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Health Care Guideline

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- health plans, health systems, health care organizations, hospitals and integrated health care delivery systems;
- medical specialty and professional societies;
- researchers;
- federal, state and local government health care policy makers and specialists; and
- employee benefit managers.

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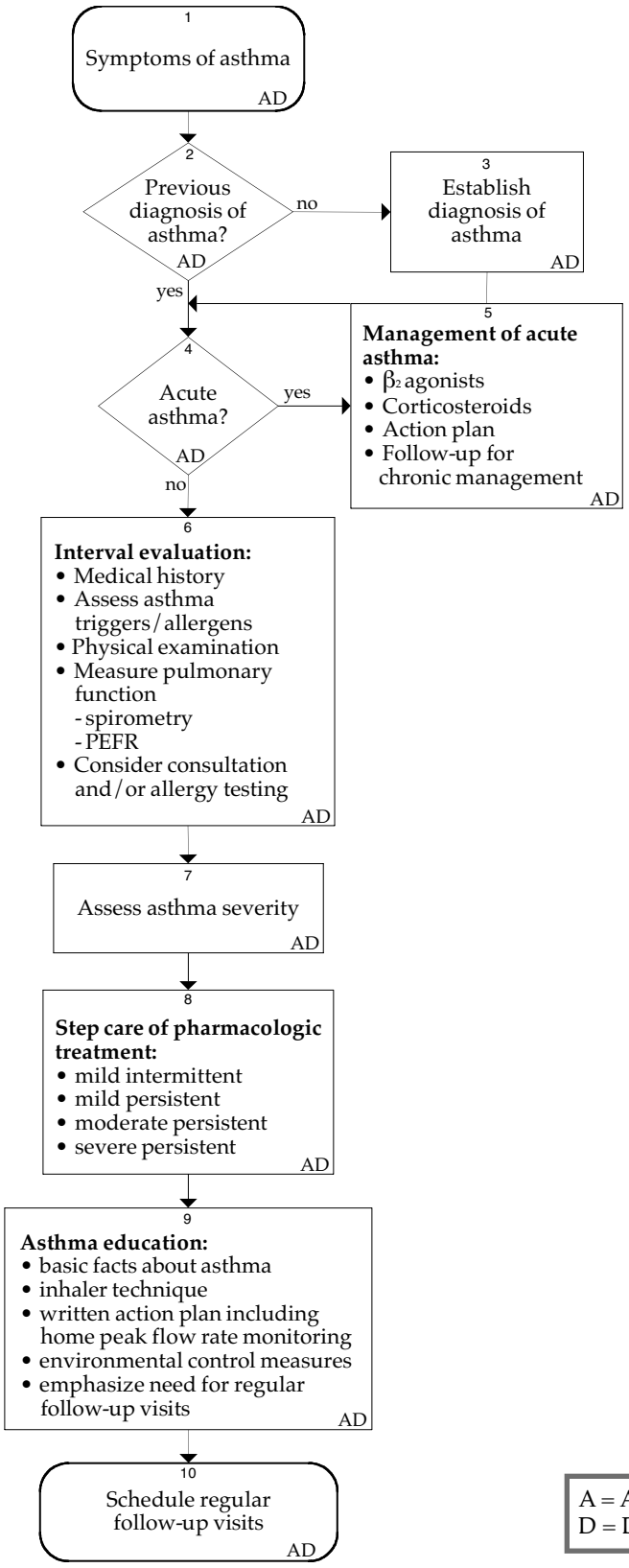
INSTITUTE FOR CLINICAL SYSTEMS IMPROVEMENT

Health Care Guideline:

Diagnosis and Management of Asthma



A = Annotation
D = Discussion

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Table of Contents

Scope and Target Population

This guideline addresses the diagnosis and primary care management of acute and chronic asthma in all patients over five years of age who present with asthma-like symptoms or have been diagnosed with asthma.

Related ICSI Scientific Documents

Other ICSI guidelines whose scope and/or recommendations are closely related to the content of this guideline are:

1. Chronic Obstructive Pulmonary Disease
2. Rhinitis

Clinical Highlights for Individual Clinicians

1. Conduct interval evaluations of asthma including medical history and physical examination, assessment of asthma triggers and allergens, measurement of pulmonary function, and consideration of consultation and/or allergy testing. *(Annotation #6)*
2. Regularly assess asthma control. *(Annotation #7)*
3. Match medical intervention with asthma severity and adjust to correspond with change over time. *(Annotation #8 and Table 8A)*
4. Achieve effective control of chronic persistent asthma through use of inhaled corticosteroid therapy. *(Table #8A)*
5. Provide asthma education to adult patients and parents of pediatric patients. Education should include basic facts about asthma, inhaler technique, a written action plan including home peak flow rate monitoring or a symptom diary, environmental control measures, and emphasis on the need for regular follow-up visits. *(Annotation #9)*

Priority Aims for Medical Groups When Using This Guideline

1. Promote the accurate assessment of asthma severity through the use of objective measures of lung function.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with asthma with spirometry or peak flow documented at the last visit.

   b. Percentage of patients with asthma, for whom a peak flow meter is appropriate, who report using a home peak flow meter.

   c. Percentage of patients with asthma with any assessment of asthma severity documented at the last visit.

2. Promote long-term control of persistent asthma through the use of inhaled corticosteroid drug therapy.

   Possible measure of accomplishing this aim:

   a. Percentage of patients with persistent asthma who are on inhaled corticosteroid medication.

3. Promote the partnership of patients with asthma and/or their parents with health care professionals through education and the use of written action plans.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with asthma with an asthma action plan in the medical record.

   b. Percentage of patients with asthma with education about asthma documented in the medical record.

EVIDENCE GRADING

Individual research reports are assigned a letter indicating the class of report based on design type: A, B, C, D, M, R, X.

Key conclusions are assigned a conclusion grade: I, II, III, or Grade Not Assignable.

A full explanation of these designators is found in the Discussion and References section of the guideline.

ALGORITHM ANNOTATIONS

1. Symptoms of Asthma

A. Symptoms
   1. Wheezing
   2. Breathlessness
   3. Cough, productive or dry
   4. Chest discomfort

B. Pattern of symptoms
   1. Perennial/seasonal
   2. Episodic/continual
   3. Diurnal

C. Severity of symptom classification
   1. Number of symptom episodes per week
   2. Number of nocturnal symptoms per week
   3. Change in activity associated with symptoms

2. Previous Diagnosis of Asthma?

At each evaluation, it is important to consider whether or not a previous diagnosis was correct.

   A. History and physical consistent with diagnosis
   B. Diagnosis confirmed by spirometry
   C. Response to therapy consistent with symptoms

3. Establish Diagnosis of Asthma

The diagnosis of asthma is based on the patient's medical history, physical examination, pulmonary function tests and laboratory test results. Spirometry is recommended for the diagnosis of asthma.

A. Asthma triggers
   1. Viral respiratory infections
   2. Environmental allergens
   3. Exercise, temperature, humidity
   4. Occupational and recreational allergens or irritants
   5. Environmental irritants (perfume, tobacco smoke, wood burning stoves)
   6. Drugs (aspirin, NSAID, beta blocker) and food (sulfites)

B. Other historical components

1. Emergency room visits and hospitalization
2. Medication use (especially oral steroids)
3. Lung function, PEFR variability
4. Associated symptoms, e.g., rhinitis, sinusitis, gastroesophageal reflux (GERD)

C. Laboratory evaluation

1. Accurate spirometry is recommended in every patient ≥ 5 years of age at the time of diagnosis.
2. Additional studies done, tailored to the specific patient.
   - allergy testing (skin testing, in vitro specific IgE antibody testing)
   - chest radiography, to exclude alternative diagnosis
   - bronchial provocation testing if spirometry is normal or near normal
   - sinus x-rays or CT scan
   - GERD evaluation
   - CBC with eosinophils, total IgE, sputum exam

Spirometry is generally valuable in children ≥ 5 years of age, however some children cannot conduct the maneuver depending on developmental ability. Spirometry measurements (FEV_1, FVC, FEV_1/FVC) before or after the patient inhales a short-acting bronchodilator should be undertaken for patients in whom the diagnosis of asthma is being considered. Airflow obstruction is indicated by reduced FEV_1 and FEV_1/FVC values relative to reference or predicted values. Significant reversibility is indicated by an increase of ≥ 12 percent *and* 200 mL in FEV_1, after inhaling a short-acting bronchodilator.

See Discussion and References section for information concerning differential diagnosis possibilities for asthma.

4. Acute Asthma?

Symptoms of an acute asthma episode include progressive breathlessness, cough, wheezing or chest tightness. An acute asthma episode is characterized by a decrease in expiratory airflow that can be documented and quantified by measurement of lung function (spirometry or PEFR). The algorithm is intended for treatment of outpatients. Critically ill patients are beyond the scope of this guideline.

Indications for emergency care include:

- Peak flow less than 50% predicted normal
- Failure to respond to a beta agonist
- Severe wheezing or coughing
- Extreme anxiety due to breathlessness
- Gasping for air, sweaty, or cyanotic
- Rapid deterioration over a few hours

- Severe retractions and nasal flaring
- Hunched forward

5. Management of Acute Asthma

Patients presenting with an acute exacerbation of their asthma should receive prompt evaluation and treatment to improve symptoms in the short-term, prevent recurrence of symptoms and provide for follow-up. The following is an outline of management:

Review history and physical exam which may include:

- History
  - Severity of symptoms, limitations, and sleep disturbance
  - Duration of symptoms
  - Current medical treatment plan
  - Adherence to medical treatment plan
  - Rescue medication use:

    recent use of short acting ß$_2$-agonists

    number of bursts of oral steroids in past year
  - Review Asthma Action Plan and daily charting of peak flows
  - Previous ER visits or hospitalization
  - Record triggers:

    URI

    Bronchitis, pneumonia

    Exposure to allergens or irritants

    Exercise
- Physical exam
  - Vital signs
  - Auscultation of chest
  - Peak flow rate or FEV_1
  - Use of accessory muscles
  - Alertness
  - Color
- Laboratory studies

  Treatment with bronchodilators should not be delayed for laboratory studies. Tests which may be useful include:
  - O_2 saturation (pulse oximetry)

- Arterial Blood Gases (ABG's)
- Chest X-Ray (CXR)
- Complete Blood Count (CBC)
- Electrocardiogram (EKG)
- Electrolytes
- Theophylline concentration

• Assess severity

Assessment is based on history and physical exam.

Treatment

Usual initial treatment is with short-acting nebulized ß$_2$-agonist (albuterol) 2.5-5 mg q 20 min up to three doses.

Alternatives:

Epinephrine: (1:1000)

Adult: 0.3-0.5 mg subq or IM q 20 min up to 3 doses

Pediatrics: 0.1 mg/kg up to 0.3-0.5 subq q 20 min up to 3 doses

Ipratropium added to nebulized ß$_2$-agonist (albuterol)

- Nebulized dose for adults and those over 12 years of age is 0.5 mg q 4 hr. Not FDA approved for any indication in those under 12 years of age.
- Ipratropium is not currently FDA-approved for use in asthma.

Levalbuterol

- Dose for adolescents 12 years of age and over and adults is 0.63 mg (via nebulizer) TID (q 6-8 hr); may increase to 1.25 mg via neb TID (q 6-8 hr) if patient does not exhibit adequate response.
- Dose for children 6-11 years of age is 0.31 mg (via nebulizer) TID. Routine dosing should not exceed 0.63 mg TID.
- Not FDA approved for those under 12 years of age.

Assess Response

Good response:

peak flow or FEV_1 > 70% predicted normal

no wheezing on auscultation

Incomplete response:

peak flow or FEV_1 50-70% predicted normal

mild wheezing

Consider hospitalization, particularly for high-risk patients:

- past history of sudden severe exacerbation
- prior intubation for asthma
- two or more hospitalizations for asthma in the past year
- three or more emergency care visits for asthma within the past year
- hospitalization or an emergency care visit for asthma within the past month
- Use of > 2 cannisters per month of inhaled short-acting ß$_2$-agonists
- current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids
- difficulty perceiving airflow obstruction or its severity
- comorbidity, as from cardiovascular disease or chronic obstructive pulmonary disease
- serious psychiatric disease or psychosocial problems
- low socioeconomic status and urban residence
- illicit drug use
- sensitivity to Alternaria

Poor response:

peak flow or FEV_1 < 50% predicted normal

no improvement in respiratory distress

strongly consider hospitalization

continue inhaled ß$_2$-agonist q 60 minutes

start oral prednisone unless contraindicated

Adult: short course "burst" 40-60 mg/day as single or 2 divided doses for 3 to 10 days
Pediatric: short course "burst" 1-2 mg/kg day, maximum 60 mg/day for 3 to 10 days

Home treatment and revised asthma action plan

Medications

- Inhaled ß$_2$-agonist every 2-6 hours
- Initiate or increase anti-inflammatory medication:

  inhaled corticosteroids

  cromolyn/nedocromil

  consider leukotriene modifiers

- Strongly consider systemic corticosteroids in patients with acute asthma exacerbation. Corticosteroids aid symptom resolution and prevent asthma relapse

- Antibiotics are not routinely used but may be warranted if patient has signs of acute bacterial infection, fever and purulent sputum

Education

- Teach or check inhaler technique/teach nebulizer use
- Explain medications
- Review action plan
- Monitor peak flow
- Reinforce trigger control

Follow-up

- All patients need return appointment for management of asthma
- Review and discuss signs and symptoms requiring emergent care

Evidence supporting this recommendation is of classes: A, D, R

6. Interval Evaluation

Interval evaluation of asthma should include the following:

Medical History

- Disruption of usual activities (work, school, home)
- Sleep disturbance
- Level of usage of short-acting ß$_2$-agonist
- Adherence to medical treatment plan
- Interval exacerbation of symptoms (either treated by self or a health care provider)
- Symptoms suggesting co-morbid conditions or alternative diagnosis
- Side effects of medications

Evidence supporting this recommendation is of classes: C, D

Assess asthma triggers/allergens

- Inquire about exposure to triggers and allergens (e.g., occupational, pets, smoke)
- Allergy testing is recommended for patients with persistent asthma who are exposed to perennial indoor allergens

Physical Examination

- Assess signs associated with asthma, concurrent illness or medication side effects
- Height in children
- Head, eyes, ears, nose, throat, lungs, heart, skin

Measure Pulmonary Function:

It is important to measure pulmonary function at each follow-up visit. The two main methods are spirometry and peak expiratory flow rate (PEFR).

Spirometry recommended:

- for initial diagnosis or to reassess or confirm diagnosis
- after treatment is initiated or changed, and once symptoms and PEFR have stabilized to document attainment of "near normal pulmonary function"
- at least every 1 to 2 years to assess maintenance of airway function; more often as severity indicates

PEFR

- Used for follow-up, not for diagnosis

During interval assessment the clinician should question the patient and review records to evaluate the frequency, severity and causes of exacerbation. Triggers that may contribute should be reviewed. All patients on chronic maintenance medication should be questioned about exposure to inhalant allergens.

Evidence supporting this recommendation is of class: C

Consider Specialty Consultation:

- Adults with severe persistent asthma, consider for moderate persistent asthma
- Children with moderate to severe persistent asthma, consider for mild persistent asthma
- Poorly controlled or complex asthma including previous life-threatening asthma exacerbation, or asthma exacerbations requiring more than 2 bursts of oral corticosteroids in 1 year, or asthma complicated by other medical or psychosocial conditions
- Additional diagnostic evaluations and/or testing, e.g., allergy skin testing, bronchoprovocation
- Allergy testing is recommended for patients with persistent asthma who are exposed to perennial indoor allergens
- Evaluation and treatment of allergy, e.g., address occupation-related asthma, environmental counseling, immunotherapy
- Patients who require additional or intensive asthma education not otherwise available

7. Assess Asthma Severity

Step 1: Mild Intermittent

- symptoms $\leq$ 2 times a week
- asymptomatic and normal PEF between exacerbations
- exacerbations are brief (few hours to a few days)
- nighttime symptoms $\leq$ 2 times a month
- FEV_1 or PEF $\geq$ 80 percent predicted and PEF variability $\leq$ 20 percent

Step 2: Mild Persistent

- symptoms ≥ 2 times a week but ≤ 1 time a day
- exacerbations may affect activity
- nighttime symptoms ≥ 2 times a month
- FEV_1 or PEF ≥ 80 percent predicted and PEF variability 20-30 percent

Step 3: Moderate Persistent

- daily symptoms
- daily use of inhaled short-acting $beta_2$-agonists
- exacerbations affect activity
- exacerbations ≥ 2 times a week; may last days
- nighttime symptoms ≤ 1 time a week
- FEV_1 or PEF ≥ 60 percent - ≤ 80 percent predicted
- PEF variability ≥ 30 percent

Step 4: Severe Persistent

- continual symptoms
- limited physical activity
- frequent exacerbations
- frequent nighttime symptoms
- FEV_1 or PEF ≤ 60 percent and PEF variability ≥ 30 percent

Evidence supporting this recommendation is of classes: M, R

8. Step Care of Pharmacologic Treatment

The aim of asthma therapy is to maintain control of asthma with the least amount of medication and hence minimize the risk for adverse effects. The stepwise approach to therapy in which the dose and number of medications and frequency of administration are increased as necessary and decreased when possible is used to achieve this control. Since asthma is a chronic inflammatory disorder of the airways with recurrent exacerbations, therapy for persistent asthma emphasizes efforts to suppress inflammation over the long-term and prevent exacerbations. See tables 8A, 8B, 8C, and 8D.

Inhaled corticosteroids are the preferred treatment option for mild persistent asthma in adults, and LTRAs are an alternative – although not preferred – treatment.

[Conclusion Grade I: See Discussion Appendix A, Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor Antagonists [LTRAs])]

Stepwise Approach for Managing Asthma in Adults and Children Older than 5 Years of Age	
Step	Long-Term Control
Step 1 - Mild Intermittent • symptoms ≤ 2 times a week • asymptomatic and normal PEF between exacerbations • exacerbations are brief (few hours to a few days) • nighttime symptoms ≤ 2 times a month • FEV_1 or PEF ≥ 80% predicted and PEF variability ≤ 20%	No daily medications needed
Step 2 - Mild Persistent • symptoms ≥ 2 times a week but ≤ 1 time a day • exacerbations may affect activity • nighttime symptoms ≥ 2 times a month • FEV_1 or PEF ≥ 80 percent predicted and PEF variability 20-30%	Daily medication: • Inhaled corticosteroids (low dose) (preferred) OR • Leukotriene modifiers, theophylline, nedocromil or cromolyn
Step 3 - Moderate Persistent • daily symptoms • daily use of inhaled short-acting ß$_2$-agonists • exacerbation affects activity • exacerbations >2 week, may last days • nighttime symptoms >1 time a week • FEV_1 or PEF ≥ 60% - ≤ 80% predicted • PEF variability ≥ 30%	Daily medications: • Inhaled corticosteroid (low or medium dose) plus inhaled long-acting β_2 agonist (preferred) OR • Inhaled corticosteroid (medium dose) plus leukotriene modifier, theophyline, or oral long-acting β_2
Step 4 - Severe Persistent • continual symptoms • limited physical activity • frequent exacerbations • frequent nighttime symptoms • FEV_1 or PEF ≤ 60 % and PEF variability ≥ 30 %	Daily medications: Inhaled corticosteroid (medium dose or high dose) PLUS: Long acting β_2 agonist (preferred) and/OR Leukotriene modifier and/OR Theophylline Recommended for uncontrolled asthma: • Oral corticosteroids (See Table 8D)
Step down: Review treatment every 1-6 months; a gradual stepwise reduction in treatment may be possible.	Step up: If control not maintained, consider step up. First review patient medication technique, adherence and environmental control (avoidance of allergens or other factors that contribute to asthma severity)
Quick relief: • Short-acting bronchodilator: inhaled ß$_2$-agonists as needed for symptoms • Intensity of treatment will depend on severity of exacerbation. • Use of short-acting inhaled ß$_2$-agonists on a daily basis, or increasing use, indicates the need for additional long-term control therapy.	
Education: Step 1: • Teach basic facts about asthma • Teach inhaler/spacer/holding chamber technique • Discuss role of medications • Develop self-management plan • Develop action plan for when and how to take rescue actions, especially for patients with a history of severe exacerbations • Discuss appropriate environmental control measures to avoid exposure to known allergens and irritants Step 2: • Teach self-monitoring • Refer to group education if available • Review and update self-management plan Step 3: • Refer to individual education/counseling	

Usual Dosages for Long-Term Medications				
Medication	**Dosage Form**	**Adult Dose**	**Child Dose**	**Comments**
Inhaled Corticosteroids (refer to Table 8C)				
Systemic Corticosteroids				**(Applies to all three systemic corticosteroids)**
Methylprednisolone	2, 4, 8, 16, 32 mg tablets	• 7.5-60 mg daily in a single dose or qid as needed for control • Short-course "burst" 40-60 mg per day as single or 2 divided doses for 3-10 days	• 0.25-2 mg/kg daily in single dose or qid as needed for control • Single course: "burst" 1-2 mg/kg/day, maximum 60 mg/day, for 3-10 days	• For long-term treatment of severe persistent asthma, administer single dose in a.m. either daily or on alternate days (alternate-day therapy may produce less adrenal suppression). If daily doses are required, one study suggests improved efficacy and no increase in adrenal suppression when administered at 3:00 p.m. (Beam et al. 1992) • Short courses or "bursts" are effective for establishing control when initiating therapy or during a period of gradual deterioration. • The burst should be continued until patient achieves 80% PEF personal best or symptoms resolve. This usually requires 3-10 days but may require longer. There is no evidence that tapering the dose following improvement prevents relapse if sufficient doses of inhaled corticosteroids are used simultaneously.
Prednisolone	5 mg tablets, 5 mg/5 cc, 15 mg/5 cc			
Prednisone	1, 2.5, 5, 10, 20, 50 mg tablets 5 mg/5 cc			
Cromolyn and Nedocromil				
Cromolyn	MDI 800 µg/puff Nebulizer solution - 20 mg/ampule	2-4 puffs tid-qid 1 ampule tid-qid	1-2 puffs tid-qid 1 ampule tid-qid	• One dose prior to exercise or allergen exposure provides effective prophylaxis for 1-2 hours.
Nedocromil	MDI 1.75 mg/puff	2-4 puffs bid-qid	1-2 puffs bid-qid	• See cromolyn above.

Usual Dosages for Long-Term Medications (continued)				
Medication	**Dosage Form**	**Adult Dose**	**Child Dose**	**Comments**
Long-Acting ß$_2$-Agonists				
	Inhaled			
Salmeterol	MDI 21 µg/puff, 60 or 120 puffs	2 puffs q 12 hours	1-2 puffs q 12 hours	• May use one dose nightly for symptoms.
	DPI 50 µg/blister	1 blister q 12 hours	1 blister q 12 hours	• Should not be used for symptom relief or for exacerbations.
Formoterol Fumarate DPI	12 µg/dose (single use capsule by inhalation)	1 capsule by inhalation BID	1 capsule by inhalation BID	• FDA approved for children 5 years of age and older.
Fluticasone propionate/ salmeterol DPI	Dosage strengths and adult dose (one inhalation) q 12 hr for all three strengths) with the strengths: 100 µg fluticasone/50µg salmeterol 250 µg fluticasone/50µg salmeterol 500 µg fluticasone/50µg salmeterol	1 puff BID	1 puff BID	• FDA approved for children 12 years of age and older.
	Tablet			
Sustained-Release Albuterol	4 mg tablet	4 mg q 12 hours	0.3-0.6 mg/kg/day, not to exceed 8 mg/day	
Methylxanthines				
Theophylline	Liquids, sustained-release tablets, and capsules	Starting dose 10 mg/kg/day up to 300 mg max; usual max 800 mg/day	Starting dose 10 mg/kg/day; usual max: • <1 year of age: 0.2 (age in weeks) + 5 = mg/kg/day • ≥1 year of age: 16 mg/kg/day	• Adjust dosage to achieve serum concentration of 5-15 µg/mL at a steady-state (at least 48 hours on same dosage). • Due to wide interpatient variability in theophylline metabolic clearance, routine serum theophyline level monitoring is important. • See factors below that can affect levels.
Leukotriene Modifiers				
Montelukast	4 mg granules 4 mg tablet** 5 mg tablet** 10 mg tablet	10 mg/qhs	4 mg/qd evening or qhs (2-5 years of age) 5 mg/qd evening or qhs (6-14 years of age) 10 mg/qd evening or qhs (15 years of age and older)	
Zafirlukast	10 mg tablet 20 mg tablet	40 mg daily (20 mg bid) (≥ 12 years of age)	10 mg bid (7-11 years of age)	• For zafirlukast, administration with meals decreases bioavailability; take at least 1 hour before or 2 hours after meals.
Zileuton	600 mg tablet	2,400 mg daily (one 600 mg tablet, qid)	600 mg tablet QID (12 years of age and older)	• For zileuton, monitor hepatic enzymes (ALT).

* This list is not all-inclusive; for discussion of other factors, see package inserts.
** Children's dose – chewable tablets.

Estimated Comparative Daily Dosage for Inhaled Corticosteroids			
ADULTS			
Drug	**Low Dose**	**Medium Dose**	**High Dose**
Beclomethasone dipropionate HFA (Hydrofluoroalkane) formulation with strengths of 40 μg/puff and 80 μg/puff)	80 mg-240 mg (2-6 puffs - 40 μg) (1-3 puffs - 80 μg)	240 μg- 480 μg (6-12 puffs - 40 μg) (3-6 puffs - 80 μg)	> 480 μg (> 12 puffs - 40 μg) (> 6 puffs - 80 μg)
Budesonide DPI 200 μg/dose	200-600 μg (1-3 inhalations)	600-1200 μg (3-6 inhalations)	> 1200 μg (> 6 inhalations)
Flunisolide 250 μg/puff	500-1,000 μg (2-4 puffs)	1,000-2,000 μg (4-8 puffs)	>2,000 μg (>8 puffs)
Fluticasone MDI: 44, 110, 220 μg/puff	88-264 μg (2-6 puffs - 44 μg) OR (2 puffs - 110 μg)	264-660 μg (2-6 puffs - 110 μg)	>660 μg (>6 puffs - 110 μg) OR (>3 puffs - 220 μg)
DPI: 50, 100, 250 μg/dose	100-300 μg (2-6 inhalations - 50 μg)	300-600 μg (3-6 inhalations - 100 μg)	> 600 μg (>6 inhalations - 100 μg) OR (>2 inhalations - 250 μg)
Combination Product – fluticasone propionate/salmeterol DPI	100 μg fluticasone/50 μg salmeterol – one inhalation q 12 hr	250 μg fluticasone/50 μg salmeterol – one inhalation q 12 hr	500 μg fluticasone/50 μg salmeterol – one inhalation q 12 hr
Triamcinolone acetonide 100 μg/puff	400-1,000 μg (4-10 puffs)	1,000-2,000 μg (10-20 puffs)	>2,000 μg (>20 puffs)

NOTES:

- 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 and adjust the dose accordingly. The stepwise approach to therapy emphasizes that once control of asthma is achieved, the dose of medication should be carefully titrated to the minimum dose required to maintain control, thus reducing the potential for adverse effect.
- Some dosages may be outside package labeling.
- MDI dosages are expressed as the actuater dose (the amount of drug leaving the actuater 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 (the amount of drug leaving the valve, all of which is not available to the patient), which is used in many European countries and in some of the scientific literature. DPI doses are expressed as the amount of drug in the inhaler following activation.

Estimated Comparative Daily Dosage for Inhaled Corticosteroids			
CHILDREN			
Drug	**Low Dose**	**Medium Dose**	**High Dose**
Beclomethasone dipropionate HFA 40 μg/puff 80 μg/puff	84-336 μg 80-160 μg (2-4 puffs - 40 μg) (1-2 puffs- 80 μg)	336-672 μg 160-320 μg (4-8 puffs - 40 μg) (2-4 puffs - 80 μg)	> 672 μg > 320 μg (> 8 puffs - 40 μg) (> 4 puffs - 80 μg)
Budesonide DPI 200 μg/dose For nebulization: strengths 0.25 mg/2 mL and 0.5 mg/2 mL	200-400 μg (1-2 inhalations) 0.5 mg	400-800 μg (2-4 inhalations - 200 μg) 1.0 mg/day	> 800 μg (> 4 inhalations - 200 μg) 2.0 mg/day
Flunisolide 250 μg/puff	500-750 μg (2-3 puffs)	1,000-1,250 μg (4-5 puffs)	>1,250 μg (> 5 puffs)
Fluticasone MDI: 44, 110, 220 μg/puff DPI: 50, 100, 250 μg/dose	88-176 μg (2-4 puffs - 44 μg) 100-200 μg (2-4 inhalations - 50 μg)	176-440 μg (4-10 puffs - 44 μg) OR (2-4 puffs - 110 μg) 200-400 μg (2-4 inhalations - 100 μg)	> 440 μg (> 4 puffs - 110 μg) OR (> 2 puffs - 220 μg) > 400 μg (> 4 inhalations - 100 μg) OR (> 2 inhalations - 250 μg)
Triamcinolone acetonide 100 μg/puff	400-800 μg (4-8 puffs)	800-1,200 μg (8-12 puffs)	> 1,200 μg (> 12 puffs)

NOTES:

- The most important determinant of appropriate dosing is the clinician's judgement of the patient's response to therapy. The clinician must monitor the patient's response on several clinical parameters and adjust the dose accordingly. The stepwise approach to therapy emphasizes that once control of asthma is achieved, the dose of medication should be carefully titrated to the minimum dose required to maintain control, thus reducing the potential for adverse effect.
- The reference point for the range in the dosages for children is data on the safety of inhaled corticosteroids in children, which, in general, suggest that the dose ranges are equivalent to beclomethasone dipropionate 200-400 μg/day (low dose), 400-800 μg/day (medium dose), and > 800 μg/day (high dose).
- Some dosages may be outside package labeling.
- MDI dosages are expressed as the actuater dose (the amount of drug leaving the actuater 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 (the amount of drug leaving the valve, all of which is not available to the patient), which is used in many European countries and in some of the scientific literature. DPI doses are expressed as the amount of drug in the inhaler following activation.

Usual Dosages for Quick-Relief Medications				
Medication	**Dosage Form**	**Adult Dose**	**Child Dose**	**Comments**
Short-Acting Inhaled Beta$_2$-Agonists				
	MDIs			
Albuterol	90 µg/puff, 200 puffs	• 2 puffs 5 minutes prior to exercise • 2 puffs tid-qid prn	• 1-2 puffs 5 minutes prior to exercise • 2 puffs tid-qid prn	• An increasing use or lack of expected effect indicates diminished control of asthma. • Not generally recommended for long-term treatment. Regular use on a daily basis indicates the need for additional long-term control therapy. • Differences in potency exist so that all products are essentially equip on a per puff basis. • May double usual dose for mild exacerbations. • Nonselective agents (i.e., epinephrine, isoproterenol, metaproterenol) are not recommended due to their potential for excessive cardiac stimulation, especially in high doses.
Albuterol HFA	90 µg /puff, 200 puffs			
Bitolterol	370 µg /puff, 300 puffs			
Pirbuterol	200 µg /puff, 400 puffs			
	DPI			
Albuterol Rotahaler	200 µg/capsule	1-2 capsules q 4-6 hours as needed and prior to exercise	1 capsule q 4-6 hours as needed and prior to exercise	• May mix with cromolyn or ipratropium nebulizer solutions. May double dose for mild exacerbations.
	Nebulizer solution			
Albuterol	5 mg/mL (0.5%)	1.25-5 mg (.25-1 cc) in 2-3 cc of saline q 4-8 hours	0.05 mg/kg (min 1.25 mg, max 2.5 mg) in 2-3 cc of saline q 4-6 hours	
Levalbuterol nebulization	0.63 mg/3 mL and 1.25 mg/3 mL	12 yrs is 0.63 mg to 1.25 mg TID	6-11 years is 0.31 mg to 0.63 mg TID	• Routine dosing should not exceed 0.63 mg TID
Bitolterol	2 mg/mL (0.2%)	0.5-3.5 mg (.25-1cc) in 2-3cc of saline q 4-8 hours	Not established	• May not mix with other nebulizer solutions.
Anticholinergics				
	MDIs			
Ipratropium	18 µg/puff, 200 puffs	2-6 puffs q 6 hours	1-2 puffs q 6 hours	• Evidence is lacking for anticholinergice producing added benefit to ß$_2$-agonists in long-term asthma therapy.
	Nebulizer/solution .25 mg/mL (0.025%)	0.25-0.5 mg q 6 hours	0.25 mg q 6 hours	
Systemic Corticosteroids		(Applies to all three systemic corticosteroids)		
Methylprednisolone	2, 4, 8, 16, 32 mg tablets	• short course "burst": 40-60 mg/day as single or 2 divided doses for 3-10 days	• Short course "burst": 1-2 mg/kg/day, maximum 60 mg/day, for 3-10 days	• Short courses or "bursts" are effective for establishing control when initiating therapy or during a period of gradual deterioration. • The burst should be continued until patient achieves 80% PEF personal best or symptoms resolve. This usually requires 3-10 days but may require longer. There is no evidence that tapering the dose following improvement prevents relapse if sufficient doses of inhaled corticosteroids are used simultaneously.
Prednisolone	5 mg tabs, 5 mg/5 cc, 15 mg/5 cc			
Prednisone	1, 2.5, 5, 10, 20, 25 mg tabs; 5 mg/cc; 5 mg/5 cc			

9. Asthma Education

Patient education is essential for successful management of asthma. It should begin at the time of diagnosis and be ongoing. The following patient education is recommended:

- Basic facts about asthma
  - The contrast between asthmatic and normal airways
  - What happens to the airways in an asthma attack
  - How medications work and need for adherence

    Long-term control: medications that prevent symptoms, often by reducing inflammation

    Quick relief: short-acting bronchodilator relaxes muscles around airways
  - Stress the importance of long-term control medications and not to expect quick relief from them
- Inhaler technique
  - Metered dose inhaler (MDI) or nebulizer use (patient should repeat demonstration)
  - Spacer/holding chamber use
  - Dry powder inhaler
- Written action plan including home peak flow monitoring

  When and how to take actions
  - Symptom monitoring and recognizing early signs of deterioration.
  - Responding to changes in asthma severity. A written Asthma Action Plan including daily medications and instructions should be offered to all patients with asthma.

    Review and refine the plan at follow-up visits.
  - Home peak flow monitoring is highly recommended for patients with moderate to severe persistent asthma, or anyone with a history of severe exacerbations.
  - Discuss plan for children at school including management of exercise-induced bronchospasm.
  - Assess adherence to pharmacotherapy and environmental control measures.
- Environmental control measures
  - Identifying and avoiding exposure to allergens or other environmental triggers
- Emphasize need for regular follow-up visits and asthma treatment adherence

  Supervised self-management, (using patient education and adjustments of anti-inflammatory medication based on PEF or symptoms coupled with regular medical review utiliza-

tion and adherence to medication) reduces asthma morbidity. This reduction includes lost work days, unscheduled office visits, and ER and hospital admissions.

[Conclusion Grade I: See Discussion Appendix B, Conclusion Grading Worksheet - Annotation #9 (Asthma Education)]

A sample Asthma Action Plan is attached in Annotation Appendix A, "Asthma Action Plan."

Evidence supporting this recommendation is of classes: A, D, R

10. Schedule Regular Follow-Up Visits

Regularly scheduled follow-up visits are essential to ensure that control is maintained and the appropriate step down in therapy is considered.

The exact frequency of clinician visits is a matter of clinical judgement

Severity	Regular follow-up visit
Mild Intermittent	6-12 months
Mild Persistent	6 months
Moderate Persistent	3 months
Severe Persistent	1 to 2 months and as often as needed to establish control

How to use the peak flow meter

1. Place indicator at base of the scale.
2. Stand up.
3. Take a deep breath.
4. Place the meter in mouth and close lips around the mouthpiece.
5. Blow out as hard and fast as possible.
6. Repeat the process two more times.
7. Record the highest of the three numbers.

How to use the inhaler

1. Shake the inhaler attach spacer if needed.
2. Stand up.
3. Breathe in medication slowly through spacer.
4. Hold breath for 10 seconds.
5. Breathe out slowly.
6. Repeat puffs as directed and wait two to five minutes between puffs.
7. Rinse mouth with water after inhaling steroids to prevent thrush.

Community Asthma Education

Super Asthma Saturday
Asthma Camps
Open Airway for Schools
Asthma Support Groups
Asthma Update Newsletter

For information, call:

American Lung Association of Minnesota at (612)227-8014 or 1-800-642-LUNG

American Lung Association of Hennepin County at (612)871-7332

Additional Information

Write or call:

Allergy and Asthma Network/
Mothers of Asthmatics, Inc.
3554 Chain Bridge Road, Suite 200
Fairfax, VA 22030-2709
(703)385-4403

Additional Reading

Children With Asthma by Thomas F. Plaut,MD
The Asthma Handbook and *The Best of Super Stuff* by the American Lung Association
What Everyone Needs to Know About Asthma by the Allergy and Asthma Network
Winning Over Asthma by Eileen Dolan Savage

Asthma Action Plan

Patient Name _____

Date of Birth _____

Chart Number _____

Provider(s) _____

_____

Clinic Phone Number _____

To best manage your asthma, you will need to follow the instructions in this asthma action plan especially designed for you.

Green Zone: All Clear

Personal best peak flow _____
Peak flow _____
(80-100% of personal best)

Symptoms:
- No symptoms of asthma
- Able to participate in usual activities
- No sleep disturbance by asthma such as coughing, wheezing, shortness of breath or chest tightness

Medications:

Name	Dose	Time

Medication side effects:

_____

_____

☐ Inhaler, spacer, nebulizer or rotocaps
☐ Participation in running, playing and sports; take _____ before exercise
☐ Diary can be used with peak flow meter and/or symptoms
☐ Environmental control of asthma triggers, e.g., cigarette smoke, exercise, illness, cold air, animals, etc.

Yellow Zone: Caution

Peak flow _____
(50-80% of personal best)

Early warning signs of acute asthma episode:
- Coughing
- Runny, stuffy or congested nose
- Sneezing
- Not sleeping or eating well
- Tired, weak or low energy
- Itchy or watery eyes
- Drop in peak flow meter reading

Symptoms of acute asthma episode:
- Rapid breathing
- Wheezing
- Frequent, tight cough
- Difficulty breathing out
- Sucking in the chest skin between the ribs

Begin or increase medications if warning signs or symptoms become worse or last more than 12 hours. If unsure, call your clinic.

Medications:

Name	Dose	Time

Medication side effects:

_____

If no symptom relief within 30 minutes of giving medication and peak flow is _____%, add oral steroid _____

_____

Red Zone: Medical Alert

Peak flow: _____
(less than 50% of personal best)

Severe symptoms requiring immediate medical care:
- Flared nostrils
- Hunched body
- Prolonged shortness of breath not relieved by medication or only brief relief

Medication instructions:

_____

_____

Give oral steroid: _____

Call clinic # _____

Call 911 if you observe these symptoms:
- Gasping for air with sweating
- Extreme anxiety due to difficulty breathing
- Condition rapidly getting worse

☐ Asthma in school or day care
☐ Next asthma appointment and how much time will be needed

Patient Name _____
Date of Birth _____
Provider Signature _____
Date _____

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All work group members: none declared.

I. CLASSES OF RESEARCH REPORTS

A. Primary Reports of New Data Collection:

Class A:	Randomized, controlled trial
Class B:	Cohort study
Class C:	Non-randomized trial with concurrent or historical controls Case-control study Study of sensitivity and specificity of a diagnostic test Population-based descriptive study
Class D:	Cross-sectional study Case series Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:	Meta-analysis Systematic review Decision analysis Cost-effectiveness analysis
Class R:	Consensus statement Consensus report Narrative review
Class X:	Medical opinion

II. CONCLUSION GRADES

Key conclusions (as determined by the work group) are supported by a conclusion grading worksheet that summarizes the important studies pertaining to the conclusion. Individual studies are classed according to the system defined in Section I, above, and are assigned a designator of +, -, or ø to reflect the study quality. Conclusion grades are determined by the work group based on the following definitions:

Grade I: The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and consistent with minor exceptions at most. The results are free of any significant doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large samples to have adequate statistical power.

Grade II: The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of minor doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.

Grade III: The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusion because of inconsistencies among the results from different studies or because of serious doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence

consists solely of results from a limited number of studies of weak design for answering the question addressed.

Grade Not Assignable: There is no evidence available that directly supports or refutes the conclusion.

The symbols **+**, **–**, **ø**, and **N/A** found on the conclusion grading worksheets are used to designate the quality of the primary research reports and systematic reviews:

+ indicates that the report or review has clearly addressed issues of inclusion/exclusion, bias, generalizability, and data collection and analysis;

– indicates that these issues have not been adequately addressed;

ø indicates that the report or review is neither exceptionally strong or exceptionally weak;

N/A indicates that the report is not a primary reference or a systematic review and therefore the quality has not been assessed.

1. Symptoms of Asthma

Definition of asthma:

Asthma is a chronic inflammatory disorder of the airways. It is characterized by:

1. Airway inflammatory cells, including eosinophils, macrophages, mast cells, epithelial cells and activated lymphocytes that release various cytokines, adhesion molecules and other mediators.
2. Inflammation resulting in an acute, subacute or chronic process that alters airway tone, modulates vascular permeability, activates neurons, increases secretion of mucus, and alters airway structure reversibly or permanently.
3. Airway hyperresponsiveness in response to allergens, environmental irritants, viral infections and exercise.
4. Airflow obstruction caused by acute bronchial constriction, edema, mucus plugs, and frequently permanent remodeling.

Symptoms of asthma:

Symptoms suggestive of asthma include episodic wheezing and cough with nocturnal, seasonal or exertional characteristics. Infants and children with frequent episodes of "bronchitis" are likely to have asthma. Atopic and positive family histories for asthma, particularly when associated with previously mentioned symptoms, should encourage one to consider a diagnosis of asthma.

Eliciting symptoms should emphasize characterizing the current classification scheme that describes frequency per week, changes in physical activity, diurnal variation, and seasonal variation. It is important to recognize that patients with asthma are heterogeneous, falling into every age group, from infancy to older age, and presenting a spectrum of signs and symptoms that vary in degree and severity from patient to patient as well as within an individual patient over time.

National Asthma Education and Prevention Program Expert Panel Report 2. "Guidelines for the diagnosis and management of asthma." Publication # 97-4051. National Institutes of Health/National Heart, Lung, and Blood Institute, April 1997. (Class R)

National Asthma Education and Prevention Program Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma. Update on Selected Topics – 2002. *J Allergy Clin Immunol* 110: S141-S219, 2002. (Class M)

2. Previous Diagnosis of Asthma?

Diagnostic spirometry and a methacholine challenge test, if necessary, are important to clinching the diagnosis. The patient's history and response to therapy should guide other diagnostic tests when considering alternative diagnoses. Follow-up pulmonary function tests every one to two years in mild asthmatics will reconfirm the diagnosis and objectify serial change and level of control. More frequent monitoring should be considered for the moderate and severe persistent categories.

Spirometry is the cornerstone of the laboratory evaluation that enables the clinician to demonstrate airflow obstruction and establish a diagnosis of asthma with certainty. Spirometry is essential for assessing the severity of asthma in order to make appropriate therapeutic recommendations. The use of objective measures of lung function is recommended because patient-reported symptoms often do not correlate with the variability and severity of airflow obstruction. Testing should be performed in com-

pliance with the American Thoracic Society standards. Obstructive and restrictive ventilatory defects can generally be determined using FEV_1/FVC ratio.

American Thoracic Society. "Lung function testing: selection of reference values and interpretive strategies." *Am Rev Respir Dis* 144:1202-18, 1991. (Class R)

3. Establish Diagnosis of Asthma

A diagnosis of asthma centers around initial spirometry combined with appropriate history and physical examination, and additional laboratory tests. Methacholine challenge testing may provide a useful confirmatory diagnostic test in patients with normal or near-normal spirometry. Investigation into the role of allergy, at least with a complete history, should be done in every patient, given high prevalence of positive skin tests among individuals with asthma and the benefits of limiting exposure to known allergens. Eosinophil count and IgE may be elevated in asthma, however, neither test has sufficient specificity or sensitivity to be used alone in a diagnosis. The chest x-ray and electrocardiogram are usually normal in asthma but may be useful to exclude other pulmonary or cardiac conditions. Sputum examination may be helpful if sputum eosinophilia or infection are suspected.

There are several clinical scenarios in children that have a frequent association with asthma and should strongly suggest asthma as a possible diagnosis. These include recurrent pulmonary infiltrates (especially right middle lobe infiltrates) that clear radiologically within two to three days, and the diagnosis of pneumonia without fever. Asthma may cause some radiologic uncertainty since mucus plugging and atelectasis may be interpreted as infiltrates.

Differential Diagnostic Possibilities for Asthma

1. Upper Airway Disease
    - allergic rhinitis and sinusitis
2. Obstruction involving large airways
    - foreign body in trachea or bronchus
    - vocal cord dysfunction
    - vascular rings or laryngeal webs
    - laryngotracheomalacia, tracheal stenosis or bronchostenosis
    - enlarged lymph nodes or tumor (benign or malignant)
    - bronchiectasis of various causes, including cystic fibrosis
3. Obstruction of small airways
    - viral bronchiolitis or obliterative bronchiolitis
    - cystic fibrosis
    - bronchopulmonary dysplasia
    - pulmonary infiltrates with eosinophilia
    - chronic obstructive pulmonary disease (chronic bronchitis or emphysema)

4. Other causes
    - pulmonary embolism
    - congestive heart failure
    - cough secondary to drugs (angio-tension-converting enzyme [ACE] inhibitors)
    - aspiration from swallowing mechanism dysfunction or gastroesophageal reflux
    - recurrent cough not due to asthma

It is important to identify infant or early childhood diseases that might superficially resemble asthma but in reality are not asthmatic in pathophysiology. These symptoms should stimulate investigation of clinical etiologies other than asthma (failure to thrive, vomiting/choking, chronic bacterial infections, cardiovascular and pulmonary abnormalities).

An important under-recognized alternative diagnosis is vocal-cord dysfunction. Patients have recurrent breathlessness and wheezing, usually inspiratory, but they can also have expiratory wheezing. It is often monophasic and loud over the glottis. Respiratory failure can occur with alveolar hypoventilation, requiring emergent intubation. It also coexists in patients who have asthma. The flow-volume loop and video image can help make the diagnosis.

4. Acute Asthma?

This guideline is intended for treatment of outpatients. Critically ill patients should be treated in the emergency department or hospital.

5. Management of Acute Asthma

Patients experiencing an acute asthma exacerbation need a focused history and physical examination and measurement of airflow.

Treatment is begun with inhaled short-acting $ß_2$-agonists usually administered with a nebulizer. Further intensification of therapy is based on severity, response, and prior history, but typically includes a short course of oral corticosteroids.

Decision to hospitalize must be individualized.

All patients should receive follow-up and short-term education.

Chapman KR, Verbeek PR, White JG, et al. "Effect of a short course of prednisone in the prevention of early relapse after the emergency room treatment of acute asthma." *N Eng J Med* 324:788-94, 1991. (Class A)

Fanta CH, Rossing TH, McFadden ER. "Glucocorticoids in acute asthma: a critical controlled trial." *Am J Med* 74:845-51, 1983. (Class A)

Harris JB, Weinberger MM, Nassif E, et al. "Early intervention with short course prednisone to prevent progression of asthma in ambulatory patients incompletely responsive to bronchodilators." *J Pediatr* 110: 627-33, 1987. (Class A)

National Asthma Education and Prevention Program Expert Panel Report 2. "Guidelines for the diagnosis and management of asthma." Publication # 97-4051. National Institutes of Health/ National Heart, Lung, and Blood Institute, April 1997. (Class R)

National Asthma Education and Prevention Program Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma. Update on Selected Topics – 2002. *J Allergy Clin Immunol* 110:S141-S219, 2002. (Class M)

O'Hollaren MT, Yunginger JW, Offord KP, et al. "Exposure to an aeroallergen as a possible precipitating factor in respiratory arrest in young patients with asthma." *N Engl J Med* 324:359-63, 1991. (Class D)

Scarfone RJ, Fuchs SM, Nager AL, et al. "Controlled trial of oral prednisone in the emergency department treatment of children with acute asthma." *Pediatrics* 2:513-18, 1993. (Class A)

6. Interval Evaluation

- **Medical history**

Reassessment of medical history can elicit factors that effect overall asthma control and sense of well-being. The key symptoms that should alert the clinician include disruptive daytime symptoms and disturbances of sleep. It is also the consensus of the Expert Panel that symptoms early in the morning that do not improve fifteen minutes after short-acting ß$_2$-agonist are a predictor of poor control. The quantity of short-acting ß$_2$-agonist that is being used should be discussed since overuse can be a marker of the potentially fatality prone asthmatic. The use of a quality of life tool or questionnaire can assist to elicit history.

Juniper EF, Guyatt GH, Epstein RS, et al. "Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials." *Thorax* 47:76-83, 1992. (Class D)

Juniper EF, Guyatt GH, Ferrie PJ, Griffith LE. "Measuring quality of life in asthma." *Am Rev Respir Dis* 147:832-38, 1993. (Class D)

Spitzer WO, Suissa S, Ernst P, et al. "The use of beta-agonists and the risk of death and near death from asthma." *N Engl J Med* 326:501-06, 1992. (Class C)

- **Assess asthma triggers/allergens**

Studies of emergency room visits and near death show allergens as a factor in asthma exacerbation. Asthma triggers in the workplace also need to be considered. About 15 percent of asthma in adults is work related.

Blanc P. "Occupational asthma in a national disability survey." *Chest* 92:613-17, 1987. (Class C)

Malo JL, Ghezzo H, D'Aquino C, et al. "Natural history of occupational asthma: relevance of type of agent and other factors in the rate of development of symptoms in affected subjects." *J Allergy Clin Immunol* 90:937-44, 1992. (Class C)

O'Hollaren MT, Yunginger JW, Offord KP, et al. "Exposure to an aeroallergen as a possible precipitating factor in respiratory arrest in young patients with asthma." *N Engl J Med* 324:359-63, 1991. (Class D)

Pollart SM, Reid MJ, Fling JA, et al. "Epidemiology of emergency room asthma in northern California: association with IgE antibody to ryegrass pollen." *J Allergy Clin Immunol* 82:224-30, 1988. (Class C)

The differential diagnosis, as previously discussed, can range from common to rare. The most common contributing disorders that exacerbate asthma are allergic rhinitis and sinusitis. Another common condition to consider is gastroesophageal reflux disease (GERD). Reflux is three times more common in asthmatics, and treating GERD leads to improved asthma control.

Corren J, Adinoff AD, Irvin CG. "Changes in bronchial responsiveness following nasal provocation with allergen." *J Allergy Clin Immunol* 89:611-18, 1992. (Class A)

Harper PC, Bergner A, Kaye MD. "Antireflux treatment for asthma: improvement in patients with associated gastroesophageal reflux." *Arch Intern Med* 147:56-60, 1987. (Class D)

Rachelefsky GS, Katz RM, Siegel SC. "Chronic sinus disease with associated reactive airway disease in children." Pediatrics 73:526-29, 1984. (Class D)

It is important to discuss any potential medication side effects as this often has a direct relationship to compliance. Common side effects from inhaled steroids include oral candidiasis and dysphonia. $ß_2$-agonists may cause tachycardia, tremor or nervousness. Individuals on long-term oral corticosteroids or frequent bursts of steroids need to be monitored for complications of corticosteroids use such as osteoporosis, hypertension, diabetes and Cushing's syndrome.

- **Physical Examination**

The height of individuals on corticosteroids should be monitored over time. The potential effect on linear growth in children is important because these drugs tend to be used over long periods of time. Childhood asthma is associated with a delay of growth but does not appear to affect predicted adult height.

Childhood Asthma Management Program Research Group, The. "Long-term effects of budesonide or nedocromil in children with asthma." *N Engl J Med* 343:1054-63, 2000. (Class A)

Inhaled glucocorticoids used to treat asthma have been shown to have deleterious effects on bone mineral density and markers of bone mineral metabolism. The risk of fracture attributable to inhaled or nasal glucocorticoids is uncertain.

Lung Health Study Research Group, The. "Effect of inhaled triamcinolone on the decline in pulmonary function in chronic obstructive pulmonary disease." *N Engl J Med* 343:1902-09, 2000. (Class A)

The remainder of the physical exam either supports or refutes conditions and co-morbidities discussed above (see history).

- **Measure Pulmonary Function**

It is important to periodically assess pulmonary function, the main methods are spirometry or PEFR. Regular monitoring of pulmonary function is particularly important for asthma patients who do not perceive their symptoms until obstruction is severe.

Kikuchi Y, Okabe S, Tamura G, et al. "Chemosensitivity and perception of dyspnea in patients with a history of near-fatal asthma." *N Engl J Med* 330:1329-34, 1994. (Class C)

Connolly MJ, Crowley JJ, Charan NB, et al. "Reduced subjective awareness of bronchoconstriction provoked by methacholine in elderly asthmatic and normal subjects as measured on a simple awareness scale." *Thorax* 47:410-13, 1992. (Class C)

Spirometry is more precise and yields more information than PEFR. It is helpful to verify the accuracy of the peak flow meter. It is useful when certain physical limitations affect accuracy of PEFR (example - very young or elderly, neuromuscular or orthopedic problems).

Miles JF, Bright P, Ayres JG, et al. "The performance of mini Wright peak flow meters after prolonged use." *Resp Med* 89:603-05, 1995. (Class C)

PEFR provides a simple, quantitative and reproductive measure of severity of airflow obstruction. The results are more reliable if the same type and preferably the patient's own meter are used.

- **Consider Specialty Consultation**

  Referral to an asthma specialist should be considered when a patient's symptoms are severe or are not responding to standard care. Referral is also necessary when specialized testing, such as allergy testing or bronchoprovocation are needed. There is evidence that referral to an asthma specialist can reduce repeat visit to the emergency room.

  Zieger RS, Heller S, Mellon MH, et al. "Facilitated referral to asthma specialist reduces relapses in asthma emergency room visits." *J Allergy Clin Immunol* 87:1160-68, 1991. (Class C)

7. Assess Asthma Severity

The classification of asthma as mild intermittent, mild persistent, moderate persistent or severe persistent is based on the clinical characteristics as well as objective assessment of lung function through FEV_1 or peak flow monitoring. The presence of one of the features of severity is sufficient to place a patient in that category and an individual's classification may change over time. Patients at any level of severity can have mild, moderate or severe exacerbations. Some patients with intermittent asthma experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms.

National Asthma Education and Prevention Program Expert Panel Report 2. "Guidelines for the diagnosis and management of asthma." Publication # 97-4051. National Institutes of Health/ National Heart, Lung, and Blood Institute, April 1997. (Class R)

National Asthma Education and Prevention Program Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma. Update on Selected Topics – 2002. *J Allergy Clin Immunol* 110:S141-S219, 2002. (Class M)

8. Step Care of Pharmacologic Treatment

Inhaled corticosteroids are the preferred treatment option for mild persistent asthma in adults and children. LTRAs are an alternative – although not preferred – treatment.

[Conclusion Grade I: See Discussion Appendix A, Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor or Antagonists [LTRAs])]

Bleecker ER, Welch MJ, Weinstein SF, et al. "Low-dose inhaled fluticasone propionate versus oral zafirlukast in the treatment of persistent asthma." *J Allergy Clin Immunol* 105:1123-29, 2000. (Class A)

Busse W, Raphael GD, Galant S, et al. "Low-dose fluticasone propionate compared with montelukast for first-line treatment of persistent asthma: a randomized clinical trial." *J Allergy Clin Immunol* 107:461-68, 2001. (Class A)

Ducharme FM, Hicks GC. "Anti-leukotriene agents compared to inhaled corticosteroids in the management of recurrent and/or chronic asthma in adults and children." *Cochrane Database Syst* Rev. 2002. (Class M)

Malmstrom K, Rodriguez-Gomez G, Guerra J, et al. "Oral montelukast, inhaled beclomethasone, and placebo for chronic asthma: a randomized, controlled trial." *Ann Intern Med* 130:487-95, 1999. (Class A)

National Asthma Education and Prevention Program Expert Panel Report 2. "Guidelines for the diagnosis and management of asthma." Publication # 97-4051. National Institutes of Health/ National Heart, Lung, and Blood Institute, April 1997. (Class R)

9. Asthma Education

Supervised self-management (using patient education and adjustments of anti-inflammatory medication based on PEF or symptoms coupled with regular medical review, utilization and adherence to medication) reduces asthma morbidity. This reduction includes lost work days, unscheduled office visits, and ER and hospital admissions.

[Conclusion Grade I: See Discussion Appendix B, Conclusion Grading Worksheet - Annotation #9 (Asthma Education)]

Gibson PG, Coughlan J, Wilson AJ, et al. "Self-management education and regular practitioner review for adults with asthma." *The Cochrane Library*, 2:2000. (Class M)

Ignatio-Garcia J, Gonzalez-Santos P. "Asthma self-management education program by home monitoring of peak flow expiratory flow." *Am J Respir Care Med* 151:353-59, 1995. (Class A)

Lahdensuo A, Haahtela T, Herrala J, et al. "Randomised comparison of guided self-management and traditional treatment of asthma over one year." *BMJ* 312:748-52, 1996. (Class A)

Mayo P, Richman J, Harris HW. "Results of a program to reduce admissions for adult asthma." *Ann Intern Med* 12:864-71, 1990. (Class A)

Ambulatory monitoring of peak flow rate is done increasingly to help with the diagnosis of asthma, to monitor effectiveness of treatment, to warn of impending asthma exacerbations, and to allow the patient to assume more responsibility and control in disease management.

Enright PL, Lebowitz MD, Cockroft DW. "Physiologic measures: pulmonary function tests." *Am J Respir Crit Care Med* 149:S9-S18, 1994. (Class R)

Epstein SW, Manning CPR, Ashley MJ, et al. "Survey of the clinical use of pressurized aerosol inhalers." *Can Med Assoc J* 120:813-16, 1979. (Class D)

10. Schedule Regular Follow-Up Visits

Asthma is a chronic inflammatory lung disease and all chronic disease need regular follow-up visits. Practitioners need to assess whether or not control of asthma has been maintained and if a step down in therapy is appropriate. Further, practitioners need to monitor and review the daily self-management and action plans, the medications, and the patient's inhaler and peak flow monitoring techniques.

Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor Antagonists [LTRAs])

Work Group's Conclusion: Based on data comparing LTRAs to inhaled corticosteroids, inhaled corticosteroids are the preferred treatment option for mild persistent asthma in adults, and by extrapolation until published data become available, for children. LTRAs are an alternative – although not preferred – treatment.

Conclusion Grade: I

Author/Year	Design Type	Class	Quality +,–,ø	Population Studied/Sample Size	Primary Outcome Measure(s)/Results (e.g., p-value, confidence interval, relative risk, odds ratio, likelihood ratio, number needed to treat)	Authors' Conclusions/ *Work Group's Comments (italicized)*
Malmstrom et al., 1999	RCT	A	ø	-Ages 15 yrs and older; males and females; healthy, nonsmoking; asthma for ≥1 yr; FEV_1 50-85% of predicted; increase of ≥15% in absolute FEV_1 after use of inhaled β-agonist (at least 2 of 3 visits); daytime asthma symptom score ≥64 (of 336 possible); average daily use of ≥1 puff of short-acting β-agonist -Excluded: use of inhaled and oral corticosteroids, cromolyn, or nedocromil within 4 wks before initial eval; use of long-acting β-agonists, antimuscarinics, or theophylline within 2 wks before initial eval; had used long-acting anthistamines -2 wk placebo run-in, 12 wk treatment period, 3 wk washout -Randomized to montelukast (10 mg 1X/day [evening]), inhaled beclomethasone (200µg 2X/day), or placebo (3:2:2 ratio) -Clinic: FEV_1 -Home: daily diary card for symptoms, PEFR, and need for salbutamol	-895 patients randomized (387 montelukast, 251 beclomethasone, 257 placebo); treatment completed by 91.5%, 92.8%, and 83.7%, respectively; total study completed by 89.4%, 90.4%, and 81.7% -Groups similar at baseline; mean compliance with inhaled medication (treatment phase) 88%-90% for all groups; mean compliance with oral medication >99% for all groups -Outcomes: Placebo Montelukast Beclomethasone FEV_1* 0.7% 7.4%[a] 13.1%[a] Symptom Score# -0.17 -0.41[a] -0.62[a] PEFR-am 0.8 l/min 23.8 l/min[a] 39.2 l/min[a] PEFR-pm 0.3 l/min 20.8 l/min[a] 32.1 l/min[a] Attacks^ 27.3% 15.6%[a] 10.1%[a] [a]p<0.001 compared with placebo; *morning value, % change from baseline; #daytime score, change from baseline; ^percentage of patients -During 3 wk washout, patients switched to placebo returned to baseline levels -Initial response greater for montelukast group; effect of beclomethasone surpassed montelukast 7-10 days after start of therapy -No interactions based on baseline FEV_1, symptom score, need for β-agonist, or PEFR -Improvements in quality of life greater with montelukast and beclomethasone (p<0.001) -Most common clinical adverse effects: worsening asthma (p<0.05 for active treatment vs. placebo), headache, upper respiratory infection (both NS)	-Oral montelukast therapy has been shown to be effective in chronic asthma, producing significant improvements in FEV_1 and significant alleviation of daytime asthma symptoms. Although inhaled beclomethasone had a larger average effect than montelukast, montelukast had a more rapid initial response. The two agents each protected against worsening episodes of asthma. NOTES: use of immunotherapy was permitted if it had been started ≥6 mos before initial evaluation; run-in was single-blind, treatment and washout was double-blind; during washout some patients continued active treatment and others switched to placebo; study done at 36 centers in 19 countries; patients could use short-acting inhaled β-agonist (salbutamol) as needed; if additional therapy was needed oral corticosteroids were given (if ≥2 such episode patient was dropped from study); compliance monitored by weighing inhalers and counting tablets; analysis included all patients with baseline and at least one measurement after randomization; did sample size estimation for 95% power to detect difference of 6% in change from baseline and 10% in daytime symptom scores (montelukast vs. placebo)

Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor Antagonists [LTRAs]) (cont)

Bleeker et al., 2000	RCT	A	0	-Ages 12+; persistent asthma (≥6 mos); predose FEV_1 of 50-80% of predicted normal and increase FEV_1 ≥12% from baseline after 180µg inhaled albuterol; had used albuterol on schedule or as-needed bases during 4 wks before screening; no montelukast, zafirlukast, or zileuton within 2 wks of screening -Excluded: history of life-threatening asthma; >3 bursts of oral or parenteral corticosteroids within 1 yr; use of tobacco products in past yr or smoking history of >10 pack-yrs; respiratory infection within 2 wks of screening, current evidence of significant disorders -8-14 day run-in with rescue albuterol (baseline data, compliance assessment) -Eligible patients randomized to inhaled fluticasone propionate (FP) aerosol (88µg) or oral zafirlukast (20 mg); both 2X/day for 12 wks with albuterol as needed -Home: symptoms, PEFR, albuterol use -Clinic: FEV_1	-220 randomized to zafirlukast, 231 to FP; groups similar at baseline; 77% of zafirlukast and 87% of placebo groups finished protocol -Outcomes (change after 12 wks of treatment): -56% of physicians rated treatment with FP as "effective" or "very effective" compared with 41% for zafirlukast ($p<0.001$) -4% of FP group and 6% of zafirlukast group had an exacerbation (NS) -10% in each group had ≥1 adverse event considered potentially related to treatment; headache, dry mouth, & hoarseness were most common *$p<0.001$		-The clinical effectiveness of a low dose of FP as first-line therapy in patients with persistent asthma who are symptomatic on β_2-agonists alone is superior to that of zafirlukast. NOTES: concurrent use of medications that might affect the course of asthma or interact with zafirlukast were prohibited; antihistamines, decongestants, and intranasal medications for allergic rhinitis were allowed; double-blind treatment phase; patients with asthma exacerbation (requiring corticosteroids) during study phase were withdrawn; study designed with ≥80% power to detect difference of 0.178 L/min in FEV_1 between groups

	FP	Zafirlukast
FEV_1-am (L)	+0.42	+0.20*
PEFR-am (L/min)	+49.94	+11.68*
PEFR-pm (L/min)	+38.91	+10.50*
Symptom score	-0.46	-0.19*
Symptom-free days (%)	+28.5	+15.6*
Albuterol (puffs/day)	-2.39	-1.45*
Rescue-free days	+40.4	+24.2*
# Night awakenings	-0.28	-0.15*

Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor Antagonists [LTRAs]) (cont)

Busse et al. for the Fluticasone Propionate Clinical Research Study, 2001	RCT	A	ø	-Ages 15+; asthma diagnosed for ≥6 mos; predose FEV_1 50-80% of predicted normal and increase in FEV_1 of ≥15% after 180 µg albuterol; used inhaled or oral short-acting β_2-agonist on a regular or as-needed basis for 3 mos before screening -Excluded: use of ICSs in past 2 mos; use of tobacco products in past year; smoking history of ≥10 pack-yrs; hospitalized for asthma in past 3 mos; respiratory tract infection in past 4 wks; hypersensitivity to asthma drugs -8-14 day run-in period (confirm eligibility, baseline data); use of albuterol as needed -Randomized (see NOTES) to 88µg 2X/day FP + placebo capsule in evening or 10 mg oral montelukast in evening + 2 puffs placebo 2X/day for 24 wks; inhaled albuterol as needed -Clinic visits: FEV_1, adverse events; physician rating of effectiveness, quality of life, patient satisfaction with medication -Home (am/pm): symptoms, PEFR, puffs of albuterol, nighttime awakenings, compliance	-271 in FP group, 262 in montelukast group; groups comparable at baseline; study completed by 72% of FP group and 71% of montelukast group; reported compliance (inhaler and capsules) ≥91% -Outcomes (change from baseline): *p<0.001 -Physicians global assessment favored FP over montelukast (71% rated FP effective or very effective vs. 53% for montelukast, p<0.001) -Patient satisfaction favored FP over montelukast (85% of patients satisfied with FP vs. 65% for montelukast, p<0.001); quality-of-life scores significantly greater in FP patients (p<0.001) especially asthma symptoms and emotional function domains -Adverse events: 71% of FP patients, 68% of montelukast patients; few were considered drug related; most common (possibly drug related) were headache, sore throat, hoarseness, oral pharyngeal candidiasis -Asthma exacerbations: 4% of FP group, 8% of montelukast group		FP	Montelukast
				FEV_1 (L)	0.51	0.33*
				PEFR-am (L/min)	68.5	34.1*
				PEFR-pm (L/min)	53.9	28.7*
				Symptom score	-0.85	-0.60*
				Albuterol (puffs/day)	-3.10	-2.31*
					-Low-dose FP is more effective than montelukast as first-line maintenance therapy for patients with persistent asthma who are underrated and remain symptomatic while taking short-acting β_2-agonists alone. NOTES: at randomization patients had to demonstrate that additional therapy was warranted (unmedicated FEV_1 of 50-80% of predicted normal and within 15% of screening FEV_1, use of albuterol on ≥6 of 7 days before randomization, and asthma symptom score ≥2 [0-5 scale] on ≥4 of 7 days before randomization); use of mediations for rhinitis was allowed; did sample size estimation for ≥80% power to detect difference of 6 percentage points in FEV_1 change between 2 treatment groups; study conducted at 52 sites

Conclusion Grading Worksheet – Annotation #8 (Leukotriene Receptor Antagonists [LTRAs]) (cont)

Ducharme & Hicks, 2002	Systematic Review	M	+	-Search of clinical trials databases; contact with pharmaceutical companies -Quality of studies assessed by 2 masked reviewers -14 trials met inclusion criteria (including Bleeker, 2000, Busse 2001, and Malmstrom, 1999, [above]); all RCTs except one; 12 focused on adults; intervention duration of 4 to 37 wks; included montelukast, pranlukast, zafirlukast, beclomethasone, and fluticasone -10 trials had high quality (≥4 of 5 points); 11 with appropriate randomization methods; 11 double-blind; withdrawal rates of 0%-29%	**-Primary outcome (results from 11 trials):** rate of exacerbations requiring systemic corticosteroids; patients treated with anti-leukotrienes had 61% increased risk of exacerbation compared to patients treated with ICSs (RR=1.61; 95%CI 1.15-2.25); no apparent difference due to montelukast vs. zafirlukast, beclomethasone vs. fluticasone, quality of studies, published vs. unpublished data, source of funding; greater effect in trials of 12-16 wks vs 4-6 wks, patients with moderate vs. mild asthma **-Other outcomes:** improvements in FEV_1, PEFR-am, change in symptom score, nighttime awakenings, symptom-free days, and quality of life all favored ICSs; anti-leukotriene therapy associated with greater risk of overall withdrawals (RR=1.3; 95%CI 1.1-1.6) apparently due to poor asthma control; no difference in patients experiencing "any adverse effects"	-For most asthma outcomes, ICSs at 400 mcg/day of beclomethasone-equivalent are more effective than anti-leukotriene agents given in the usual licensed doses. The exact dose-equivalence of anti-leukotriene agents in mcg of ICSs remains to be determined.

Conclusion Grading Worksheet – Annotation #9 (Asthma Education)

Work Group's Conclusion: Supervised self-management (using patient education and adjustments of anti-inflammatory medication based on PEF or symptoms coupled with regular medical review, utilization and adherence to medication) reduces asthma morbidity. This reduction includes lost work days, unscheduled office visits, and ER and hospital admissions.

Conclusion Grade: I

Author/Year	Design Type	Class	Quality +,–,0	Population Studied/Sample Size	Primary Outcome Measure(s)/Results (e.g., p-value, confidence interval, relative risk, odds ratio, likelihood ratio, number needed to treat)	Authors' Conclusions/ *Work Group's Comments (italicized)*
Mayo, Richman, & Harris, 1990	RCT	A	0	-Patients hospitalized with acute asthma exacerbation; 18+ yrs old; >4 ER visits in past 12 mos or >1 hospitalization in past 24 mos -Randomized to special clinic group or routine clinic group; after 8 months, 19 patients from routine group selected (based on multiple hospitalizations) to cross to special clinic group	-104 randomized (47 to special clinic, 57 to routine clinic); 10 of 47 never attended special clinic; after 8 months 19 from routine clinic group joined special clinic group (n=56 with 1 lost to follow-up) -Special clinic, routine clinic, and cross-over groups similar at baseline except fewer in cross-over group ever required intubation -After enrollment in special clinic (n=56): less use of oral beta agonists and daily prednisone, greater use of chronic inhaled corticosteroids, brief prednisone pulses, reservoir spacer devices, and home peak flow monitors -Special clinic group (n=47) had lower hospital use than routine clinic (n=57) (0.4 vs. 1.2 admissions per patient [p<0.004] and 3.1 vs. 6.7 re-hospitalization days per patient [p<0.02]) -For 34 of 37 who attend special clinic re-admission rate per patient per month decreased from 0.13 before enrollment to 0.04 after (p=0.003) and re-hospitalization days per patient per month decreased from 0.73 to 0.26 (p=0.003); similar findings for cross-over group -No deaths from asthma in special clinic group; one death in routine group; 4 special clinic patients required intubation in 32 months follow-up	-A vigorous medical regimen and intensive education program was able to decrease hospital use among a group of adult asthmatics who had previously required repeated readmissions for acute asthma exacerbations. NOTES: a special outpatient asthma clinic was developed to reduce re-admissions for asthma exacerbation; all patients treated by same physician; clinic program included patient education and individual medication regimens with emphasis on self-management; hospital usage before special clinic enrollment was limited to 1 hospital while usage after enrollment included other hospitals in the area; no attempt was made to determine what element of the program, if any, was essential *Work Group's Comments: different observation schedules; no statistics for drug use data; population was largely Hispanic; no data on compliance with programs*

Conclusion Grading Worksheet – Annotation #9 (Asthma Education) (cont)

Author/Year	Design Type	Class	Quality +,–,0	Population Studied/Sample Size	Primary Outcome Measure(s)/Results (e.g., p-value, confidence interval, relative risk, odds ratio, likelihood ratio, number needed to treat)	Authors' Conclusions/ *Work Group's Comments (italicized)*
Ignacio-Garcia & Gonzalez-Santos, 1995	RCT	A	0	-Patients from one outpatient asthma clinic; 14 to 65 years with asthma diagnosed ≥2 yrs prior -Randomized to experimental (self management with peak-flow readings as basis for treatment plan plus education program) or control (symptoms and spirometric data for following physician's treatment plan) -Medical regimens tailored to individual patient -Follow-up: 1, 3, 5, and 6 mos -Degree of illness: morbidity parameters, spirometric data, consumption of drugs, rates attained by peak flow metering -Compared 6 mos before intervention with 6 mos after	-94 enrolled; 24 completed initial assessment but later dropped out or were excluded for protocol violations (9 control, 15 experimental) -Analysis based on 70 patients (32M, 38F), mean age 42 (range 16-64); 35 experimental, 35 control; groups comparable at baseline in age, gender, social class, smoking, years of asthma, chronic bronchitis -After intervention groups differed ($p<0.05$) in days lost from work, exacerbations, days on antibiotics, physician consultations, ER admissions, nocturnal wakening -Control group: fewer exacerbations and physician consultations after study period (both $p<0.01$) -Experimental group: fewer days lost from work, exacerbations, days on antibiotics, physician consultations, ER admissions after study period (all $p<0.01$) -FEV_1, FVC, and FEV_1/FVC improved over study period in experimental group (all $p<0.003$ from baseline); control group improved FEV_1 and FEV_1/FVC at first follow-up but returned toward baseline thereafter -Mean peak expiratory flow rate (PEFR) higher in experimental group at all follow-up visits (all $p<0.05$); mean PEFR and morning PEFR increased significantly from baseline in experimental group ($p<0.001$); PEFR more variable in control group -Experimental group used less fenoterol and prednisone (both $p<0.05$) than control and decreased use of albuterol, terbutaline, fenoterol, theophylline, and budesonide during study period (all $p<0.05$);	-Peak flow monitoring associated with an education program reduced morbidity, improved lung function, and optimized the use of medication in adult asthma patients. NOTES: one physician (unblinded) assessed patients' condition and modified treatment at follow-up visits; before intervention groups comparable in days lost from work, acute exacerbations, days on antibiotics, physician consultations, ER admissions, hospital admissions *Work Group's Comments: Little information about inclusion/exclusion criteria or co-morbidities; analysis was not intention-to-treat*

Conclusion Grading Worksheet – Annotation #9 (Asthma Education) (cont)

Author/Year	Design Type	Class	Quality +, –, 0	Population Studied/Sample Size	Primary Outcome Measure(s)/Results (e.g., p-value, confidence interval, relative risk, odds ratio, likelihood ratio, number needed to treat)	Authors' Conclusions/ *Work Group's Comments (italicized)*
Lahdensuo et al., 1996	RCT	A	0	-Adults (18+) from 3 outpatient centers; mild to moderately severe asthma; inclusion/exclusion criteria based on peak flow rate and medications (see NOTES) -Randomized to self-management (personal education sessions, daily morning peak flow measurements with medication plan based on results) or traditional treatment (info. on inhaler use, no changes in medications on their own) -Baseline and 3 follow-up visits over 12 months	-122 initially enrolled, analysis based on 115 with at least 4 mos follow-up (56 self-management, 59 traditional); more women and lower mean weight in self-management group (p=0.02) otherwise comparable at baseline -Outcome Self-mgmt Traditional p Admissions for asthma 2 patients 3 patients Unscheduled outpatient visits* 0.5 1.0* 0.04 Days off work* 2.8 4.8 0.02 Courses of antibiotics* 0.4 0.9 0.009 Courses of prednisone* 0.4 1.0 0.006 Total (any incident caused by asthma)* 0.6 2.1 <0.001 *mean numbers per patient -Incidence free survival (p<0.0001) and quality of life (p=0.009) favored self-management group (p<0.0001) throughout study period -Exploratory analyses: 62% adhered to self-management instructions for budesonide dose; 77% to instructions to start oral prednisolone; adherence was related to severity of symptoms	-Guided self-management, using patient education and adjustment of anti-inflammatory treatment based on peak expiratory measurements, reduced by half or more the number of incidents caused by asthma when compared with traditional treatment and improved quality of life. It is not possible to determine whether early treatment of inflammation, peak flow measurement per se, patient education, or improved compliance is most important. NOTES: study was single-blind; eligible patients had a) morning-evening peak flow value that varied by >15% in 2 days within 1 wk during past 6 mos, b) optimal peak flow ≥250 l/min, c) anti-inflammatory treatment with budesonide (400-1600µg/day) or beclomethasone dipropionate (500-2000 µg/day) in past 6 mos, d) ≥4 wks since last course of oral corticosteroids; sample size estimation of 60 per group based on estimated number of incidents per year caused by asthma (1 with traditional tx, 0.47 with self-management); patients with severe asthma were excluded as most already have peak flow meters *Work Group's Comments: Little information about co-morbidities; analysis was not intention-to-treat*

Support for Implementation:

Diagnosis and Management of Asthma

This document provides resources, strategies and measurement specifications for use in closing the gap between current clinical practice and the recommendations set forth in the guideline.

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Overview

The following aims were identified by the guideline work group as key areas in which medical groups may receive benefits in implementing this guideline.

The measures associated with these aims are presented as suggested measures. Measures of aim help medical groups determine progress in achieving a particular aim. However, additional approaches may be customized by individual medical groups to ferret out improvement information important to the medical group's individual practice.

Priority Aims and Suggested Measures for Health Care Systems

1. Promote the accurate assessment of asthma severity through the use of objective measures of lung function.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with asthma with spirometry or peak flow documented at the last visit.

   b. Percentage of patients with asthma, for whom a peak flow meter is appropriate, who report using a home peak flow meter.

   c. Percentage of patients with asthma with any assessment of asthma severity documented at the last visit.

2. Promote long-term control of persistent asthma through the use of inhaled corticosteroid drug therapy.

   Possible measure of accomplishing this aim:

   a. Percentage of patients with persistent asthma who are on inhaled corticosteroid medication.

3. Promote the partnership of patients with asthma and/or their parents with health care professionals through education and the use of written action plans.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with asthma with an asthma action plan in the medical record.

   b. Percentage of patients with asthma with education about asthma documented in the medical record.

Possible Success Measure #1a

Percentage of patients with asthma with spirometry or peak flow meter reading documented in the medical record at the last visit.

Population Definition

Patients age 5 through 55 years diagnosed with asthma, continuously enrolled for 6 months.

Data of Interest

$$\frac{\text{\# of patients with asthma with spirometry or peak flow meter reading documented at the last visit}}{\text{total \# of patients ages 5-55 with asthma}}$$

Numerator/Denominator Definitions

Numerator: Documented is defined as any evidence in the medical record that spirometry or peak flow reading was done at the last visit as recommended in the guideline.

Denominator: Patients with a diagnosis code of 493.00, 493.01, 493.10, 493.11, 493.90, 493.91, continuously enrolled for 6 months.

Method/Source of Data Collection

Data may be collected electronically using the claims/encounter database or the enrollment database. Medical groups should identify patients with asthma seen at the clinic. Each medical group can then generate a list of all eligible patients with asthma seen during the target month/quarter. A random sample of 20 charts can be chosen from this list. The eligible patients are those who are 5-55 years old and have been diagnosed with asthma. The patient medical records are reviewed for any evidence that spirometry or peak flow meter reading was done at the last visit as recommended in the guideline.

Time Frame Pertaining to Data Collection

A minimum of 20 charts per month can be reviewed.

Notes

It is important to periodically assess pulmonary function. The main methods are spirometry or PEFR. Spirometry is more precise and yields more information than PEFR. It is helpful to verify the accuracy of the peak flow meter. It is useful when certain physical limitations affect accuracy of PEFR (e.g., very young or elderly, neuromuscular or orthopedic problems). PEFR provides a simple, quantitative and reproductive measure of severity of airflow obstruction. The results are more reliable if the same type and preferably the patient's own meter are used.

Possible Success Measure #2a (children)

Percentage of children with persistent asthma who are on inhaled corticosteroids medication.

Population Definition

Children aged 17 and under with persistent asthma, continuously enrolled for 6 months.

Data of Interest

$$\frac{\text{\# children in denominator who have one or more prescriptions for inhaled corticosteroids medications}}{\text{\# of children with persistent asthma}}$$

Numerator/ Denominator Definitions

Numerator

Among the children in the denominator, the number who have one or more prescriptions for inhaled corticosteroids medications:

- beclomethasone HFA (Vanceril®, Beclovent®, QVAR®)
- triamcinolone (Azmacort®)
- fluticasone (Flovent®, Advair®)
- cromolyn sodium (Intal®)
- flunisolide (Aerobid®)
- budesonide (Pulmicort®)

Denominator

Children with persistent asthma with a diagnosis code of 493.00, 493.01, 493.10, 493.11, 493.90, 493.91, continuously enrolled for 6 months.

Method/Source of Data Collection

This measure may be collected electronically using the pharmacy data base, the claims/encounter data base, or the enrollment data base.

Time Frame of Data Collection

It is suggested that data are collected quarterly.

Notes

Since asthma is a chronic inflammatory disorder of the airways with recurrent exacerbations, therapy for persistent asthma emphasizes efforts to suppress inflammation over the long-term and prevent exacerbations.

Possible Success Measure #2a (adults)

Percentage of adults with persistent asthma who are on inhaled corticosteroids medication.

Population Definition

Adults age 18 through 39 with persistent asthma, continuously enrolled for 6 months.

Data of Interest

$$\frac{\text{\# of adults in the denominator who have 1 or more prescriptions for inhaled corticosteroids medications}}{\text{\# of adults with persistent asthma}}$$

Numerator/Denominator Definitions

Numerator: Persons in the denominator who have 1 or more prescriptions filled for inhaled anti-inflammatory medications

Inhaled anti-inflammatory medications are:

- beclomethasone HFA	- triamcinolone	- fluticasone
- flunisolide	- budesonide	- fluticasone propionatel salmeterol DPI

Denominator: Adults age 18 through 39 with persistent asthma with a diagnosis code of 493.00, 493.01, 493.10, 493.11, 493.90, 493.91, continuously enrolled for 6 months, identified by having received one or more refills of the following medications during the 6 month period:

- beclomethasone HFA	- triamcinolone	- fluticasone
- flunisolide	- budesonide	- fluticasone propionatel salmeterol DPI

Method/Source of Data Collection

Data may be collected electronically using the pharmacy database, the claims/encounter database or the enrollment database.

Time Frame Pertaining to Data Collection

It is suggested that data are collected quarterly.

Possible Success Measure #3b

Percentage of patients with asthma with education about asthma documented in the medical record.

Population Definition

Patients age 5 through 55 years diagnosed with asthma continuously enrolled for 6 months.

Data of Interest

$$\frac{\text{\# of patients in the denominator with documentation in the record of education about asthma}}{\text{total \# of patients with asthma whose medical records are reviewed}}$$

Numerator/Denominator Definitions

Numerator: Documented is defined as any evidence in the medical record that a clinician provided patient (or parent) education related to:

- basic facts about asthma
- role of medications
- skills (in managing asthma)
- environmental control measures
- when and how to take actions
- need for follow-up visits

Denominator: Patients with a diagnosis code of 493.00, 493.01, 493.10, 493.11, 493.90, 493.91, continuously enrolled for 6 months.

Method/Source of Data Collection

Data may be collected electronically using the claims/encounter database or the enrollment database. Medical groups should identify patients with asthma seen at the clinic. Each medical group can then generate a list of all eligible patients with asthma seen during the target month/quarter. The eligible patients are those who are 5-55 years old and have been diagnosed with asthma. A random sample of 20 charts can be chosen from this list. The patients' medical records will be reviewed for any evidence that a clinician provided patient education.

Time Frame Pertaining to Data Collection

A minimum of 20 charts per month can be reviewed.

Notes

Patient education is essential for successful management of asthma. It should begin at the time of diagnosis and be ongoing.

Systems Approaches to Implementation for this Guideline

1. Facilitate timely and accurate diagnosis of asthma and asthma severity.

2. Educate providers in the use of spirometry as a diagnostic tool.

3. Educate providers and patients in the importance of developing and maintaining an asthma action plan and assessing adherence.

*Recommended Website Resources**

Note: Websites are listed in alphabetical order, not in order of work group preference.

Website Sponsor	Target Audience	Description	Website Address
Allergy and Asthma Network/Mothers of Asthmatics	Patients Professionals	A national nonprofit network of families whose desire is to overcome allergies and asthma through knowledge. This website produces accurate, timely, practical, and livable alternatives to suffering.	www.aanma.org
ALA (American Lung Association)	Patients Professionals	Offers comprehensive information for patients and practitioners on asthma care and reduction of exacerbations and asthma triggers.	www.lungusa.org/
American Academy of Allergy, Asthma and Immunology (AAAAI)	Patients Professionals	The website offers asthma education resources for patients and providers. The site includes special sections for children and seniors, seasonal educational materials. Health Headlines are posted daily.	www.aaaai.org/
American College of Allergy, Asthma and Immunology	Patients Professionals	Provides both patient-and professional-oriented information on asthma diagnosis and management.	www.allergy.mcg.edu
Asthma and Allergy Foundation of America	Patients Professionals	Focus is on improving the quality of life for people with asthma and allergies and their caregivers, through education, advocacy and research. Provides practical information, community based services, support and referrals through a national network of chapters and educational groups.	www.aafa.org

RECOMMENDED WEBSITE RESOURCES (CONT)

Website Sponsor	Target Audience	Description	Website Address
EPA (U.S. Environmental Protection Agency)	Patients Professionals	Offers asthma education that incorporates an awareness of indoor environmental asthma triggers (e.g., secondhand smoke, dust mites, mold, pet dander, and cockroaches) and actions that can be taken to reduce children's exposure to them in homes, schools and child care settings.	www.epa.gov/iaq
National Heart, Lung, and Blood Institute (NHLBI)	Patients Professionals	Provides asthma health education resources for patients, school/day care providers and health professionals. Materials written in Spanish are available.	www.nhlbi.nih.gov

These websites were reviewed by the ICSI *Diagnosis and Management of Asthma* guideline work group as credible resources. ICSI does not have the authority to monitor the content of these sites. Any health-related information offered from these sites should not be interpreted as giving a diagnosis or treatment.

*** Criteria for Selecting Websites**

The preceding websites were selected by the *Diagnosis and Management of Asthma* guideline work group as additional resources for practitioners and the public. The following criteria were considered in selecting these sites.

- The site contains information specific to the particular disease or condition addressed in the guideline.
- The site contains information that does not conflict with the guideline's recommendations.
- The information is accurate and/or factual. The author of the material or the sponsor of the site can be contacted by means other than e-mail. For example, a nurse line or other support is provided.
- The material includes the source/author, date and whether the information has been edited in any way. The site clearly states revision dates or the date the information was placed on the internet.
- The site sponsor is an objective group without an obvious or possible bias. For example, the site does not promote a product, service or other provider.
- The coverage of the topic is appropriate for the guideline's target audience. It is clearly written, well-organized and easy to read. The site is easy to navigate.