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Summary of recommendations

from the Canadian Asthma Consensus Report, 1999

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Summary of recommendations from the Canadian Asthma Consensus Report, 1999

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Special Supplement

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This article has been peer reviewed.

Canadian asthma consensus report, 1999

Under the leadership of the Asthma Committee of the Canadian Thoracic Society, a group of respirologists, pediatricians, immunoallergists and emergency and family physicians met at Niagara-on-the-Lake, Ont., from 28 to 31 May 1998, to review Canadian recommendations for the best management of asthma. Their goals were to:

- review and discuss recent developments in the treatment of asthma
- review and revise the 1995 Canadian guidelines on asthma for children and adults
- develop strategies to implement the asthma guidelines
- determine what key studies are required to increase the level of evidence supporting the recommendations.

Recommendations were based on

- a critical review of the scientific literature by designated contributors before the conference
- discussions at the conference
- review of the integrated proceedings by all participants.

Each recommendation is graded according to the strength of the scientific evidence supporting it (Table 1). However, we emphasize that these are general guidelines and that decisions should be made according to the individual patient's situation and condition.

General principles of asthma care

Asthma is characterized by paroxysmal or persistent symptoms such as dyspnea, chest tightness, wheezing, sputum production and cough, associated with variable airflow limitation and a variable degree of hyperresponsiveness of airways to endogenous or exogenous stimuli.

Inflammation and its resultant effects on airway structure are considered to be the main mechanisms leading to the development and maintenance of asthma; therefore, the main thrust of asthma therapy is to limit exposure to triggering factors and to reduce the inflammatory process using anti-inflammatory agents. If needed, therapies to maintain optimal airway calibre and to control symptoms may

Table 1: Levels of evidence

Level I	Evidence is based on randomized controlled trials (or meta-analysis of such trials) of adequate size to ensure a low risk of incorporating false-positive or false-negative results.
Level II	Evidence is based on randomized controlled trials that are too small to provide level I evidence. They may show either positive trends that are not statistically significant or no trends and are associated with a high risk of false-negative results.
Level III	Evidence is based on nonrandomized controlled or cohort studies, case series, case–control studies or cross-sectional studies.
Level IV	Evidence is based on the opinion of respected authorities or expert committees as indicated in published consensus conferences or guidelines.
Level V	Evidence is based on the opinions of those who have written and reviewed the guidelines, based on their experience, knowledge of the relevant literature and discussion with their peers

be added to ensure acceptable asthma control and to improve quality of life. This requires individual assessment of the need for therapeutic intervention and establishment of the risks and benefits of various therapeutic choices (environmental measures, education and pharmacotherapy).

Conference participants retained the concept of the *asthma treatment continuum* adopted at the 1995 Canadian Asthma Consensus Conference. This reflects a more dynamic therapeutic approach than stepped care, and it supports the adaptation of drug therapy to the individual patient according to the severity of the underlying illness and the degree of control achieved.

Although, ideally, optimal control of asthma means the absence of respiratory symptoms, no need for a rescue bronchodilator and normal pulmonary function, this is may be difficult to achieve. Therefore, the participants preferred to base treatment needs on what they defined as "acceptable control" according to clinical and physiologic measures (Table 2). Acceptable control is achieved through appropriate environmental measures, proper education of patients and individual pharmacotherapy. It should be assessed regularly and treatment adjusted accordingly.

The initial measure of the severity of asthma in a patient is based on the frequency and duration of respiratory symptoms and the degree of airflow limitation. Once asthma is well controlled, one of the best ways to judge severity is to determine the level of treatment needed to maintain acceptable control (Table 3 and Fig. 1). Indications of severe or poorly controlled asthma also include a prior near-fatal episode (loss of consciousness, need for intubation), recent admission to hospital or a visit to the emergency department; night-time symptoms; limitation of daily activities; the need for an inhaled β_2-adrenoreceptor agonist (β_2-agonist) several times a day or at night; and forced expiratory volume in one second (FEV_1) or peak expiratory flow (PEF) below 60% of predicted value. Asthma severity may vary over time; it may also decrease after anti-inflammatory therapy and with age, especially in children.

Table 2: Indicators of asthma control

Parameter	Frequency or value
Daytime symptoms	< 4 days/week
Night-time symptoms	< 1 night/week
Physical activity	Normal
Exacerbations	Mild, infrequent
Absence from work or school	None
Need for short-acting β_2-agonist	< 4 doses/week*
FEV_1 or PEF	> 85% of personal best, ideally 90%
PEF diurnal variation†	< 15% of diurnal variation

FEV_1 = forced expiratory volume in 1 second; PEF = peak expiratory flow obtained with a portable peak flow meter.
*May use 1 dose/day for prevention of exercise-induced symptoms.
†Diurnal variation is calculated by subtracting the lowest PEF from the highest and dividing by the highest PEF multiplied by 100.

When control of asthma has been maintained for several weeks or months, an attempt should be made to reduce medication within the bounds of acceptable control.

Figs. 1 and 2 demonstrate the recommended approach to the diagnosis and management of asthma. Briefly, when asthma is suspected, the physician should confirm the diagnosis and assess the severity of asthma by objective measures of variable airflow obstruction (Table 4), then prescribe the medication required to achieve asthma control rapidly (Table 5) while assessing environmental and other contributing factors (Table 2). Education of the patient should then be initiated. This process will allow the physician to determine the best results achievable (symptoms, expiratory flows) and to use medication needs and degree of control achieved as measures of asthma severity (Table 3, Fig. 2). After determining the minimum amount of medication needed to keep the asthma controlled, the physician should devise an action plan for the management of exacerbations and explain it to the patient. Regular follow-up visits should be ensured (Table 6). (Principles of care for acute asthma are discussed in the section on emergency care of the long version of this report.)

The 5 most important aspects of asthma care are considered to be

1. achievement of acceptable control of the disease as the main goal of treatment (Table 2)
2. control of the environment
3. asthma education, favouring self-management and use of an action plan
4. inhaled glucocorticosteroids as the first-line anti-inflammatory therapy for all ages

Table 3: Levels of asthma severity based on treatment needed to maintain control

Asthma severity	Symptoms	Treatment required
Very mild	Mild–infrequent	None, or inhaled short-acting β_2-agonist rarely
Mild	Well-controlled	Short-acting β_2-agonist (occasionally) and low-dose inhaled glucocorticosteroid*
Moderate	Well-controlled	Short-acting β_2-agonist and low to moderate doses of inhaled glucocorticosteroid with or without additional therapy
Severe	Well-controlled	Short-acting β_2-agonist and high doses of inhaled glucocorticosteroid and additional therapy
Very severe	May be controlled or not well-controlled	Short-acting β_2-agonist and high doses of inhaled glucocorticosteroid and additional therapy and oral glucocorticosteroid

*See Table 8.

5. additional therapy (e.g., long-acting β_2-agonists, leukotriene-receptor antagonists [LTRAs], etc.) can be added to moderate doses of glucocorticosteroids if acceptable asthma control is not obtained.

General principles of drug therapy

Each treatment should be considered as a therapeutic trial, and its benefit carefully assessed in terms of its impact on symptoms and lung function. Medications used to treat asthma may be divided into 2 main categories: controllers and relievers (Table 7).

Relievers are best represented by the short-acting β_2-agonists. These quick-acting bronchodilators are used to relieve acute intercurrent asthma symptoms, only on demand and at the minimum required dose and frequency. Inhaled ipratropium bromide is less effective but is occasionally used as a reliever medication in patients intolerant of short-acting β_2-agonists.

Controllers (or preventers) include anti-inflammatory medications, such as inhaled (and oral) glucocorticosteroids, LTRAs and anti-allergic or "nonsteroidal" inhaled agents, such as cromoglycate and nedocromil. These agents are generally taken regularly to control asthma, although some patients, such as those with seasonal asthma, may need them only intermittently. Inhaled glucocorticosteroids are the most effective agents in this category and are considered the first-line anti-inflammatory therapy. The role of LTRAs during the initial anti-inflammatory treatment remains to be determined, but they can be used for this purpose in patients who will not or cannot use glucocorticosteroids. When inhaled glucocorticosteroids are insufficient; control of asthma symptoms may be achieved using additional therapy, such as the long-acting inhaled β_2-agonists salmeterol and formoterol or the LTRAs zafirlukast and montelukast, as adjuncts. In a few patients, there may be a role for other bronchodilators such as theophylline and ipratropium. The β_2-agonists and ipratropium do not diminish airway inflammation. There is some evidence that theophylline may have immunomodulatory effects, but the clinical significance of this remains to be demonstrated.

Asthma drugs are preferably inhaled, because this route minimizes systemic absorption and, thus, improves the ratio of the therapeutic benefit to the potential side-effects. The patient must have repeated instruction on how to use the inhaled medication. The recently developed LTRAs have good safety and tolerance profiles and are taken orally, which may help certain patients comply with treatment.

Asthma medications should be used at the lowest dose and frequency required to maintain acceptable asthma control; they should not be used as a substitute for proper control of the environment. Asthma medications are considered to be safe over many years when used appropriately. Long-term use of bronchial anti-inflammatory agents has not resulted in any clinically significant reduction in their efficacy.

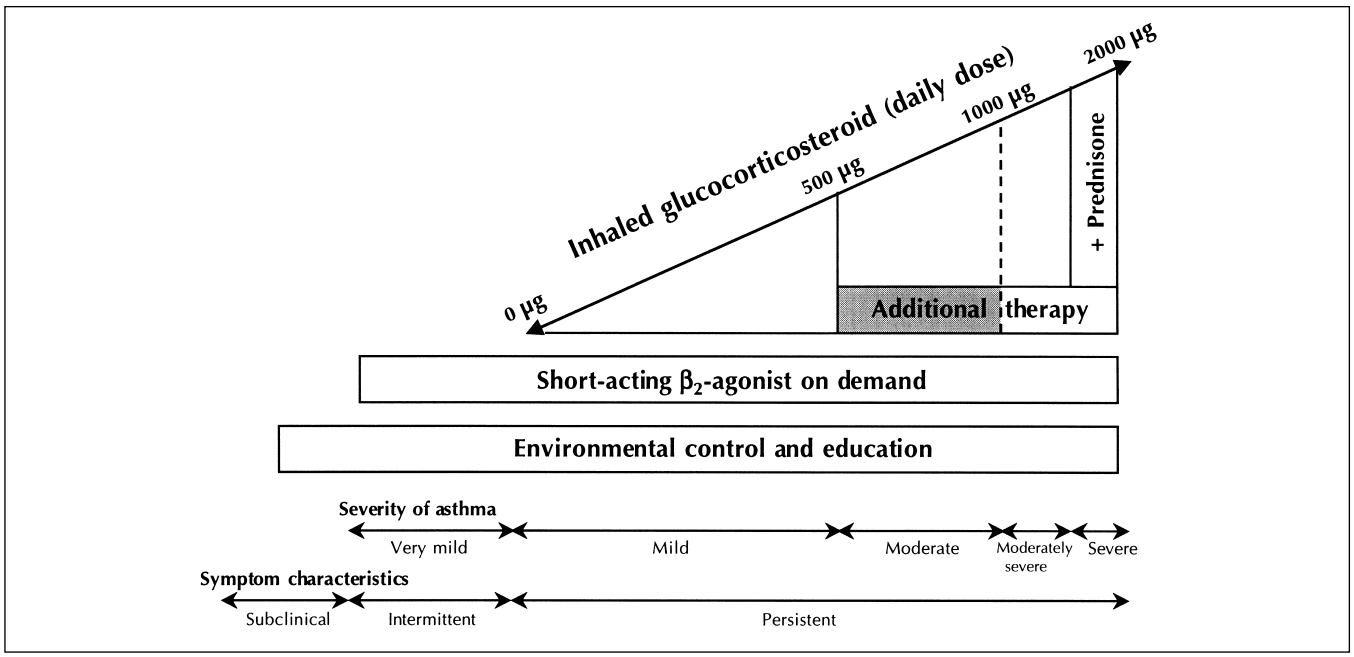

Fig. 1: Continuum of asthma management. Severity of asthma is ideally assessed by medication required to maintain asthma control. Environmental control and education should be instituted for all asthma patients. Very mild asthma is treated with short-acting β_2-agonists, taken as needed. If β_2-agonists are needed more than 3 times/week (excluding 1 dose/day before exercise), then inhaled glucocorticosteroids should be added at the minimum daily dose required to control the asthma. If asthma is not adequately controlled by moderate doses (500–1000 µg/d of beclomethasone or equivalent), additional therapy (including long-acting β_2-agonists, leukotriene antagonists or, less often, other medications) should be considered. Severe asthma may require additional treatment with prednisone.

Recommendations

Recommendations apply to both adults and children unless otherwise indicated. Some repetition is unavoidable, but allows for emphasis of certain important points. The full set of references supporting the recommendations is included with the long version of the consensus guidelines.

Chronic management of asthma

Diagnosis and evaluation

Physical examination is a poor indicator of the degree of airflow obstruction. Objective measurements are needed to confirm the diagnosis and to assess asthma control and the efficacy of therapy. In most patients, asthma is associated with atopy, and the relevance of common allergens to asthma should be assessed using both questionnaires and allergy tests (usually skin-prick tests). When young age or lack of cooperation prevent the performance of the necessary objective measurements, diagnosis and evaluation are necessarily based on the history and physical examination.

- Objective measurements are needed to confirm the diagnosis of asthma and to assess its severity in all symptomatic patients (level III) using:
  Spirometry: A 12% (preferably 15%) or greater (at least 180 mL) improvement in FEV_1 from the baseline 15 minutes after use of an inhaled short-acting β_2-agonist, a

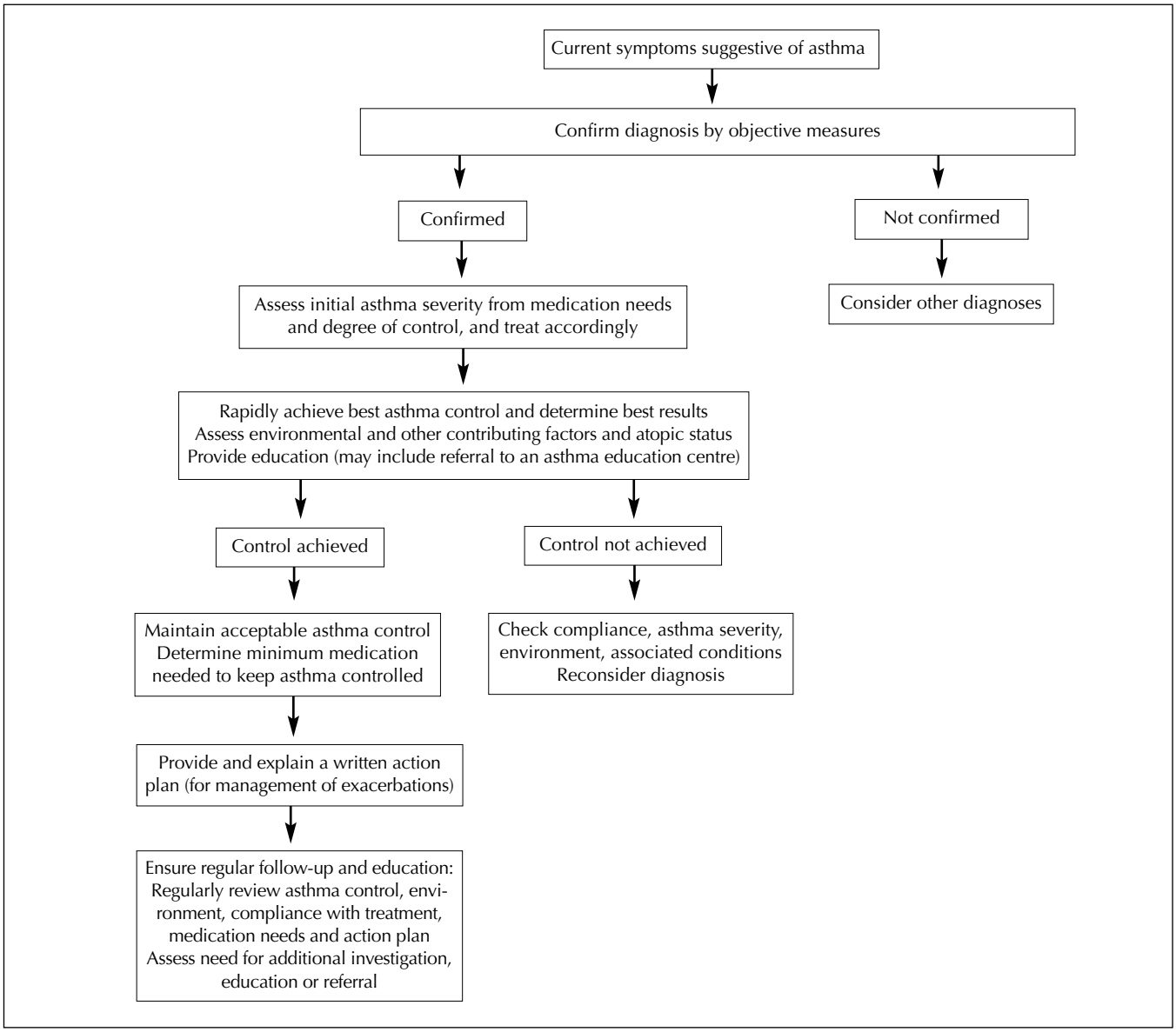

Fig. 2: Steps in the diagnosis and management of asthma

20% (250 mL) improvement after 10–14 days of inhaled glucocorticosteroid or ingested prednisone when symptoms are stable or a 20% (250 mL) or greater "spontaneous variability" is considered significant (level IV).
Peak expiratory flow: When spirometry and methacholine testing are unavailable, variable airflow obstruction (i.e., ideally 20% or greater diurnal variability) can be documented by home-measured PEF (level II), although this measure is not as sensitive or reliable as FEV_1.
Airway hyperresponsiveness: Measurement of airway responsiveness to methacholine in specialized pulmonary function laboratories may help to diagnose asthma (level III).

- Appropriate allergy assessment is warranted in patients with asthma (level III) and must be interpreted in light of the patient's history (level III).
- The primary measure of asthma severity in the treated patient should be the minimum therapy required to achieve acceptable control (level III).

Environmental control

The most common factors affecting asthma patients include allergens, respiratory irritants and viral infections. Allergens and irritants are encountered both outdoors and indoors. Outdoor air pollutants, such as respirable particulates, ground-level ozone and sulphur dioxide may exacerbate asthma. Indoors, irritants (particularly tobacco smoke) represent an even greater health risk. Intense efforts to avoid relevant allergens and irritants are clearly indicated. However, exercise should be encouraged, even if it triggers asthma symptoms as long as they are easily controlled with medication.

In children viral and sometimes chlamydia or possibly mycoplasma infections can cause intermittent episodes of coughing and wheezing and subsequent persistent changes in airway function. In particular, respiratory syncytial virus is associated with bronchiolitis in infancy and recurrent bouts of wheezing.

- Allergens to which a person is sensitized should be identified (level I).
- A systematic program to eliminate, or at least substantially reduce, allergen exposure in sensitized people should be undertaken (level II).
- Measures to control household dust mites can be effective in decreasing exposure and relieving asthma of patients sensitized to their allergens (level II).
- Humidity in the home, including the bedroom, should be kept below 50% (level II).
- Reduction of exposure to pet allergens cannot be effective without removing the pet from the home (level II).
- Compliance with avoidance measures must be reviewed repeatedly and its importance emphasized (level III).
- Increasing medication for asthma control should not be used as a substitute for avoidance of exposure to allergens and irritants (level III).
- Exposure to environmental tobacco smoke should be avoided (level III).
- Pregnant women and parents or caregivers of children with asthma should be particularly encouraged not to smoke (level II).
- There is insufficient information to recommend the use of residential air cleaners and humidifiers (level III).
- High concentrations of respiratory irritants should be avoided (level III).

Asthma is the pulmonary disease most frequently associated with the workplace; therefore, it is important to identify this type of asthma to avoid progressive deterioration of respiratory function and even permanent disability.

- Occupational asthma should be suspected and investigated in all adults with new-onset asthma (level II).
- Once the diagnosis of occupational asthma has been confirmed, the patient should be removed from exposure to the causative substance (level III).
- In industries associated with a high risk of occupational asthma, the level of exposure in the workplace should be reduced and regularly monitored (level IV).

Table 4: Asthma diagnosis confirmed by objective measures of variable airflow obstruction

Objective measure	Indicator of significant variable airflow obstruction
Spirometry	≥ 12%, preferably 15% (minimum 180 mL in adults), improvement in FEV_1 from the baseline after use of a bronchodilator ≥ 20% (minimum 250 mL in adults) improvement over time when symptoms are stable or after 10–14 days of corticosteroid therapy
Serial measures of PEF	≥ 20% change after using a bronchodilator or over time
Methacholine challenge	Provocative concentration of methacholine resulting in a 20% fall in FEV_1 from the baseline (PC_{20}) < 8 mg/mL (there is a "grey zone" between 8 and 16 mg/mL [Juniper method])

Note: Apart from helping to diagnose asthma if expiratory flows are normal, assessment of airway responsiveness may also be useful to reassess the diagnosis and severity of asthma in those who require doses of medication that seem excessive for symptom control or fail to respond to therapy.

Table 5: Initial treatment (to obtain rapid asthma control)

Signs and symptoms	Initial treatment
Infrequent symptoms and normal expiratory flows	Inhaled short-acting β_2-agonist on demand
Short-acting β_2-agonist needed more than 3 times a week, or lung function abnormal	Inhaled glucocorticosteroid (equivalent to a daily dose of 200–1000 μg beclomethasone dipropionate)*
Frequent symptoms and expiratory flows < 60% of predicted value	Prednisone should be considered

*See Table 8.

Patient education

In the management of asthma, education of the patient is mandatory and should be aimed, primarily, at changing behaviour and improving self-management skills. Emphasis should be on preventive measures and rapid adjustment of treatment at the onset of asthma exacerbations. All people with asthma should be provided with an action plan and shown how to implement it in case of exacerbation. A multidisciplinary approach is preferable: education should be initiated by the physician and continued by other specialized health professionals. Patients with high asthma-associated morbidity should be given highest priority in terms of access to education.

- Asthma education is an essential component of asthma therapy (level I).
- The goal of asthma education is control of asthma via improved knowledge and change in behaviour (level III).
- Asthma education should not rely on written or videotaped material alone (level I).
- Asthma education is effective only in the presence of effective asthma therapy (level III).
- Education must be provided at each patient contact (level II).
- Good communication between health professionals and coordination of their interventions is essential (level III).
- Patient self-monitoring may be effective using either measurement of PEF or monitoring of asthma symptoms (level I).
- Monitoring PEF may be useful in some patients, particularly those who are poor perceivers of airflow obstruction (level III).
- A written action plan for guided self-management, usually based on an evaluation of symptoms, must be provided for all patients (level II).
- Monitoring of pulmonary function in physicians' offices should be routine (level III).
- Patients with severe or poorly controlled asthma should be referred to an asthma expert (level II).

Immunotherapy

- Immunotherapy is generally not recommended in the treatment of asthma (level IV).
- Immunotherapy should not be used in place of avoidance of environmental allergens (level III).
- Immunotherapy with clinically relevant allergens may be considered if disease activity is inadequately controlled by avoidance of the allergens and pharmacotherapy (level I).
- Immunotherapy should be avoided while asthma is poorly controlled (level III).
- Well-controlled asthma is not a contraindication for immunotherapy for allergic rhinoconjunctivitis or insect venom hypersensitivity (level III).
- Immunotherapy must be administered only by trained personnel in centres where there is medical supervision and resuscitative equipment (level III).

Table 6: Follow-up check-list

Is acceptable asthma control maintained?
How has the patient used the health care system (particularly acute care)?
Is current drug therapy appropriate?
Is compliance to treatment and environmental measures sufficient?
Does the patient understand and apply the action plan?
Is there a need for additional education (reference to an education centre)?
Are associated diseases or problems being addressed?
Is there a need to refer the patient to a specialist?

Drug therapy

Inhaled glucocorticosteroids

Inhaled glucocorticosteroids are the mainstay of asthma therapy and are clearly indicated in all but patients with the mildest disease. They are very effective in preventing persistent symptoms, improving lung function, decreasing airway hyperresponsiveness and reducing morbidity. Benefits are usually observed within a few days or weeks, and the greatest effect is usually observed within 3 months. Most of the therapeutic benefit is obtained at doses equivalent to 1000 μg/d or less of beclomethasone dipropionate administered using a metered-dose inhaler (MDI) with chlorofluorocarbons as propellant and a spacer device. There is an exponential increase in the risk of adverse effects at doses greater than the equivalent of 1000 μg/d of beclomethasone dipropionate (or lower in children).

- Inhaled glucocorticosteroids offer the best option for the initial anti-inflammatory treatment of asthma (level I).
- The initial daily dose in adults is commonly in the range of 400–1000 μg of beclomethasone dipropionate or the equivalent (Table 8); higher doses of inhaled or the addition of oral or systemic glucocorticosteroid may be required if the asthma is more severe (level III).
- The initial daily dose of inhaled glucocorticosteroid in

Table 7: Asthma medication categories

Relievers (for intermittent symptoms)	Short-acting β_2-agonists Ipratropium, rarely
Controllers (maintenance therapy)	
Anti-inflammatory medications	
Steroidal	Inhaled (and oral) glucocorticosteroids
Nonsteroidal	Leukotriene-receptor antagonists Anti-allergic agents (cromoglycate and nedocromil)
Bronchodilators	Long-acting inhaled β_2-agonists (salmeterol, formoterol) Theophylline Ipratropium

children should be 200–1000 μg of beclomethasone dipropionate or the equivalent; higher doses are rarely needed (level III).
- Early initiation of treatment with inhaled glucocorticosteroids in the natural history of the disease is associated with a better functional outcome (level III).
- Once best results are achieved, the dose should be reduced to determine the minimum required to maintain control (level III). This is especially true in children because they are more likely to have adverse effects but are also more likely to experience improvement or remission of their asthma (level III).
- Loss of control of asthma should be treated as early as possible to prevent exacerbation from becoming severe (level III). The dose of glucocorticosteroid required and the duration of the increase in dose depends on the severity of the exacerbation. Inhaled glucocorticosteroids must be added or increased 2- to 4-fold (level IV), or prednisone at the dose of 0.5 to 1.0 mg/kg a day (level I) must be added if the exacerbation is severe. This increased level of glucocorticosteroids must be maintained until the best results are achieved and for a minimum of 10–14 days (level III).
- Inhaled glucocorticosteroids at the low and moderate doses generally required to control symptoms in asthma infrequently exhibit clinically important side-effects and provide the best risk–benefit profile (level I).
- Children who regularly require higher doses of inhaled corticosteroids (i.e., equivalent to 400 μg or more of beclomethasone dipropionate per day) should have their height measured regularly using a calibrated stadiometer (level IV). A change in growth velocity should lead to a reassessment of the therapy with emphasis on reducing glucocorticosteroid doses while maintaining adequate asthma control through environmental control and possibly the use of additional therapy.
- People who use inhaled glucocorticosteroids regularly should be encouraged to rinse and expectorate after inhalation to reduce oropharyngeal deposition and systemic absorption (level I).
- Physicians should frequently consider reducing the dose of inhaled glucocorticosteroid in patients who have achieved acceptable control of their asthma. Patients, whether children or adults, consistently requiring doses equivalent to more than 1000 μg/d of beclomethasone dipropionate to maintain acceptable control should be referred for specialized assessment (level IV).
- In patients with a personal or family history of glaucoma, intraocular pressure should be measured within a few days of their commencing use of inhaled glucocorticosteroids, particularly if high doses are taken, and monitored at appropriate intervals (level IV).
- Patients using a pressurized inhaler should avoid depositing any of the aerosolized glucocorticosteroid in the eye. A dry powder inhaler or spacer may prevent such an occurrence (level IV).
- Bone densitometry is recommended in adult patients who require the equivalent of more than 1000 μg/d of beclomethasone dipropionate to maintain acceptable control or who have one or more risk factors for osteoporosis (level III).

Table 8: Proposed dose equivalencies for inhaled glucocorticosteroids

	Dose, μg/d		
Product	Low	Medium	High
BDP pMDI and spacer	≤ 500	501–1000	> 1000
BUD Turbuhaler*	≤ 400	401–800	> 800
FP pMDI and spacer	≤ 250	251–500	> 500
FP Diskus†	≤ 250	251–500	> 500
BDP pMDI (HFA)‡	≤ 250	251–500	> 500
BUD wet nebulization¶	≤ 1000	1001–2000	> 2000

Note: For children, the consensus group defined low dose as < 400 μg of BDP delivered via a pMDI attached to a spacer.
BDP = beclomethasone dipropionate; pMDI = pressurized metered-dose inhaler; BUD = budesonide; FP = fluticasone propionate; HFA = hydrofluoralkane (propellant).
*Budesonide Turbuhaler™ (Astra Pharma Inc., Mississauga, Ont.)
†Fluticasone propionate Diskus™ (Glaxo Wellcome Canada Inc., Mississauga, Ont.).
‡In solution with alcohol (QVAR®); other HFA inhalers may provide dose equivalencies similar to BDP delivered with a traditional pMDI.
¶Budesonide solution for wet nebulization (Astra Pharma Inc.)

Short-acting β_2-agonists

Short-acting β_2-agonists remain the drugs of choice for the relief of acute asthma symptoms. They are most useful as a rescue medication to be taken as needed. Use of frequent or high doses of short-acting β_2-agonists for chronic maintenance therapy may result in long-term decreased control of asthma and, possibly, increased morbidity and mortality.
- Short-acting inhaled β_2-agonists are the drugs of choice in both adults and children for relief of acute symptoms and short-term prevention of exercise-induced bronchospasm (level I).
- When daily use of short-acting inhaled β_2-agonist is needed, an anti-inflammatory medication is required (level I).
- Regular anti-inflammatory medication should be used if short-acting β_2-agonists are used more than 3 times a week in addition to their once daily use to prevent exercise-induced symptoms (level IV).
- Patients who need a short-acting β_2-agonist several times a day require urgent reassessment with a view to increasing anti-inflammatory therapy (level III).

Long-acting β_2-agonists

Because the benefit obtained with high doses of inhaled glucocorticosteroids is limited and the long-term potential for adverse effects is significant, it seems preferable to add other

therapy to moderate doses of inhaled glucocorticosteroids when asthma control is not yet achieved. This will most often be in the form of inhaled long-acting β_2-agonists or LTRAs. Some benefits may be obtained by adding a theophylline to moderate doses of inhaled glucocorticosteroids, but intolerance and the significant adverse effects that may occur with this medication are important limiting factors.

- Inhaled long-acting β_2-agonists (salmeterol and formoterol) may be considered as an alternative to increased doses of inhaled glucocorticosteroids and should be used as an add-on therapy to moderate or higher doses of inhaled glucocorticosteroids to achieve control of persistent asthma symptoms (level I).
- Long-acting β_2-agonists are not recommended for relief of acute symptoms or for use in the absence of inhaled anti-inflammatory therapy (level II).

Leukotriene-receptor antagonists

Because leukotrienes play a significant role in the inflammatory pathophysiology of asthma, LTRAs, or antileukotrienes, have recently been developed. Although these molecules are recognized for their inhibition of leukotriene-induced airway inflammation, their potential for modifying the natural evolution of the disease has yet to be confirmed. Without this evidence, the members of the consensus group believe that their use as monotherapy cannot be promoted in most circumstances. However, even though there are fewer studies on LTRAs than on long-acting β_2-agonists, LTRAs may be used as add-on therapy to inhaled glucocorticosteroids. These agents have been shown to reduce exercise-induced asthma when used regularly and may be of particular benefit in patients with ASA-induced asthma although comparative studies with other drugs remain to be done.

- LTRAs may be considered as an alternative to increased doses of inhaled glucocorticosteroids. LTRAs may be used as adjunct therapy to moderate or higher doses of inhaled glucocorticosteroids to achieve control of persistent asthma symptoms (level II).
- There is insufficient evidence to recommend LTRAs as first-line anti-inflammatory therapy in place of inhaled glucocorticosteroids; however, for patients who cannot or will not use inhaled glucocorticosteroids, LTRAs should be the primary treatment choice (level IV).

Anti-allergic agents

Disodium cromoglycate and nedocromil have been used less frequently in the treatment of asthma since other agents have become available. They are a less-efficient alternative to prevention of exercise-induced asthma than short-acting β_2-agonists, and they can help to reduce allergen-induced responses following short-term exposures.

- Disodium cromoglycate should not be added to an established regimen of inhaled or systemic glucocorticosteroids (level I).
- Disodium cromoglycate may be used as a less-effective alternative to short-acting β_2-agonist bronchodilators for the prevention of exertion-induced symptoms (level I).
- In children with mild symptoms, disodium cromoglycate may be an alternative to low-dose inhaled glucocorticosteroids when the patient is unwilling to take inhaled glucocorticosteroids (level I).
- Nedocromil is a safe but modestly effective alternative to low-dose inhaled glucocorticosteroid in children older than 12 years and in adults with mild asthma where the fear of side-effects preclude the use of glucocorticosteroids (level I).
- Nedocromil may be considered as a less-effective alternative to short-acting β_2-agonist bronchodilators for the prevention of exertion-induced bronchospasm (level I).

Ketotifen

- Ketotifen is not recommended in first-line therapy for asthma (level II).

Theophylline

Although some reports suggest that theophylline has potential immunomodulatory effects, it is most often used as an alternative third-line agent; however, the incidence of side-effects is generally higher than that of other agents, even when low doses are used.

- Theophylline should not be used as first-line therapy in children or adults with asthma (level I).
- In patients whose symptoms do not respond to moderate-dose inhaled glucocorticosteroids alone, the addition of theophylline may result in asthma control that is equivalent to increasing to high-dose inhaled glucocorticosteroids alone (level II).
- Theophylline may be useful in some children requiring high-dose inhaled glucocorticosteroids (level III).
- Because theophylline has a narrow therapeutic range and potential for severe side-effects, the dose must be titrated to minimize side-effects in patients starting the drug, especially if high doses are required (level III).

Anticholinergic agents

- Anticholinergic bronchodilators are not recommended as first-line agents. They may be used as relievers for patients who are unable to tolerate β_2-adrenergic bronchodilators (level III).

Other therapies and unconventional medicines

- In chronic severe asthma that seems unresponsive to

moderate doses of oral glucocorticosteroids, confounding issues should be assessed before increasing the dose of oral glucocorticosteroids or using other immunosuppressive agents (level I).
- Because of the associated clinical problems, patients with asthma who have a severe glucocorticosteroid dependence requiring further intervention should be referred to a specialized centre (level III).
- Potentially toxic immunosuppressive agents, such as methotrexate, cyclosporine and gold salts, should be reserved for patients with severe asthma who are dependent on long-term high-dose oral glucocorticosteroids and should be used only in specialized centres (level III).
- There is no objective evidence of any benefit, apart from placebo effect, from the more frequently used unconventional therapies such as acupuncture, chiropractic, homeopathy, naturopathy, osteopathy and herbal remedies (level I or III, depending on the therapy).

Delivery devices

For most children and adults with asthma, medications delivered via inhalation devices still represent the mainstay of therapy, especially for the acute relief of asthma symptoms. The benefits and side-effects related to the various inhaled medications depend specifically on the type of inhaler and their pulmonary deposition characteristics. The effectiveness of the inhalers depends heavily on appropriate inhalation technique. It is thus necessary to take into account the type of inhalation device used when medications are prescribed. More than 50% of patients use their inhalation devices inappropriately, reducing the effectiveness of their medication.
- Inhaled drug delivery is recommended over oral or parenteral delivery for adrenergic bronchodilators and glucocorticosteroids (level I).
- The inhalation device that best fits the needs of the individual patient should be chosen (level III).
- With adequate teaching, adults and older children can use any of the commercially available hand-held inhalation devices. MDIs with spacers can be considered for all age groups, and specifically MDIs with valved spacer and face mask are advocated for young children and the elderly. Dry-powder inhalers can provide adequate drug delivery for most children by the time they reach age 5 years (level II).
- MDIs that use hydrofluoroalkane propellant are recommended over those using chlorofluorocarbons (level IV).
- Health care professionals must teach correct inhaler technique when devices are prescribed and dispensed (level I).
- Patients' method of using their inhalation device must be reassessed and reinforced periodically (level II).
- Asthma control should be reassessed when changing an aerosol device (level IV).
- Wet nebulizers for home use are rarely indicated in the management of asthma at any age (level III).
- A trial of wet nebulization in infants and children at home may be appropriate if an MDI with a spacer is not effective (level IV).
- When spacers are used, conversion from a mask to a mouthpiece is strongly encouraged as soon as the age and the cooperation of the child permit (level II).

Asthma in the elderly

- A diagnosis of asthma should be more widely considered in elderly patients with dyspnea, wheezing or nocturnal cough (level III).
- Investigation to determine exposure to environmental and other asthma-inducing factors in elderly patients with recent-onset asthma should include a careful review of medications including self-prescribed ASA and other drugs with asthma-inducing potential (level II).
- Special care should be taken to allow elderly patients with asthma to choose an inhaler device with which they are comfortable and competent (level III).
- Measures should be taken to prevent osteoporosis in elderly patients with asthma who require prolonged treatment with oral corticosteroid (level I).
- Elderly patients with asthma require careful follow-up because they have an increased risk of exacerbations, which may be related to impaired perception of their disease severity (level II).

Asthma in pregnancy

During pregnancy the severity of asthma often changes and patients require close follow-up and adjustment of medications. The use of inhaled asthma medications is not associated with any known adverse effects on the fetus, but uncontrolled asthma poses a substantial risk to both the mother and fetus. Specialists tend to prefer medications that have been used extensively and for long periods to reduce the potential of adverse effects to the fetus, especially during the first trimester of pregnancy.
- Avoidance of allergic and nonallergic triggering factors should be the first form of therapy for asthma during pregnancy (level III).
- The patient should be informed about the background risk of drugs in pregnancy in the general population. It should be made clear that, although relatively few medications have been proved harmful during pregnancy, no asthma or allergy medication can be considered to be proved safe (level II).
- Physicians should discuss with the patient the possible consequences for the mother and fetus of inadequately controlled asthma, including the impact on maternal and fetal morbidity and mortality (level II).

- Physicians should discuss medication choices and the rationale for the treatment plan; they should emphasize that the treatment is considered to entail less risk than the uncontrolled illness that could result in its absence (level II).
- Treatment should take the same stepped approach as in the nonpregnant patient and may include inhaled β_2-agonists, inhaled corticosteroids, ipratropium bromide, cromolyn and systemic glucocorticosteroids. Theophylline may increase nausea and reflux and is less desirable. There is significantly less information about the effects of the long-acting β_2-agonists and the leukotriene inhibitors, and there is less clinical experience with these drugs than with other classes of drugs. These drugs should be used only for patients whose asthma cannot be controlled using the more studied therapies (level II).
- The use of systemic glucocorticosteroids for severe asthma, especially for prolonged periods, may be associated with a greater risk of pre-eclampsia, antepartum or postpartum hemorrhage, low birth weight, preterm birth and hyperbilirubinemia (level II).
- Patients requiring systemic glucocorticosteroid therapy should be considered to be in a higher risk pregnancy (level II).
- Physicians should address all of the patient's questions and obtain and document the patient's concurrence with the therapeutic decisions (level IV).
- Physicians should monitor and support the patient and other health professionals with respect to asthma management during the pregnancy (level IV).

Emergency management of asthma

The management of exacerbations of asthma requires rapid access to facilities and personnel capable of delivering the medication appropriately, defining the severity of the asthma episode objectively, ensuring appropriate monitoring of oxygen delivery and instituting safe referral and disposition. Bronchodilators should be titrated using clinical and objective measurements and systemic glucocorticosteroids should be given to almost all patients who require a visit to the emergency department because of exacerbation of asthma. In addition to relief of symptoms and improvement in objective measures of airflow, a detailed review of risk factors for severe asthma is needed and an educational intervention offered .

Assessment

- A structured management plan should be used to treat patients with asthma in the emergency department (level III).
- The severity of airflow limitation should be determined objectively using spirometry (the preferred method), PEF measures or both, before and after bronchodilator therapy (level III), unless the patient is too young (< 6 years), uncooperative or moribund. These measurements should not postpone necessary treatment (level IV).
- The arterial oxygen saturation in (S_aO_2) should be measured before and after treatment (level III).

Drug therapy in the emergency department

- Supplemental oxygen should be used in treating patients with acute asthma to maintain $S_aO_2 > 94\%$ (level IV).
- Short-acting β_2-agonists should be considered the primary class of medication for the management of exacerbations. It should be administered by inhalation and titrated using objective and clinical measures of airflow obstruction as guides (level I).
- The choice of delivery device (MDI with spacer, wet nebulization, dry powder) will depend on the need for expedient treatment, availability of staff and the individual patient of any age (level I).
- The use of an MDI with a chamber (valved spacer device) is preferred over the use of a wet nebulizer for patients of all ages at all levels of severity (level I).
- All patients treated in the emergency department for an acute episode of asthma should be considered candidates for systemic glucocorticosteroid therapy (oral or intravenous) and receive it as soon as possible (level I).
- An anticholinergic drug should be added to β_2-agonist therapy for severe acute asthma and β-blocker-induced bronchospasm and may also help in cases of moderate acute asthma (level I).
- Aminophylline is not usually recommended for use as a bronchodilator in patients of any age during the first 4 hours of asthma management in the emergency department (level I).

Management of refractory cases

- Epinephrine (intramuscular or intravenous), salbutamol (intravenous) and inhaled anesthetics are recommended as alternatives to conventional therapy in unresponsive cases of life-threatening asthma (level II).
- Intravenous magnesium sulfate (level I) and heliox (level III) may be useful in addition to usual therapy for refractory asthma.
- Ketamine and succinylcholine are recommended for rapid-sequence intubation in cases of life-threatening asthma (level I).
- Intubation should be performed by physicians experienced in this procedure (level IV).

Discharge treatment plan and follow-up care

- Consideration for discharge should be based on results of spirometry (percent of previous best, or percent of predicted or absolute value) and assessment of clinical risk factors for relapse (level III).
  - Patients with a pretreatment FEV_1 or PEF below 25% of previous best level or the predicted value (i.e., FEV_1 < 1.0 L or PEF < 100 L/min) usually require admission to hospital.
  - Patients with a post-treatment FEV_1 or PEF below 40% of previous best level or the predicted value (i.e., FEV_1 < 1.6 L or PEF < 200 L/min) usually require admission to hospital.
  - Patients with a post-treatment FEV_1 or PEF between 40% and 60% of previous best level or predicted value (i.e., FEV_1 = 1.6–2.1 L or PEF = 200–300 L/min) are possible candidates for discharge.
  - Patients with a post-treatment FEV_1 or PEF above 60% of previous best level or predicted value (i.e., FEV_1 > 2.1 L or PEF > 300 L/min) are likely candidates for discharge.
- Adults discharged from the emergency department who require glucocorticosteroid therapy should be given 30–60 mg/d of prednisone orally (or equivalent) for 7–14 days. No tapering is required over this period (level I). Children should receive 1–2 mg/kg a day of prednisone or equivalent (up to a maximum of 50 mg) for 3–5 days (level I).
- Inhaled glucocorticosteroids are an integral component of asthma therapy and should be prescribed for almost all patients at discharge, including those receiving oral glucocorticosteroids (level I).
- A treatment plan and clear instructions for follow-up should be given to patients discharged from the emergency department. Patients with high-risk factors, poor lung function or indications of chronic poor control should be referred to an asthma education clinic (level IV).

The patient in hospital with acute asthma

Response to emergency treatment, clinical features that reflect the current attack and past disease severity, socioeconomic risk factors and pulmonary function tests are all used to determine the need for admission to hospital. Normally, patients over age 5 years who achieve 60%–70% of predicted or previous best lung function (measured by PEF or FEV_1) do not require admission to hospital unless there is significant risk of relapse. Important factors that indicate a patient at high risk of relapse include: hospital admission or a visit to the emergency department in the previous 12 months; recent systemic glucocorticosteroid use; use of multiple categories of asthma medication; previous severe or life-threatening asthma attack; the presence of psychosocial problems; and the frequent, regular use of inhaled β_2-agonists.

The principles of inpatient management incorporate the spectrum of treatment options that are used in both the acute and long-term phases of asthma management. Opportunities exist to evaluate the need for education and a review of barriers to adherence to treatment plans.

- All patients admitted to hospital for acute asthma should be given systemic glucocorticosteroids, preferably by the oral route (level I).
- All patients should receive inhaled glucocorticosteroids in addition to systemic glucocorticoids (level IV).
- Bronchodilators should be administered by the inhaled route and their need should be determined using objective measurements. The choice of delivery device (MDI with spacer, wet nebulization, dry-powder inhaler) will depend on the need for expedient treatment, the availability of staff and patient selection (level I). Rapid onset, the possibility of titration, reduced cost, more effective use of hospital staff, better side-effect profile and increased opportunities for education all make metered-dose or dry-powder inhalers preferable to nebulization in all age groups (level I).
- Inhaled anticholinergics should be added to β_2-agonist therapy for 24–48 hours in cases of severe asthma and possibly moderate asthma (level I).
- Response to treatment and criteria for discharge should be based on serial pulmonary function studies and control of symptoms (level III).
- Patients with severe airflow obstruction (FEV_1 or PEF < 40% of previous best or predicted value following emergency treatment) or those who are hypercapnic, are unresponsive to treatment, deteriorating or have been intubated must have continuous care in the emergency department or a unit capable of frequent or continuous monitoring of oxygenation until their condition is stable or improved (level IV).
- Supplemental oxygen guided by oximetry to achieve S_aO_2 > 94% is recommended (level IV).
- Serial administration of arterial blood gases is recommended for critically ill patients and those with severe asthma if S_aO_2 is persistently low (< 90%) or if there is suspicion of hypercapnia (level IV).
- Patient education, including a formal written action plan for treatment after discharge, should occur during the hospital stay (level I).
- After discharge, patients should continue systemic glucocorticosteroids (30 to 60 mg/d for adults and 1 to 2 mg/kg per day for children) for at least 3–5 days in children and 7–10 days for adults (level I).
- Patients should continue to take inhaled glucocorticosteroids after discharge with adjustment of the dose according to the action plan or on the advice of a physician at a follow-up visit (level I).

- Follow-up arrangements with the primary care physician or asthma specialist must be made before discharge (level IV).
- Patients with severe disease (FEV_1 or PEF < 40% of previous best or predicted value post-treatment and/or frequent attacks) should be seen by a specialist during the hospital stay or as a follow-up after discharge (level IV).
- Patients who have achieved more than 70% of predicted or previous best pulmonary function, who have access to the required medication, whose inhaled drug delivery technique is confirmed to be adequate and who have a written action plan can be discharged from hospital (level IV).

Dissemination of the guidelines

There is evidence that many physicians and other caregivers do not know the treatment guidelines for asthma or integrate them into current practice. The Canadian Thoracic Society's Asthma Committee and all participants in the consensus conference have formed a committee to determine the best strategy for disseminating and implementing the recommendations included in this report. This should be done collaboratively at all levels of the health care system to reduce the gap between current practice and what is considered optimal care.

- National guidelines should be adapted and implemented at a local level (level IV). This initiative could take the form of small-group problem-based workshops and case-based reviews, complemented by medical grand rounds. Workshops should focus on the practical day-to-day management issues, i.e., appropriate diagnosis, anti-inflammatory therapy, correct inhaler technique.
- The use of a stamp in asthma patients' charts has been shown to improve asthma care compared with no such intervention (level I).
- Key opinion leaders should be engaged to help promote asthma guidelines both as facilitators and as content experts for workshop programs (level IV).
- There is a need for further controlled trials to define more clearly the optimum strategies for guideline implementation and to evaluate the impact of asthma guidelines on the management of asthma, especially the effect on patient outcome. Ongoing audit and re-evaluation by various stakeholders, e.g., college of family physicians, government health groups, may be particularly important (level IV).
- A consortium of professional organizations, government, divisions of continuing medical education and industry should be encouraged to work together on implementing strategies to disseminate the recommendations. Industry, in particular, should be encouraged to collaborate in non-product-related programs that will make the best use of resources and prevent unnecessary duplication (level IV).

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