daily use of LABAs.**

- **LABAs should not be used as monotherapy for long-term control.** Even though symptoms may improve significantly, it is important to keep taking ICS while taking LABA.

- **Daily use should generally not exceed 100 mcg salmeterol or 24 mcg formoterol.**

- **It is not currently recommended that LABAs be used to treat acute symptoms or exacerbations.**

*Usual therapy included a wide range of regimens, from those in which no other daily therapy was taken to those in which varying doses of other daily medications were taken.*
EDUCATIONAL RESOURCES

National Heart, Lung, and Blood Institute

- Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3)
  www.nhlbi.nih.gov/guidelines/asthma
- Physician Asthma Care Education (PACE): www.nhlbi.nih.gov/health/prof/lung/asthma/pace/

Allergy & Asthma Network Mothers of Asthmatics
800–878–4403
www.aanma.org

American Academy of Allergy, Asthma, and Immunology
414–272–6071
www.aaaai.org

American Academy of Pediatrics
847–434–4000
www.aap.org

American Association of Respiratory Care
972–243–2272
www.aarc.org

American College of Chest Physicians
847–498–1400
www.chestnet.org

American College of Allergy, Asthma & Immunology
847–427–1200
www.acaai.org

American Lung Association
800–LUNG–USA (800–586–4872)
www.lungusa.org

American School Health Association
800–445–2742
www.ashaweb.org

Asthma and Allergy Foundation of America
800–7–ASTHMA (800–727–8462)
http://aafa.org

Centers for Disease Control and Prevention
800–CDC–INFO (800–232–4636)
www.cdc.gov/asthma

Environmental Protection Agency/Asthma Community Network
www.asthmacommunitynetwork.org
800–490–9198 (to order EPA publications)
www.epa.gov/asthma/publications.html

National Association of School Nurses
240–821–1130
www.nasn.org

For more information contact:

NHLBI Information Center
P.O. Box 30105
Bethesda, MD 20824–0105
Phone: 301–592–8573
Fax: 301–592–8563
Web site: www.nhlbi.nih.gov
Expert Panel Report 3 (EPR3) – Highlights of the 2007 Asthma Guidelines

1) Poorly controlled asthma has a very negative impact on the lives of children.  
9.7% of Missouri children, ~111,000 have asthma (2004, MO DHSS); more than 55,000 Missouri children take asthma medications at school (2006, MO DESE); approximately 25,000 Missouri children experience disability due to asthma (2005, Francisco & Konig)

2) EPR3 is the result of a rigorous, systematic review of the scientific literature.  
Ten committees composed of dozens of national experts spent 3 years screening 15,444 abstracts. They reviewed the full-text of 2,122 articles and judged 1,654 to contribute evidence relating to asthma best practices. Twenty evidence tables were constructed to integrate findings from 316 articles on critical topics. EPR3 recommendations are weighted by evidence level (Categories A, B, C, & D).

3) A four component approach is effective for achieving control of asthma.  
i) Measures of Asthma Assessment & Monitoring, ii) Education for a Partnership in Asthma Care, iii) Control of Environmental Factors & Comorbid Conditions that Affect Asthma and iv) Medications

4) Assessment of severity, evaluation of control and stepwise treatment of asthma differ for three age groups – 0-4 years, 5-11 and those 12 and above.  
Initiation of therapy requires assessment of asthma severity. Continuation of therapy should be based on assessment of asthma control. Use of medications should be based on evidence of effectiveness among the target age group.

5) Inhaled corticosteroids (ICS) are the foundation of asthma pharmacotherapy.  
Whereas, the treatment of Intermittent Asthma requires only SABA, preferred treatment for all levels of persistent asthma includes ICS. Comparative dose tables are available to aid in the determination of low, medium, or high dose therapy for the various age groups.

6) Inhalation technique is critical and requires correct use of assistive devices and objective assessment of inspiratory flow rate & time for MDIs and DPIs.

7) Spirometric parameters improve assessment of severity, control, exacerbations and response to therapy (FEV1, FEV1/FVC ratio and PEF). Symptom reports are also useful, but under-estimate the degree of airway obstruction in many individuals.

8) Effective initial management of exacerbations is based on aggressive use of SABA and ipratropium, guided by reassessment & evaluation of response to therapy.

9) Evaluation of contributing factors (comorbidities & inhalant triggers) is essential for achieving optimal control with the lowest possible doses of medications.

10) Regular office visits are required to develop a partnership that enhances adherence by reassessment, mutual goal-setting, written plans and education for self-care.

Abbreviations: MO DHSS=Missouri Department of Health & Senior Services, MO DESE=Missouri Department of Elementary & Secondary Education, MDI=metered dose inhaler, DPI=dry powder inhaler, FEV1=forced expiratory volume in 1 second, FEV1/FVC ratio=percentage of forced vital capacity exhaled in the first second, PEF=peak inspiratory flow rate, SABA=short-acting beta agonists

Benjamin D. Francisco, PhD, PNP, AE-C   2008
Assess Severity
- Patients at high risk for a fatal attack (see figure 5–2a) require immediate medical attention after initial treatment.
- Symptoms and signs suggestive of a more serious exacerbation such as marked breathlessness, inability to speak more than short phrases, use of accessory muscles, or drowsiness (see figure 5–3) should result in initial treatment while immediately consulting with a clinician.
- Less severe signs and symptoms can be treated initially with assessment of response to therapy and further steps as listed below.
- If available, measure PEF—values of 50–79% predicted or personal best indicate the need for quick-relief mediation. Depending on the response to treatment, contact with a clinician may also be indicated. Values below 50% indicate the need for immediate medical care.

Initial Treatment
- Inhaled SABA: up to two treatments 20 minutes apart of 2–6 puffs by metered-dose inhaler (MDI) or nebulizer treatments.
- Note: Medication delivery is highly variable. Children and individuals who have exacerbations of lesser severity may need fewer puffs than suggested above.

Good Response
No wheezing or dyspnea (assess tachypnea in young children).
PEF ≥80% predicted or personal best.
- Contact clinician for followup instructions and further management.
- May continue inhaled SABA every 3–4 hours for 24–48 hours.
- Consider short course of oral systemic corticosteroids.

Incomplete Response
Persistent wheezing and dyspnea (tachypnea).
PEF 50–79% predicted or personal best.
- Add oral systemic corticosteroid.
- Continue inhaled SABA.
- Contact clinician urgently (this day) for further instruction.

Poor Response
Marked wheezing and dyspnea.
PEF <50% predicted or personal best.
- Add oral systemic corticosteroid.
- Repeat inhaled SABA immediately.
- If distress is severe and nonresponsive to initial treatment:
  — Call your doctor AND
  — PROCEED TO ED;
  — Consider calling 9–1–1 (ambulance transport).

Key: ED, emergency department; MDI, metered-dose inhaler; PEF, peak expiratory flow; SABA, short-acting beta₂-agonist (quick-relief inhaler)
### FIGURE 5–3. FORMAL EVALUATION OF ASTHMA EXACERBATION SEVERITY IN THE URGENT OR EMERGENCY CARE SETTING

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Subset: Respiratory Arrest Imminent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathlessness</td>
<td>While walking</td>
<td>While at rest (infant—softer, shorter cry, difficulty feeding)</td>
<td>While at rest (infant—stops feeding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can lie down</td>
<td>Prefers sitting</td>
<td>Sits upright</td>
<td></td>
</tr>
<tr>
<td>Talks in</td>
<td>Sentences</td>
<td>Phrases</td>
<td>Words</td>
<td></td>
</tr>
<tr>
<td>Alertness</td>
<td>May be agitated</td>
<td>Usually agitated</td>
<td>Usually agitated</td>
<td>Drowsy or confused</td>
</tr>
<tr>
<td><strong>Signs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Increased</td>
<td>Increased</td>
<td>Often &gt;30/minute</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guide to rates of breathing in awake children:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Normal rate</td>
<td>&lt;60/minute</td>
<td>&gt;120</td>
<td></td>
</tr>
<tr>
<td>&lt;2 months</td>
<td>&lt;50/minute</td>
<td>&gt;120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–12 months</td>
<td>&lt;40/minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–5 years</td>
<td>&lt;30/minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6–8 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of accessory muscles; suprasternal retractions</td>
<td>Usually not</td>
<td>Commonly</td>
<td>Usually</td>
<td>Paradoxical thoracoabdominal movement</td>
</tr>
<tr>
<td>Wheeze</td>
<td>Moderate, often only end expiratory</td>
<td>Loud; throughout exhalation</td>
<td>Usually loud; throughout inhalation and exhalation</td>
<td>Absence of wheeze</td>
</tr>
<tr>
<td>Pulse/minute</td>
<td>&lt;100</td>
<td>100–120</td>
<td>&gt;120</td>
<td>Bradycardia</td>
</tr>
<tr>
<td></td>
<td>Guide to normal pulse rates in children:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Normal rate</td>
<td>&lt;160/minute</td>
<td>&gt;120</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>&lt;2 months</td>
<td>&lt;120</td>
<td>&gt;120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–12 months</td>
<td>&lt;110/minute</td>
<td>&gt;120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2 years</td>
<td>&lt;100</td>
<td>&gt;120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–8 years</td>
<td></td>
<td>&gt;120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulsus paradoxus</td>
<td>Absent &lt;10 mmHg</td>
<td>May be present</td>
<td>Often present</td>
<td>Absence suggests respiratory muscle fatigue</td>
</tr>
<tr>
<td></td>
<td>10–25 mmHg</td>
<td>&gt;25 mmHg (adult)</td>
<td>20–40 mmHg (child)</td>
<td></td>
</tr>
<tr>
<td><strong>Functional Assessment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEF percent predicted or percent personal best</td>
<td>≥70 percent</td>
<td>Approx. 40–69 percent or response lasts &lt;2 hours</td>
<td>&lt;40 percent</td>
<td>&lt;25 percent</td>
</tr>
<tr>
<td>PaO₂ (on air)</td>
<td>Normal (test not usually necessary)</td>
<td>≥60 mmHg (test not usually necessary)</td>
<td>&lt;60 mmHg: possible cyanosis</td>
<td></td>
</tr>
<tr>
<td>and/or PCO₂</td>
<td>&lt;42 mmHg (test not usually necessary)</td>
<td>&lt;42 mmHg (test not usually necessary)</td>
<td>≥42 mmHg: possible respiratory failure (See pages 393–394, 399.)</td>
<td></td>
</tr>
<tr>
<td>SaO₂ percent (on air) at sea level</td>
<td>&gt;95 percent (test not usually necessary)</td>
<td>Hypercapnia (hypoventilation) develops more readily in young children than in adults and adolescents.</td>
<td>&lt;90 percent</td>
<td></td>
</tr>
</tbody>
</table>

**Key:** PaO₂, arterial oxygen pressure; PCO₂, partial pressure of carbon dioxide; PEF, peak expiratory flow; SaO₂, oxygen saturation

**Notes:**
- The presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.
- Many of these parameters have not been systematically studied, especially as they correlate with each other. Thus, they serve only as general guides (Cham et al. 2002; Chey et al. 1999; Gorelick et al. 2004b; Karras et al. 2000; Kelly et al. 2002b and 2004; Keogh et al. 2001; McCarron et al. 2000; Rodrigo and Rodrigo 1998b; Rodrigo et al. 2004; Smith et al. 2002).
- The emotional impact of asthma symptoms on the patient and family is variable but must be recognized and addressed and can affect approaches to treatment and followup (Ritz et al. 2000; Strunk and Mrazek 1986; von Leupoldt and Dahme 2005).
FIGURE 5–6. MANAGEMENT OF ASTHMA EXACERBATIONS: EMERGENCY DEPARTMENT AND HOSPITAL-BASED CARE

**Initial Assessment** (see figures 5–1, 5–3)
- Brief history, physical examination (auscultation, use of accessory muscles, heart rate, respiratory rate), PEF or FEV₁, oxygen saturation, and other tests as indicated.

**FEV₁ or PEF ≥40% (Mild-to-Moderate)**
- Oxygen to achieve SaO₂ ≥90%
- Inhaled SABA by nebulezor or MDI with valved holding chamber, up to 3 doses in first hour
- Oral systemic corticosteroids if no immediate response or if patient recently took oral systemic corticosteroids

**FEV₁ or PEF <40% (Severe)**
- Oxygen to achieve SaO₂ ≥90%
- High-dose inhaled SABA plus ipratropium by nebulezor or MDI plus valved holding chamber, every 20 minutes or continuously for 1 hour
- Oral systemic corticosteroids

**Impending or Actual Respiratory Arrest**
- Intubation and mechanical ventilation with 100% oxygen
- Nebulized SABA and ipratropium
- Intravenous corticosteroids
- Consider adjunct therapies

**Repeat Assessment**
- Symptoms, physical examination, PEF, O₂ saturation, other tests as needed

**Admit to Hospital Intensive Care** (see box below)

**Severe Exacerbation**
- FEV₁ or PEF <40% predicted/personal best
- Physical exam: severe symptoms at rest, accessory muscle use, chest retraction
- History: high-risk patient
- No improvement after initial treatment
- Oxygen
- Nebulized SABA + ipratropium, hourly or continuous
- Oral systemic corticosteroids
- Consider adjunct therapies

**Moderate Exacerbation**
- FEV₁ or PEF 40–69% predicted/personal best
- Physical exam: moderate symptoms
- Inhaled SABA every 60 minutes
- Oral systemic corticosteroids
- Continue treatment 1–3 hours, provided there is improvement; make admit decision in <4 hours

**Incomplete Response**
- FEV₁ or PEF 40–69%
- Mild-to-moderate symptoms
- Continue treatment, provided there is improvement; make admit decision in <4 hours

**Discharge Home**
- Continue treatment with inhaled SABA.
- Continue course of oral systemic corticosteroid.
- Consider initiation of an ICS.
- Patient education
  - Review medications, including inhaler technique.
  - Review/initiate action plan.
  - Recommend close medical followup.

**Good Response**
- FEV₁ or PEF ≥70% after last treatment
- No distress
- Physical exam: normal

**Incomplete Response**
- FEV₁ or PEF 40–69%
- Monitor vital signs, FEV₁ or PEF, SaO₂

**Admit to Hospital Ward**
- Oxygen
- Inhaled SABA
- Systemic (oral or intravenous) corticosteroid
- Consider adjunct therapies

**Poor Response**
- FEV₁ or PEF <40%
- PCO₂ ≥42 mm Hg
- Physical exam: symptoms severe, drowsiness, confusion

**Admit to Hospital Intensive Care**
- Oxygen
- Inhaled SABA hourly or continuously
- Intravenous corticosteroid
- Consider adjunct therapies
- Possible intubation and mechanical ventilation

**Admit to Hospital Intensive Care**

**Moderate Exacerbation**
- FEV₁ or PEF 40–69% predicted/personal best
- Physical exam: moderate symptoms
- Inhaled SABA every 60 minutes
- Oral systemic corticosteroids
- Continue treatment 1–3 hours, provided there is improvement; make admit decision in <4 hours

**Incomplete Response**
- FEV₁ or PEF 40–69%
- Mild-to-moderate symptoms
- Continue treatment, provided there is improvement; make admit decision in <4 hours

**Discharge Home**
- Continue treatment with inhaled SABAs.
- Continue course of oral systemic corticosteroid.
- Consider initiation of an ICS.
- Patient education (e.g., review medications, including inhaler technique and, whenever possible, environmental control measures; review/initiate action plan; recommend close medical followup).
- Before discharge, schedule followup appointment with primary care provider and/or asthma specialist in 1–4 weeks.

Key: FEV₁, forced expiratory volume in 1 second; ICS, inhaled corticosteroid; MDI, metered dose inhaler; PCO₂, partial pressure carbon dioxide; PEF, peak expiratory flow; SABA, short-acting beta₂-agonist; SaO₂, oxygen saturation
### Figure 5–5. Dosages of Drugs for Asthma Exacerbations

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhaled Short-Acting Beta-2-Agonists (SABA)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Albuterol</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution</td>
<td>0.15 mg/kg (minimum dose 2.5 mg) every 20 minutes for 3 doses then 0.15–0.3 mg/kg up to 10 mg every 1–4 hours as needed, or 0.5 mg/kg/hour by continuous nebulization.</td>
<td>2.5–5 mg every 20 minutes for 3 doses, then 2.5–10 mg every 1–4 hours as needed, or 10–15 mg/hour continuously. Only selective beta-2-agonists are recommended. For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 6–8 L/min. Use large volume nebulizers for continuous administration. May mix with ipratropium nebulizer solution.</td>
</tr>
<tr>
<td>MDI</td>
<td>4–8 puffs every 20 minutes for 3 doses, then every 1–4 hours inhalation maneuver as needed. Use VHC; add mask in children &lt;4 years.</td>
<td>4–8 puffs every 20 minutes up to 4 hours, then every 1–4 hours as needed. In mild-to-moderate exacerbations, MDI plus VHC is as effective as nebulized therapy with appropriate administration technique and coaching by trained personnel.</td>
</tr>
<tr>
<td><strong>Bitolterol</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution</td>
<td>See albuterol dose; thought to be half as potent as albuterol on mg basis.</td>
<td>See albuterol dose. Has not been studied in severe asthma exacerbations. Do not mix with other drugs.</td>
</tr>
<tr>
<td>MDI</td>
<td>See albuterol MDI dose.</td>
<td>See albuterol MDI dose. Has not been studied in severe asthma exacerbations.</td>
</tr>
<tr>
<td><strong>Levalbuterol</strong> (R-albuterol)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution</td>
<td>0.075 mg/kg (minimum dose 1.25 mg) every 20 minutes for 3 doses, then 0.075–0.15 mg/kg up to 5 mg every 1–4 hours as needed.</td>
<td>1.25–2.5 mg every 20 minutes for 3 doses, then 1.25–5 mg every 1–4 hours as needed. Levalbuterol administered in one-half the mg dose of albuterol provides comparable efficacy and safety. Has not been evaluated by continuous nebulization.</td>
</tr>
<tr>
<td>MDI</td>
<td>See albuterol MDI dose.</td>
<td>See albuterol MDI dose.</td>
</tr>
<tr>
<td><strong>Pirbuterol</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDI</td>
<td>See albuterol MDI dose; thought to be half as potent as albuterol on a mg basis.</td>
<td>See albuterol MDI dose. Has not been studied in severe asthma exacerbations.</td>
</tr>
<tr>
<td><strong>Systemic ( Injected ) Beta-2-Agonists</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Epinephrine</strong></td>
<td>0.01 mg/kg up to 0.3–0.5 mg every 20 minutes for 3 doses sq.</td>
<td>0.3–0.5 mg every 20 minutes for 3 doses sq. No proven advantage of systemic therapy over aerosol.</td>
</tr>
<tr>
<td><strong>Terbutaline</strong></td>
<td>0.01 mg/kg every 20 minutes for 3 doses then every 2–6 hours as needed sq.</td>
<td>0.25 mg every 20 minutes for 3 doses sq. No proven advantage of systemic therapy over aerosol.</td>
</tr>
</tbody>
</table>

### August 28, 2007
## Figure 5–5. Dosages of Drugs for Asthma Exacerbations (Continued)

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anticholinergics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ipratropium bromide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution J. (0.25 mg/mL)</td>
<td>0.25–5 mg every 20 minutes for 3 doses, then as needed</td>
<td>0.5 mg every 20 minutes for 3 doses then as needed</td>
</tr>
<tr>
<td>MDI K. (18 mcg/puff)</td>
<td>4–8 puffs every 20 minutes as needed up to 3 hours</td>
<td>8 puffs every 20 minutes as needed up to 3 hours</td>
</tr>
<tr>
<td>Ipratropium with albuterol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (Each 3 mL vial contains 0.5 mg ipratropium bromide and 2.5 mg albuterol.)</td>
<td>1.5 mL every 20 minutes for 3 doses, then as needed</td>
<td>3 mL every 20 minutes for 3 doses, then as needed</td>
</tr>
<tr>
<td>MDI (Each puff contains 18 mcg ipratropium bromide and 90 mcg of albuterol.)</td>
<td>4–8 puffs every 20 minutes as needed up to 3 hours</td>
<td>8 puffs every 20 minutes as needed up to 3 hours</td>
</tr>
<tr>
<td><strong>Systemic Corticosteroids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td>1 mg/kg in 2 divided doses (maximum = 60 mg/day) until PEF is 70% of predicted or personal best</td>
<td>40–80 mg/day in 1 or 2 divided doses until PEF reaches 70% of predicted or personal best</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisolone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Children ≤ 12 years of age

Key: ED, emergency department; MDI, metered-dose inhaler; PEF, peak expiratory flow; VHC, valved holding chamber

**Notes:**
- There is no known advantage for higher doses of corticosteroids in severe asthma exacerbations, nor is there any advantage for intravenous administration over oral therapy provided gastrointestinal transit time or absorption is not impaired.
- The total course of systemic corticosteroids for an asthma exacerbation requiring an ED visit of hospitalization may last from 3 to 10 days. For corticosteroid courses of less than 1 week, there is no need to taper the dose. For slightly longer courses (e.g., up to 10 days), there is probably no need to taper, especially if patients are concurrently taking ICSs.
- ICSs can be started at any point in the treatment of an asthma exacerbation.