



Complete Summary

GUIDELINE TITLE

Diagnosis and management of asthma.

BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Diagnosis and management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2008 Jan. 69 p. [83 references]

GUIDELINE STATUS

This is the current release of guideline.

This guideline updates previous versions:

Diagnosis and outpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2005 Mar. 49 p.

Emergency and inpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2006 Mar. 40 p.

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
QUALIFYING STATEMENTS
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INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT
CATEGORIES
IDENTIFYING INFORMATION AND AVAILABILITY
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SCOPE

DISEASE/CONDITION(S)

Asthma

- Acute asthma
- Chronic asthma

GUIDELINE CATEGORY

Counseling
Diagnosis
Evaluation
Management
Risk Assessment
Treatment

CLINICAL SPECIALTY

Allergy and Immunology
Emergency Medicine
Family Practice
Internal Medicine
Pediatrics
Pharmacology
Pulmonary Medicine

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Emergency Medical Technicians/Paramedics
Health Care Providers
Health Plans
Hospitals
Managed Care Organizations
Nurses
Pharmacists
Physician Assistants
Physicians
Respiratory Care Practitioners

GUIDELINE OBJECTIVE(S)

- To promote the accurate assessment of asthma severity and control through the use of objective measures of lung function and symptoms
- To promote long-term control of persistent asthma through the use of inhaled corticosteroid drug therapy
- To promote the partnership of patients with asthma and/or their parents with health care professionals through education and use of written action plans
- To improve the timely and accurate assessment of patients presenting with an asthma exacerbation
- To improve the treatment and management of inpatient asthma
- To schedule follow-up visits to ensure asthma control is maintained and appropriate therapy is administered

TARGET POPULATION

Patients over 5 years of age who present with asthma-like symptoms or have been diagnosed with asthma

INTERVENTIONS AND PRACTICES CONSIDERED

Outpatient Management

Diagnostic Assessments (at Initial Diagnosis and Interval Evaluations)

1. Medical history
2. Physical examination
3. Asthma triggers/allergens assessment
4. Pulmonary function tests: spirometry, including measurements of forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC), ratio of forced expiratory volume in 1 second to forced vital capacity (FEV₁/FVC), or peak expiratory flow rate (PEFR)
5. Additional clinical testing, such as oxygen saturation, arterial blood gases, chest x-ray, complete blood count with eosinophils, total immunoglobulin E, sputum exam, bronchial provocation tests, electrolytes, electrocardiogram, and evaluation for gastroesophageal reflux disease (GERD)
6. Assessment of asthma severity, based on frequency and severity of symptoms, frequency and severity of exacerbations, and spirometry measurements
7. Specialty consultation as indicated

Management of Acute Asthma Exacerbations

1. Assess severity based on measures of lung function (FEV₁, PEFr, oxygen saturation), review of history and physical exam
2. Treatment with beta₂-agonists or alternatives
3. Assessment of response based on pulmonary function tests and symptoms
4. Patient education and follow-up

Treatment/Management

1. Annual influenza vaccination
2. Determine level of control
3. Stepped care management plan, where dose, medications, and frequency are increased as necessary and decreased when possible. Pharmacologic treatment options include the following (alone and in combination):
 - Short-acting inhaled beta₂-agonists
 - Inhaled corticosteroids (ICS)
 - Long-acting beta₂-agonists
 - Oral systemic corticosteroids
 - Leukotriene modifiers
 - Combination of ICS and leukotriene modifiers
 - Combination of ICS and Long-acting beta₂-agonists
 - Anti-immunoglobulin E if applicable
4. Asthma education, including need for adherence, inhaler technique, environmental control measures, and written action plan

5. Follow-up visits

Emergency Department and Inpatient Management

1. Assessment of severity of asthma exacerbation through history, physical exam, lung function measurements, and laboratory studies
2. Assessment of risk factors for death from asthma
3. Short-acting inhaled beta₂-agonists by metered dose inhaler or nebulizer
4. Intravenous or oral corticosteroids, anticholinergics
5. Bi-level positive airway pressure (PAP) therapy, heliox, ketamine and magnesium sulfate in severe cases

Note: The guideline developers considered, but did not find sufficient evidence to recommend the following drugs in acute asthma exacerbations: inhaled corticosteroids, leukotriene modifiers

6. Discharge home with necessary medications and instructions how to use them, an action plan for managing recurrence of airflow obstructions, and a follow-up appointment
7. Hospital admission as indicated and patient reassessment
8. Continued treatment, consideration of other illnesses and comorbidities

MAJOR OUTCOMES CONSIDERED

- Asthma symptom control
- Sensitivity and specificity of diagnostic tests
- Asthma morbidity measures such as level of physical activity, lost work days, unscheduled office visits, and emergency room and hospital admissions
- Side effects or complications of asthma pharmacotherapy
- Effect of asthma treatment on asthma score, oxygen saturation, and rate of hospitalization

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

A literature search of clinical trials, meta-analysis, and systematic reviews is performed.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

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 presented below, and are designated as positive, negative, or neutral to reflect the study quality.

Conclusion Grades:

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 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 uncertainty attached to the conclusion because of inconsistencies among the results from different 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.

Study Quality Designations

The quality of the primary research reports and systematic reviews are designated in the following ways on the conclusion grading worksheets:

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

Negative: indicates that these issues (inclusion/exclusion, bias, generalizability, and data collection and analysis) have not been adequately addressed.

Neutral: indicates that the report or review is neither exceptionally strong nor exceptionally weak.

Not Applicable: indicates that the report is not a primary reference or a systematic review and therefore the quality has not been assessed.

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
- Systemic review
- Decision analysis
- Cost-effectiveness study

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

New Guideline Development Process

A new guideline, order set, and protocol is developed by a 6- to 12-member work group that includes physicians, nurses, pharmacists, other healthcare professionals relevant to the topic, along with an Institute for Clinical Systems Improvement (ICSI) staff facilitator. Ordinarily, one of the physicians will be the leader. Most work group members are recruited from ICSI member organizations, but if there is expertise not represented by ICSI members, 1 or 2 members may be recruited from medical groups or hospitals outside of ICSI.

The work group will meet for seven to eight three-hour meetings to develop the guideline. A literature search and review is performed and the work group members, under the coordination of the ICSI staff facilitator, develop the algorithm and write the annotations and footnotes and literature citations.

Once the final draft copy of the guideline is developed, the guideline goes to the ICSI members for critical review.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

The guideline developers reviewed a published cost analysis.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Critical Review Process

Every newly developed guideline or a guideline with significant change is sent to Institute for Clinical Systems Improvement (ICSI) members for Critical Review.

The purpose of critical review is to provide an opportunity for the clinicians in the member groups to review the science behind the recommendations and focus on the content of the guideline. Critical review also provides an opportunity for clinicians in each group to come to consensus on feedback they wish to give the work group and to consider changes necessary across systems in their organization to implement the guideline.

All member organizations are expected to respond to critical review guidelines. Critical review of guidelines is a criterion for continued membership within the ICSI.

After the critical review period, the guideline work group reconvenes to review the comments and make changes, as appropriate. The work group prepares a written response to all comments.

Approval

Each guideline, order set, and protocol is approved by the appropriate steering committee. There is one steering committee each for Respiratory, Cardiovascular, OB/GYN, and Preventive Services. The Committee for Evidence-based Practice approves guidelines, order sets, and protocols not associated with a particular category. The steering committees review and approve each guideline based on the following:

- Member comments have been addressed reasonably.
- There is consensus among all ICSI member organizations on the content of the document.
- Within the knowledge of the reviewer, the scientific recommendations within the document are current.
- Either a critical review has been carried out, or to the extent of the knowledge of the reviewer, the changes proposed are sufficiently familiar and sufficiently agreed upon by the users that a new round of critical review is not needed.

Once the guideline, order set, or protocol has been approved, it is posted on the ICSI Web site and released to members for use. Guidelines, order sets, and protocols are reviewed regularly and revised, if warranted.

Revision Process of Existing Guidelines

ICSI scientific documents are revised every 12 to 36 months as indicated by changes in clinical practice and literature. Every 6 months, ICSI checks with the work group to determine if there have been changes in the literature significant enough to cause the document to be revised earlier than scheduled.

Prior to the work group convening to revise the document, ICSI members are asked to review the document and submit comments. During revision, a literature search of clinical trials, meta-analysis, and systematic reviews is performed and reviewed by the work group. The work group will meet for 1-2 three-hour meetings to review the literature, respond to member organization comments, and revise the document as appropriate.

If there are changes or additions to the document that would be unfamiliar or unacceptable to member organizations, it is sent to members to review prior to going to the appropriate steering committee for approval.

Review and Comment Process

ICSI members are asked to review and submit comments for every guideline, order set, and protocol prior to the work group convening to revise the document.

The purpose of the Review and Comment process is to provide an opportunity for the clinicians in the member groups to review the science behind the recommendations and focus on the content of the order set and protocol. Review and Comment also provides an opportunity for clinicians in each group to come to consensus on feedback they wish to give the work group and to consider changes needed across systems in their organization to implement the guideline.

All member organizations are encouraged to provide feedback on order sets and protocol, however responding to Review and Comment is not a criterion for continued membership within ICSI.

After the Review and Comment period, the work group reconvenes to review the comments and make changes as appropriate. The work group prepares a written response to all comments.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Note from the National Guideline Clearinghouse (NGC) and the Institute for Clinical Systems Improvement (ICSI): For a description of what has changed since the previous version of this guidance, refer to [Summary of Changes Report -- January 2008](#).

The recommendations for diagnosis and management of asthma are presented in the form of two algorithms: [Diagnosis and Management of Asthma](#) and [Emergency Department or Inpatient Management](#) with 32 components, accompanied by detailed annotations. Clinical highlights and selected annotations (numbered to correspond with the algorithm) follow.

Class of evidence (A-D, M, R, X) and key conclusions (I-III, Not Assignable) definitions are repeated at the end of the "Major Recommendations" field.

Clinical Highlights

- 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 #11*)
- Assess control using objective measures and the asthma control test. (*Annotation #12*)

- Match medical intervention with asthma control and adjust to correspond with change over time. (*Annotation #13*)
- Provide asthma education to patients and parents of pediatric patients. Education should include basic facts about asthma, how medications work, 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 #14*)
- Patients should receive appropriate follow-up as per Diagnosis and Management of Asthma guideline. (*Annotation #15*)
- Early intervention with bi-level positive airway pressure (PAP) may prevent mechanical intubations. (*Annotation #27*)

Diagnosis and Management of Asthma Algorithm Annotations

1. Patient Presents with 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 [R].

2. Previous Diagnosis of Asthma?

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

- History and physical consistent with diagnosis
- Response to therapy consistent with symptoms

3. Establish Diagnosis of Asthma and Determine Level of Severity

Key Points:

- 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.
- The level of asthma severity is determined by both impairment and risk.

Asthma Triggers

- Viral respiratory infections
- Environmental allergens
- Exercise, temperature, humidity
- Occupational and recreational allergens or irritants
- Environmental irritants (perfume, tobacco smoke, wood burning stoves)
- Drugs (aspirin, nonsteroidal anti-inflammatory drugs [NSAIDs], beta blocker) and food (sulfites)

Other Historical Components

- Emergency room visits and hospitalization
- Medication use (especially oral steroids)
- Lung function, peak expiratory flow rate (PEFR) variability
- Associated symptoms (e.g., rhinitis, sinusitis, gastroesophageal reflux disease [GERD])

Clinical Testing

- Accurate spirometry is recommended in every patient 5 years of age or older at the time of diagnosis.
- Additional studies done, tailored to the specific patient.
- Allergy testing (skin testing, in vitro specific immunoglobulin E [IgE] antibody testing)
- Chest radiography, to exclude alternative diagnosis
- Bronchial provocation testing if spirometry is normal or near normal
- Sinus x-rays or computed tomography (CT) scan
- Gastroesophageal reflux disease (GERD) evaluation
- Complete blood count (CBC) with eosinophils, total IgE, sputum exam

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 compliance with the American Thoracic Society standards. Obstructive and restrictive ventilatory defects can generally be determined using forced expiratory volume in one second (FEV_1)/forced vital capacity (FVC) ratio [R].

Spirometry is generally valuable in children 5 years of age or older; however, some children cannot conduct the maneuver depending on developmental ability. Spirometry measurements (FEV_1 , FVC, and 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 or greater and 200 mL in FEV_1 after inhaling a short-acting bronchodilator.

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. History may help to distinguish seasonal allergies but may be inadequate for perennial allergies. 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 is 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) with volume loss that clear radiologically within two to three days, and the diagnosis of pneumonia without fever. Asthma may cause radiologic uncertainty since mucus plugging and atelectasis may be interpreted as infiltrates.

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 spirometry 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.

See Table 1, "Classifying Asthma Severity in Children 5-11 Years" and Table 2, "Classifying Asthma Severity in Youths and Adults" in the original guideline document.

(See the original guideline document for additional information concerning differential diagnostic possibilities for asthma.)

4. Acute Asthma Exacerbation?

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). Indications for emergency care include:

- Peak flow less than 50% predicted normal
- Failure to respond to a beta₂ 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. Assess Severity of Asthma Exacerbation

Key Points:

- Severity should be promptly assessed using objective measures of lung function.
- Patients experiencing an acute asthma exacerbation need a focused history and physical examination and measurement of airflow.

Patients presenting with an acute exacerbation of their asthma should receive prompt evaluation to assess the severity of their symptoms. Treatment should begin as rapidly as possible even while still assessing severity.

Assessment of asthma severity should include history, physical examination, an objective measure of lung function, either FEV₁ or PEF, oxygen saturation, and other tests as indicated.

History

- Symptoms consistent with asthma
- 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 beta₂-agonists
 - Number of bursts of oral steroids in past year
- Review Asthma Action Plan and daily charting of peak flows
- Previous emergency department (ED) visits or hospitalization
- Record triggers:
 - Upper respiratory infection (URI)
 - Bronchitis, pneumonia, sinusitis
 - Exposure to allergens or irritants
 - Exercise
 - GERD

Clinicians treating asthma exacerbations should be familiar with the characteristics of patients at risk for life-threatening deterioration. See Table 3, "Risk Factors for Death from Asthma" in the original guideline document.

Lung Function

- Spirometry (FEV₁) – preferred, FEV₁/FVC

or

- Peak expiratory flow rate
- Pulse oximetry

Physical Exam

- Vital signs: Temperature, blood pressure, pulse rate, respiratory rate, pulsus paradoxus

- Alertness
- Ability to talk
- Use of accessory muscles
- Auscultation of chest
- Color

Laboratory Studies

Treatment with bronchodilators should not be delayed for laboratory studies. Tests which may be useful include:

- Arterial blood gases (ABGs)
- Chest x-ray (CXR)
- Complete blood count (CBC)
- Electrocardiogram (EKG)
- Electrolytes
- Theophylline level (if appropriate)

See Table 4, "Assessment of Severity" in the original guideline document.

8. Management of Asthma Exacerbation

Key Points:

- Treatment is begun with inhaled short-acting beta₂-agonists administered by meter dose inhaler (MDI)/spacer or nebulizer.
- Further intensification of therapy is based on severity, response and prior history, but typically includes a short course of oral corticosteroids [R].

Treatment

Usual initial treatment is with short-acting beta₂-agonist (albuterol) administered by nebulizer or MDI/spacer.

Alternatives:

Epinephrine: (1:1000)

- Adults: 0.3 to 0.5 mg subcutaneously or intramuscularly every 20 minutes up to three doses
- Pediatrics: 0.01 mg/kg up to 0.3 to 0.5 mg subcutaneously or intramuscularly every 20 minutes up to three doses

Ipratropium added to nebulized beta₂-agonist (albuterol)

- Nebulized dose for adults and those over 12 years of age is 0.5 mg every 4 hours. Not U.S. Food and Drug Administration (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) three times daily (every six to eight hours); may increase to 1.25 mg via nebulizer three times daily (every six to eight hours) if patient does not exhibit adequate response.
- Dose for children 6 to 11 years of age is 0.31 mg (via nebulizer) three times daily. Routine dosing should not exceed 0.63 mg three times daily.

Corticosteroids

- 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 [A].

Note: The Food and Drug Administration has reported that salmeterol monotherapy may be associated with an increased risk of death from asthma.

Antibiotics are not recommended for the treatment of acute asthma except for those patients with signs of acute bacterial infection, fever and purulent sputum.

9. Assess Response to Treatment

Good Response:

- PEF_R or FEV₁ greater than 70% predicted normal
- No wheezing on auscultation

Incomplete Response:

- PEF_R or FEV₁ 50 to 70% predicted normal
- Mild wheezing
- Consider hospitalization, particularly for high-risk patients (see chart in annotation #4)

Poor Response:

- PEF_R or FEV₁ less than 50% predicted normal
- No improvement in respiratory distress
- Strongly consider hospitalization
- Continue inhaled beta₂-agonist every 60 minutes
- Start oral prednisone unless contraindicated
 - Adult: short course "burst" 40 to 60 mg/day as single or two divided doses for 3 to 10 days

- Pediatric: short course "burst" 1 to 2 mg/kg day in two divided doses, maximum 60 mg/day for 3 to 10 days

10. Does Patient Need ED or Inpatient Asthma Management?

A recent study suggests that most children who require hospitalization can be identified by a repeat assessment one hour after initial treatment [D]. After one hour, those children who continue to meet the criteria for a severe exacerbation have greater than 86% chance of requiring hospitalization; those who meet the criteria for moderate exacerbation at one hour have an 84% chance of requiring hospitalization; and those whose assessment has remained the same or dropped to the mild level have only an 18% chance of requiring hospitalization. These severity assessment studies highlight the importance of regular, multifaceted assessments and close observation of children and adolescents who present to the office or ED with acute asthma exacerbations [R].

11. Evaluation

Evaluation of asthma should include the following:

- Medical history
- Use of a validated asthma questionnaire
- Assess asthma triggers/allergens
- Physical examination
- Measure pulmonary function.
- Consider specialty consultation.

Medical History

- Disruption of usual activities (work, school, home)
- Sleep disturbance
- Level of usage of short-acting beta₂-agonist
- Adherence to medical treatment plan
- Interval exacerbation of symptoms (either treated by self or a health care provider)
- Symptoms suggesting comorbid conditions or alternative diagnosis
- Side effects of medications

Reassessment of medical history can elicit factors that affect overall asthma control and sense of well-being [D]. The key symptoms that should alert the clinician include disruptive daytime symptoms and disturbances of sleep; symptoms early in the morning that do not improve fifteen minutes after short-acting beta₂-agonist are a predictor of poor control. The quantity of short-acting beta₂-agonist that is being used should be discussed since overuse can be a marker of the potentially fatality-prone asthmatic [C]. The use of a quality of life tool or questionnaire can assist to elicit history [D].

Self-Assessment with a Validated Asthma Questionnaire

The self-assessment questionnaires that can be completed at office visits are intended to capture the patient's and family's impression of asthma control, self-management skills, and overall satisfaction with care. Several multidimensional instruments have been developed to assess control (<http://www.nhlbi.nih.gov/guidelines/asthma/index.htm>) [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

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. Beta₂-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.

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. Cumulative data in children suggest that low-to-medium doses of inhaled corticosteroids may have the potential of decreasing growth velocity, but this effect is not sustained in subsequent years of treatment, is not progressive, and may be reversible [A, R].

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 [A].

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

Measure Lung Function

It is important to measure lung function at each follow-up visit. The two main methods are spirometry and 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 (example - very young or elderly, neuromuscular or orthopedic problems) [R].

Spirometry is 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 one to two years to assess maintenance of airway function; more often as severity indicates

Regular monitoring of pulmonary function is particularly important for asthma patients who do not perceive their symptoms until obstruction is severe [C].

PEFR:

- Used for follow-up, not for diagnosis

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

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.

Consider Specialty Consultation

Referral is recommended for consultation or care to a specialist in asthma care (allergist or pulmonologist, or other physicians who have expertise in asthma management, developed through additional training and experience) [C] when:

- Patient has had a life-threatening asthma exacerbation.
- Patient is not meeting the goals of asthma therapy after three to six months of treatment. An earlier referral or consultation is appropriate if the physician concludes that the patient is unresponsive to therapy.
- Signs and symptoms are atypical, or there are problems in differential diagnosis.
- Other conditions complicate asthma or its diagnosis (e.g., sinusitis, nasal polyps, aspergillosis, severe rhinitis, vocal cord dysfunction [VCD], GERD, chronic obstructive pulmonary disease [COPD]).
- Additional diagnostic testing is indicated (e.g., allergy skin testing, rhinoscopy, complete pulmonary function studies, provocative challenge, bronchoscopy).
- Patients require additional education and guidance on complications of therapy, problems with adherence, or allergen avoidance.
- Patient is being considered for immunotherapy.

- Patient requires step 4 care or higher. Consider referral if patient requires step 3 care.
- Patient has required more than two bursts of oral corticosteroids in one year or has an exacerbation requiring hospitalization.
- Patient requires confirmation of a history that suggests that an occupational or environmental inhalant or ingested substance is provoking or contributing to asthma. Depending on the complexities of diagnosis, treatment or the intervention required in the work environment, it may be appropriate in some cases for the specialist to manage the patient over a period of time or to co-manage with the primary care physician (PCP).

12. Determine Level of Asthma Control

Key Points:

- The level of control is based on the most severe impairment or risk category.
- The level of asthma control (well controlled, not well controlled, or poorly controlled) is the degree to which both dimensions of the manifestations of asthma—impairment and risk—are minimized by therapeutic intervention.
- The level of control at the time of follow-up assessment will determine clinical actions—that is, whether to maintain or adjust therapy.

See Table 5, "Assessing Asthma Control in Children 5-11 Years of Age" and Table 6, "Assessing Asthma Control in Youths 12 Years of Age through Adults" in the original guideline document.

13. 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 below for management approach for asthma.

Based on data comparing leukotriene receptor antagonists (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: See Conclusion Grading Worksheet -- Appendix A - Annotation #13 (Leukotriene Receptor Antagonists [LTRAs]) in the original guideline document.*] [A, M, R].

NOTE: Annual influenza vaccinations are recommended for patients with persistent asthma [R].

See Appendix B, "Usual Dosages for Quick-Relief Medications" in the original guideline document.

Table. Management Approach for Asthma: Children 5 to 11 Years of Age

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 |
|--|--|--|---|--|---|
| Asthma Education Environmental Control Management of Comorbidities | | | | | |
| Assess Asthma Control | | | | | |
| As-Needed Short-Acting Beta ₂ -Agonist | | | | | |
| <-----Step Down-----Asthma Control-----Step UP-----> | | | | | |
| Short-acting beta ₂ -agonist as needed | Low-dose ICS Alternative Leukotriene Modifier | Medium-dose ICS OR--> | Medium-dose ICS Add One LABA Leukotriene Modifier | High-dose ICS OR----> Add One or More LABA Alternative High-Dose ICS + Leukotriene Modifier | High-Dose ICS Add LABA + Oral Systemic Corticosteroid Alternative High-Dose ICS + Leukotriene Modifier + Oral Systemic Corticosteroid |

Adapted from: Global Initiative for Asthma, 2006; National Heart, Lung, Blood Institute EPR-3, 2007.

Abbreviations: ICS, inhaled corticosteroids; LABA, Long-acting beta₂-agonist

Table. Management Approach for Asthma

12 Years of Age and Older

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 |
|--|--|--|--|--|--|
| Asthma Education Environmental Control Management of Comorbidities | | | | | |
| Assess Asthma Control | | | | | |
| As-Needed Short-Acting Beta ₂ -Agonist | | | | | |
| <-----Step Down-----Asthma Control-----Step UP-----> | | | | | |
| Short-acting beta ₂ -agonist as needed | Low-dose ICS | Medium-dose ICS | Medium-dose ICS + LABA | High-dose ICS + LABA | High-dose ICS + LABA |
| | Alternative Leukotriene Modifier | Alternative Low-Dose ICS + LABA Low-Dose ICS + Leukotriene Modifier | Alternative Medium-dose ICS + Leukotriene Modifier | Add One or More Leukotriene Modifier Anti-IgE if applicable | + Oral corticosteroid ADD One or More Leukotriene Modifier Anti-IgE if applicable |

Adapted from: Global Initiative for Asthma, 2006; National Heart, Lung, Blood Institute EPR-3, 2007.

Abbreviations: ICS, inhaled corticosteroids; LABA, Long-acting beta₂-agonist; IgE, immunoglobulin E.

14. Asthma Education

Key Points:

- Asthma self-management education is essential to provide patients with the skills necessary to control asthma and improve outcomes.
- Asthma self-management education should be integrated into all aspects of asthma care, and it requires repetition and reinforcement.

Asthma self-management should include:

- Begin at the time of diagnosis and continue through follow-up care.
- Involve all members of the health care team.
- Introduce the key educational messages by the principal clinician, and negotiate agreements about the goals of treatment, specific medications, and the actions patients will take to reach the agreed-upon goals to control asthma.

- Reinforce and expand key messages (e.g., the patient's level of asthma control, inhaler techniques, self-monitoring, and use of a written asthma action plan) by all members of the health care team.
- Occur at all points of care where health professionals interact with patients who have asthma, including clinics, medical offices, emergency departments and hospitals, pharmacies, homes and community sites (e.g., schools, community centers).

Regular review, by an informed clinician, of the status of the patient's asthma control is an essential part of asthma self-management education. Teach and reinforce at **every** opportunity.

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

Refer to the original guideline document for additional information on asthma education including basic facts about asthma, how medications work, inhaler technique, environmental control measures, written asthma action plan, need for adherence, and developing an active partnership with the patient and family.

Sample Asthma Action Plans are attached in Appendix F of the original guideline document.

See also Minnesota Department of Health Action Plan at <http://www.mnasthma.org/AAP/>.

15. Schedule Regular Follow-up Visits

Asthma is a chronic inflammatory lung disease, and all chronic diseases 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.

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 visits is a matter of clinical judgment. If asthma is uncontrolled or a change in medication or clinical status has occurred, the patient should be followed in two to six weeks for an evaluation. A stable asthma patient should be followed at regular intervals of one to six months.

Emergency Department or Inpatient Management Algorithm Annotations

18. Assess Severity of Asthma Exacerbation

See Annotation #5.

21. Initial Treatment

Also see Annotation #8, "Management of Asthma Exacerbation."

Usual treatment is with short-acting beta₂-agonist by metered dose inhaler or nebulizer:

- Albuterol or Albuterol HFA (90 micrograms per puff) 4-8 puffs
- Albuterol solution 2.5 to 5 mg by nebulizer
- Levalbuterol MDI solution 1.25 to 2.5 mg by nebulizer

25. Treatment (Incomplete Response)

Key Points:

- Systemic corticosteroids should be used for all patients who do not favorably respond to the initial beta₂-agonist therapy.
- Anticholinergic therapy may increase lung function and may decrease hospital admission rate.

Corticosteroids

Parenteral and enteral administration of corticosteroids requires about 6 to 24 hours to be effective. Intravenous (IV) and oral routes of corticosteroid administration appear to be equivalent [A]. Medium to high doses of corticosteroids appear to be better than low doses; however, there is still a large range, roughly 160 mg methylprednisolone per day or 2 mg/kg/day in children. There is no evidence to support very high doses of steroids [A, M]. The National Asthma Education and Prevention Program guidelines recommend that patients admitted to the hospital should receive IV or oral steroids [R].

There may be a role for inhaled high-dose corticosteroids in the emergency department in addition to the IV or oral route; however, the data do not support this as standard of care at this time [A, M].

In adult asthmatic cases where intolerance or non-compliance with oral steroid therapy is a concern, consider the use of intramuscular (IM) methylprednisone [A].

Anticholinergics

Ipratropium bromide or another anticholinergic may be used as an additional bronchodilator in conjunction with a beta₂-agonist in cases of acute moderate to severe asthma. [Conclusion Grade II: See Conclusion Grading Worksheet B – Annotation #25 (Anticholinergic Therapy) in the original guideline document]. Its most beneficial effects appear to be in multiple doses in more severe exacerbations [M]. Literature has been inconsistent but indicates that anticholinergic therapy may increase FEV₁ or PEFr [A, M], may decrease hospital admission rates slightly [A], may decrease the amount of beta₂-agonist needed, and may prolong bronchodilator effect. These findings were

not always statistically significant, and some studies found no benefits [A]. There were no significant adverse reactions. In view of this, it is recommended to consider anticholinergic use in moderate to severe asthma exacerbations [M].

27. Treatment (Poor Response)

See Appendix A, "Dosages of Drugs for Asthma Exacerbations in the Emergency Medical Care or Hospital" in the original guideline document.

Key Points:

- Early intervention with bi-level positive airway pressure may prevent mechanical intubations.
- Heliox may be a secondary therapy in asthma patients who do not respond to first-line therapies.
- Ketamine should be considered for use only in severe asthma exacerbations.
- The decision when to discharge from the emergency department or admit to the hospital must be individualized and depends on response to treatment, pulmonary function and socioeconomic factors.
- Magnesium sulfate may be beneficial in the treatment of acute asthma.
- Reassess patients shortly after inpatient admission.

Intermittent Nebulization versus Continuous Nebulization

A recent meta-analysis suggests equivalence of continuous versus intermittent albuterol in treating asthma. This is determined by spirometry measurement and rates of admission to the hospital [M]. There does not seem to be any advantage of higher doses of albuterol for continuous nebulization. There was no difference in lung function in patients treated with 7.5 mg or 15 mg of albuterol [A]). Utilizing albuterol and ipratropium bromide continuously versus albuterol alone demonstrated a trend toward improvement in reducing the length of stay in the emergency department and in hospital admission rates [A].

Bi-level Positive Airway Pressure (Bi-Level PAP)

Bi-level PAP therapy should be considered for patients presenting with an acute asthma exacerbation. Accumulating studies have shown a benefit in using Bi-level PAP for patients presenting with non-cardiogenic respiratory failure. These studies included, but were not limited to, patients with asthma exacerbations.

Heliox

There is not enough evidence from large, prospective, randomized controlled trials to recommend heliox as first-line therapy in patients with asthma exacerbations. However, it is recommended that heliox be considered [M] as

a secondary therapy in patients with a severe asthma exacerbation who are not responding to first-line therapies.

Ketamine

Ketamine and propofol are anesthetic agents with neuro-regulatory properties resulting in bronchodilation. The use of ketamine has shown benefit in improving airway parameters [*D*], but increased side effects have resulted in longer hospitalizations [*M*]. Increased side effects of increased secretions, dysphoria and hallucinations are noted. Clinical data suggests that in the non-intubated patient the side effects may cancel benefit. Some reported case reports suggest benefit in intubated patients [*M*]. Well-controlled studies are required to make a clear strong recommendation for use. Use of ketamine has been pursued only in severe asthmatic exacerbations.

Magnesium Sulfate

There is insufficient evidence to support the routine use of IV magnesium in the emergency room setting [*M*, *R*]. However since it is safe and inexpensive, it should be considered for use in patients with severe asthma exacerbations.

Leukotrienes

The evaluation of leukotrienes for acute asthma care is in its infancy. Pulmonary function has been shown to improve more rapidly when a leukotriene administered orally is added to the standard therapy of asthma care (beta₂-agonists/corticosteroids) in emergency room settings [*R*, *A*]. More studies are needed to confirm these reports.

Montelukast in acute asthma management has been shown to improve pulmonary function in randomized controlled trials [*A*]. However, statistical significance could not always be maintained.

The evidence is too preliminary to recommend leukotriene modifiers in acute asthma exacerbations.

29. Admit to Hospital?

Also see Annotation #10, "Does Patient Need ED or Inpatient Asthma Management?"

The decision when to discharge from the ED or admit to the hospital must be individualized and depends on response to treatment, pulmonary function, and socioeconomic factors. It is important to consider risk factors for asthma-related death [*R*]. Actual length of stay in the ED will vary; some departments have the ability for more extended treatment and observation, provided there is sufficient monitoring and nursing care.

Response to initial treatment in the ED can be based on a repeat assessment approximately 60 to 90 minutes after initiating bronchodilator therapy, which is a better predictor of the need for hospitalization than is the severity of an

exacerbation on presentation [C]. Evaluation includes the patient's subjective response, physical findings, O₂ saturation and measurement of airflow. Other aspects to consider include duration and severity of symptoms, course and severity of prior exacerbations, medications used at the time of the exacerbation, access to medical care and medications, adequacy of support and home conditions, and presence of psychiatric illness. Pretreatment O₂ saturation less than 90%, persisting respiratory acidosis, or severe obstruction that does not improve with the administration of sympathomimetics indicates the need for hospitalization [R].

Discharge is appropriate if FEV₁ or PEF_R has returned to greater than or equal to 80% personal best or predicted, and symptoms are minimal or absent. Patients with an incomplete response (FEV₁ or PEF_R 50% to 80%), and with mild symptoms should be assessed individually and may be appropriate for discharge with consideration of the above factors. It is recommended that patients with a rapid good response be observed for 30 to 60 minutes after the most recent dose of bronchodilator to ensure stability of response before being discharged home.

30. Continue Management in Hospital

Patients being admitted from the ED with an acute asthma exacerbation should be reassessed shortly after admission, with special emphasis on whether the patient is showing any clinical signs of improvement or deterioration (see Annotation #5, "Assess Severity of Asthma Exacerbation"). Objective data should include repeating of the patient's FEV₁ or PEF_R. A complete physical exam should include emphasis on the patient's respiratory rate, air entry on lung exam, and the presence/absence of signs of increased work of breathing, such as supraclavicular or intercostal retractions.

Consider other illnesses and comorbidities. These may also cause dyspnea, chest tightness and wheezing.

- Viral pneumonitis
- Pneumothorax
- Pulmonary embolism
- Vocal cord dysfunction syndrome
- Chronic obstructive pulmonary disease
- Pulmonary edema
- Endobronchial obstruction (tumor or foreign body)
- Acute hypersensitivity pneumonitis
- Epiglottitis [D]

32. Discharge Home

Key Points:

- At discharge, provide patients with necessary medications and education in how to use them, instruction in self-assessment, an action plan for managing recurrence of airflow obstruction, and a follow-up appointment.

It is recommended that follow-up with an asthma care provider occur within one week of discharge.

Medications

See the table below for hospital discharge checklist for patients with asthma exacerbations.

- Inhaled beta₂-agonist every two to six hours.
- Systemic corticosteroids are almost always the treatment of choice in patients with acute asthma exacerbation. Corticosteroids aid symptom resolution and prevent asthma relapse.
- Initiate or increase anti-inflammatory medication:
 - Inhaled corticosteroids

The role of inhaled corticosteroids after an emergency room visit is controversial [M, A]. However, it is the consensus of the guideline development group that inhaled corticosteroids should be encouraged at the time of discharge.

- Consider leukotriene modifiers as an additive therapy.
- Antibiotics are not routinely used but may be warranted if patient has signs of acute bacterial infection, fever and purulent sputum.
- Long-acting beta₂-agonists as monotherapy are NOT recommended.

See Annotation #14 for asthma education and action plan.

See Annotation #15 for follow-up care.

Table. Hospital Discharge Checklist for Patients with Asthma Exacerbations

| Intervention | Dose/Timing | Education/Advice |
|--|---|--|
| Inhaled medications (metered-dose inhaler + spacer/holding chamber) Beta ₂ -agonist Corticosteroids | Select agent, dose, and frequency (e.g., albuterol) 2-6 puffs every 3-4 hours as needed Medium dose | Teach purpose. Teach technique Emphasize need for spacer/holding chamber. Check patient technique. |
| Oral medications | Select agent, dose and frequency (e.g., prednisone 20 mg twice daily for 3-10 days) | Teach purpose. Teach side effects. |
| Peak flow meter | Measure a.m. and | Teach purpose. Teach |

| Intervention | Dose/Timing | Education/Advice |
|---------------------|--|--|
| | p.m. PEF and record best of three tries each time. | technique. Distribute peak flow diary. |
| Follow-up visit | Make appointment for follow-up care with primary clinician or asthma specialist. | Advise patient (or caregiver) of date, time, and location of appointment within 7 days of hospital discharge. |
| Action plan | Before or at discharge | Instruct patient (or caregiver) on simple plan for actions to be taken when symptoms, signs, and PEF values suggest recurrent airflow obstruction. |

Source: National Heart, Lung, Blood Institute EPR-2, 1997

Special Populations

Asthma in Pregnancy

The goals of asthma management in pregnancy include reducing medication toxicity, teratogenicity and preserving uteroplacenta circulation. Changes in the mother's asthma status are expected in almost half of patients, with half of these expecting a worsening of asthma status, particularly if previous pregnancies had similar outcomes. Typical changes of pregnancy—those of increased heart rate, respiratory rate and decreases in baseline CO₂ levels—can lead to underdiagnosing asthma severity if not recognized.

The treatment of acute asthma in pregnancy follows the guidelines for acute asthma care, keeping in mind the goals of the management and changes in physiology.

Albuterol is the preferred short-acting beta₂-agonist and has not been linked to adverse fetal outcomes in follow-up studies. Inhaled corticosteroids (ICS) are the preferred treatment for long-term control medication. Budesonide is the preferred ICS because more data are available on using budesonide in pregnant women than are available on other ICSs, and the data are reassuring [R]. Systemic steroids, if used in the first trimester, may, though rarely, increase the frequency of cleft palate and possibly be associated with development of preeclampsia. However, the risk to both mother and fetus of an unmanaged severe asthmatic attack overshadows the medication observed risks [R].

Definitions:

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
- Systemic review
- Decision analysis
- Cost-effectiveness study

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

Conclusion Grades

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 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 uncertainty attached to the conclusion because of inconsistencies among the results from different 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 that directly supports or refutes the conclusion.

CLINICAL ALGORITHM(S)

Detailed and annotated clinical algorithms are provided in the original guideline document for:

- [Diagnosis and Management of Asthma](#)
- [Emergency Department or Inpatient Management](#)

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is classified for selected recommendations (see "Major Recommendations").

In addition, key conclusions contained in the Work Group's algorithm are supported by a grading worksheet that summarizes the important studies pertaining to the conclusion. The type and quality of the evidence supporting these key recommendations (i.e., choice among alternative therapeutic approaches) is graded for each study.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Accurate diagnosis and assessment of asthma severity and asthma control through the use of objective measures of lung function and symptoms
- Effective long-term control of persistent asthma through the use of inhaled corticosteroid drug therapy
- Effective partnership of patients with asthma and/or their parents with health care professionals through education and the use of written action plans

- Improved assessment of patient presenting with asthma exacerbations
- Improved treatment and management of inpatient asthma
- Appropriate follow-up

POTENTIAL HARMS

Adverse Effects Associated with Asthma Pharmacotherapy

- Common side effects from inhaled steroids include oral candidiasis and dysphonia.
- Beta₂-agonists may cause tachycardia, tremor, or nervousness.
- The Food and Drug Administration has reported that salmeterol monotherapy may be associated with an increased risk of death from asthma.
- Individuals on long-term oral corticosteroids or frequent bursts of steroids need to be monitored for complications of corticosteroid use such as osteoporosis, hypertension, diabetes, and Cushing's syndrome.
- 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. Cumulative data in children suggest that low-to-medium doses of inhaled corticosteroids may have the potential of decreasing growth velocity, but this effect is not sustained in subsequent years of treatment, is not progressive, and may be reversible.
- 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.
- The use of ketamine has shown increased side effects resulting in longer hospitalization. Increased secretions, dysphoria, and hallucinations are noted. Clinical data suggests that in the nonintubated patient the side effects may cancel benefit.
- Systemic steroids in the first trimester of pregnancy may, though rarely, increase the frequency of cleft palate and possibly be associated with development of preeclampsia. However, the risk to both mother and fetus of an unmanaged severe asthmatic attack overshadows the medication observed risks.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- These clinical guidelines are designed to assist clinicians by providing an analytical framework for the valuation and treatment of patients, and are not intended either to replace a clinician's judgment or to establish a protocol for all patients with a particular condition. A guideline will rarely establish the only approach to a problem.
- This clinical guideline should not be construed as medical advice or medical opinion related to any specific facts or circumstances. Patients are urged to consult a health care professional regarding their own situation and any specific medical questions they may have.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Once a guideline is approved for general implementation, a medical group can choose to concentrate on the implementation of that guideline. When four or more groups choose the same guideline to implement and they wish to collaborate with others, they may form an action group.

In the action group, each medical group sets specific goals they plan to achieve in improving patient care based on the particular guideline(s). Each medical group shares its experiences and supporting measurement results within the action group. This sharing facilitates a collaborative learning environment. Action group learnings are also documented and shared with interested medical groups within the collaborative.

Currently, action groups may focus on one guideline or a set of guidelines such as hypertension, lipid treatment, and tobacco cessation.

Detailed measurement strategies are presented in the original guideline document to help close the gap between clinical practice and the guideline recommendations. Summaries of the measures are provided in the National Quality Measures Clearinghouse (NQMC).

Key Implementation Recommendations

The following system changes were identified by the guideline work group as key strategies for health care systems to incorporate in support of the implementation of this guideline.

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

IMPLEMENTATION TOOLS

Chart Documentation/Checklists/Forms
Clinical Algorithm
Pocket Guide/Reference Cards
Quality Measures

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

RELATED NQMC MEASURES

- [Diagnosis and management of asthma: percentage of patients with asthma with spirometry or peak flow meter reading documented in the medical record at the last visit.](#)

- [Diagnosis and management of asthma: percentage of children with uncontrolled asthma who are on inhaled corticosteroids medication.](#)
- [Diagnosis and management of asthma: percentage of adults with uncontrolled asthma who are on inhaled corticosteroids medication.](#)
- [Diagnosis and management of asthma: percentage of patients with asthma with education about asthma documented in the medical record.](#)

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Diagnosis and management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2008 Jan. 69 p. [83 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 Jun (revised 2008 Jan)

GUIDELINE DEVELOPER(S)

Institute for Clinical Systems Improvement - Private Nonprofit Organization

GUIDELINE DEVELOPER COMMENT

Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Community Medical Centers, Allina Medical Clinic, Altru Health System, Aspen Medical Group, Avera Health, CentraCare, Columbia Park Medical Group, Community-University Health Care Center, Dakota Clinic, ENT Specialty Care, Fairview Health Services, Family HealthServices Minnesota, Family Practice Medical Center, Gateway Family Health Clinic, Gillette Children's Specialty Healthcare, Grand Itasca Clinic and Hospital, HealthEast Care System, HealthPartners Central Minnesota Clinics, HealthPartners Medical Group and

Clinics, Hutchinson Area Health Care, Hutchinson Medical Center, Lakeview Clinic, Mayo Clinic, Mercy Hospital and Health Care Center, MeritCare, Mille Lacs Health System, Minnesota Gastroenterology, Montevideo Clinic, North Clinic, North Memorial Care System, North Suburban Family Physicians, Northwest Family Physicians, Olmsted Medical Center, Park Nicollet Health Services, Pilot City Health Center, Quello Clinic, Ridgeview Medical Center, River Falls Medical Clinic, Saint Mary's/Duluth Clinic Health System, St. Paul Heart Clinic, Sioux Valley Hospitals and Health System, Southside Community Health Services, Stillwater Medical Group, SuperiorHealth Medical Group, University of Minnesota Physicians, Winona Clinic, Ltd., Winona Health

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GUIDELINE COMMITTEE

Respiratory Steering Committee

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Institute for Clinical Systems Improvement (ICSI) has adopted a policy of transparency, disclosing potential conflict and competing interests of all individuals who participate in the development, revision and approval of ICSI documents (guidelines, order sets and protocols). This applies to all work groups (guidelines, order sets and protocols) and committees (Committee on Evidence-

Based Practice, Cardiovascular Steering Committee, Women's Health Steering Committee, Preventive & Health Maintenance Steering Committee, Respiratory Steering Committee and the Patient Safety & Reliability Steering Committee).

Participants must disclose any potential conflict and competing interests they or their dependents (spouse, dependent children, or others claimed as dependents) may have with any organization with commercial, proprietary, or political interests relevant to the topics covered by ICSI documents. Such disclosures will be shared with all individuals who prepare, review and approve ICSI documents.

Richard Sveum has received less than \$10,000 in speaker's fees from Novartis, Merck and Schering.

David Lowe has received \$10,000-\$50,000 as a member of Speaker's Bureau for Glaxo and Schering.

No other work group members have potential conflicts of interest to disclose.

ICSI's conflict of interest policy and procedures are available for review on ICSI's Web site at www.icsi.org.

GUIDELINE STATUS

This is the current release of guideline.

This guideline updates previous versions:

Diagnosis and outpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2005 Mar. 49 p.

Emergency and inpatient management of asthma. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2006 Mar. 40 p.

GUIDELINE AVAILABILITY

Electronic copies: Available from the [Institute for Clinical Systems Improvement \(ICSI\) Web site](http://www.icsi.org).

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Diagnosis and management of asthma. Executive summary. Bloomington (MN): Institute for Clinical Systems Improvement, 2008 Mar. 1 p. Electronic copies: Available from the [Institute for Clinical Systems Improvement \(ICSI\) Web site](http://www.icsi.org).

- Health care order set: admission for asthma order set. Bloomington (MN): Institute for Clinical Systems Improvement, 2008 Jan. 18 p. Electronic copies: Available from the [Institute for Clinical Systems Improvement \(ICSI\) Web site](#).
- ICSI pocket guidelines. May 2007 edition. Bloomington (MN): Institute for Clinical Systems Improvement, 2007.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

Additionally, a sample asthma action plan can be found in Annotation Appendix E in the original guideline document. Electronic copies: Available from the [Institute for Clinical Systems Improvement \(ICSI\) Web site](#).

PATIENT RESOURCES

None available

NGC STATUS

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